Factors influencing agro-environmental regulatory compliance behaviour on Canterbury dairy farms

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Marin Anne-Elise MacNamara

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The Canterbury dairy industry has grown significantly in the past several decades in both the number of cows being milked and effective farming area. The industry has seen substantial growth in farm size, productivity and intensity. These increases have the potential to significantly impact the environment. Environmental regulations were implemented under the Resource Management Act (1991) to limit and mitigate the impacts of agricultural production, among other sectors. Compliance with environmental regulation as it pertains to effluent management on Canterbury dairy farms for the past several seasons has remained around 70 per cent upon first inspection. This research examines the factors influencing effluent consent compliance and the impact of their relationship on compliance. Understanding the factors influencing compliance behaviour is key to further developing efficient and effective regulation.

An email-based electronic questionnaire collected quantitative data from Canterbury dairy effluent consent holders. The questionnaire was distributed to 513 consent holders, representing approximately 70 per cent of consents, for whom valid email addresses were available. A 14 per cent response rate was achieved. Data was analysed utilising SPSS 23.

The results reveal insights into consent holder attitudes and perceptions and provide 11 statistically significant relationships between explanatory variables and compliance levels in the bivariate analysis and four significant relationships in the logistic regression analysis. These explanatory variables included: training workshop and farm group meeting attendance; farm size; amount of milking livestock on farm; the response to which group in society should have the primary responsibility of managing the environment sustainably; perception of the ease of access to information on compliance requirements; the perceived impact of non-compliance on reputation; the perceived ease with which the regulatory agency can detect non-compliance; the rating given for the regulatory process and inspections; historical non-compliance; and confidence in their ability and intention to comply at their next inspection.

Recommendations provided to ensure a high level of, and an increase in compliance included an updated compliance rating system, leveraging communication tools and the ongoing development of a collaborative and education-focused strategy.

Keywords: New Zealand, Canterbury, dairy industry, environmental regulation, compliance, compliance behaviour, effluent.

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Terms and abbreviations

Environment Canterbury	ECAN
Environment Canterbury Land and Water Regional Plan	LWRP
Farm Environment Plan	FEP
Resource Management Act 1991	RMA
National Policy Statement	NPS
Matrix of Good Management	MGM
Good Management Practices	GMP
Reasoned Action Approach	RAA
Responsive Regulation Theory	RR
United States of America	US

Chapter 1

Introduction

1.1 Research background

Dairy farming practices in the Canterbury region have shifted over the last several decades to relatively more intensive systems that rely more heavily on irrigation (Environment Canterbury, 2015b). Farm size and cows per herd in the region have grown to twice the New Zealand average, with Canterbury farms grazing 21 per cent more cows per hectare than the national average and holding 18 percent of the national herd (DairyNZ Limited, 2015).

In the past decade, cow numbers in Canterbury have increased 182 per cent – representative of continued growth in the industry nationwide (DairyNZ Limited, 2015). This increasing scale and intensification of the dairy industry nationally has generated concern from the public, government and consumers about the consumption and deterioration in quality of fresh water. The dairy industry is a major player in the New Zealand economy – one of the largest export earners at $14 billion NZD annually (Ministry for Primary Industries, 2015). Consequently, debates have ensued on how to appropriately balance environmental protection and economic viability.

Twenty-five per cent of the population of New Zealand served by community drinking water sources receive water that is not microbiologically safe (Community and Public Health, 2012). Notably, farming activities can accelerate water pollution via nutrient (nitrogen and phosphorus) loading, resulting in negative impacts on the environment and human health (Carpenter, et al., 1998). The Ministry for the Environment (2015) estimates that between 1990 and 2012, nitrogen leached from agricultural production increased 29 per cent, with the main causes cited as increased dairy cattle numbers and use of nitrogen fertiliser. High concentrations of nitrogen and phosphorus can lead to oxygen depletion in bodies of water, making them uninhabitable (United Nations Environment Programme, 2016). The abundance of native freshwater fish is an indicator of the health of New Zealand's streams, wetlands and lakes (Tipa & Teirney, 2006). In 2013, 74 per cent of New Zealand's native freshwater fish were labelled 'threatened' or 'at risk' – a nine per cent increase since 2009 (Department of Conservation, 2013). This increase in the decline of freshwater fish populations reveals a failure to protect ecosystem integrity, largely due to agricultural expansion and intensification (Baskaran, Cullen & Colombo, 2009).

Environment Canterbury's (ECAN) November 2012 groundwater survey (as cited in Young, 2013), found nitrate levels increasing upwards of 30 per cent in wells that were tested in the

past 10 years: notably, 20 wells in the Ashburton region exceeded safe nitrate levels for human consumption. High levels of nitrate in drinking water can cause serious, often fatal illnesses that can be acquired or result in congenital defects (Canterbury District Health Board, 2013). Life-threatening methemoglobinemia in infants is one possible outcome – an inhibition of the ability to incorporate oxygen in their blood (United Nations Environment Programme, 2016). Toxins in drinking water produced through water pollution can affect the nervous, digestive, respiratory and cutaneous systems (World Health Organization, 2002). New Zealand has a high rate of waterborne diseases relative to other industrialised (OECD) countries: it is estimated that 18,000 – 34,000 people contract waterborne diseases annually (Environmental Science and Research Ltd., 2007; OECD, 2007). Additionally, methods for nitrate removal are limited - filters, boiling and chemical treatments are all insufficient (Canterbury District Health Board, 2013). To assist in mitigating the detrimental impacts of nutrient loading, ECAN has developed a water and land management strategy in an attempt to limit leaching and run-off, among other activities that negatively impact the environment.

Monaghan, et al. (2007) noted research conducted worldwide over the past three decades demonstrates that the amount of nitrate excreted by animals is the leading determinant of nitrogen losses from pastoral farms. Monaghan et al. (2007), suggest nutrient management principles are developing to include a greater emphasis on innovations aiming to minimise nutrient losses. This suggests improvements in water quality could be achieved by adopting 'best management practices' that may also provide economic opportunities (Monaghan et al., 2007).

Despite scientific evidence on the impact agricultural production has on water quality, a recent study by Austin (2014) found that Canterbury farmers in the Waimakariri catchment exhibited a mix of denial and lack of understanding about the impact their farming activities have on water quality and the concomitant impact water quality has on human health. This result is consistent with studies performed in Switzerland and Scotland that concluded farmers rarely considered environmental issues beyond their farms' fence lines, unless they affect their individual productivity or profit margins (Bratt, 2002; Macgregor & Warren, 2006). Farmers did not feel they were responsible for water quality issues or environmental degradation linkages between their catchments and nearby waterways. Most farmers surveyed by Austin (2014) reported a lack of knowledge regarding nutrient losses restricted their understanding of how their practices contributed to the issues surrounding groundwater and surface water quality. In contrast, Duncan (2014) interviewed farmers in the Hurunui Waiau zone of North Canterbury, who demonstrated understanding of their local water quality issues. This farmer

group did not object to the nutrient limits being imposed on farm, as long as they were perceived to be equitable and not substantially affect farm viability or profitability (Duncan, 2014). Respondents all considered their own farm's contribution to the deterioration of water quality as minimal or within a reasonable range – individually, their role in local water quality degradation is negligible (Duncan, 2014). As is common with nonpoint source pollution, individually their role is minor, but collectively, the impact can be extensive. Farmers' understanding could impact the implementation of good management practices expected by regional governments, as they must work collectively to address the problem (Duncan, 2014). Achieving consensus on what the problem is and who is responsible for its amelioration, is fundamental to regulatees being persuaded (1) there is a need to change and (2) they then must act on this understanding (Blackstock, Ingrahm, Burton, Brown & Slee, 2010).

Since these studies were conducted, ECAN's regulatory processes have changed. Its water and land management strategy and monitoring systems continue to evolve, along with farmers' knowledge. Critical to this process is understanding how regulatees make decisions about compliance as a pre-condition for designing an effective regulatory system.

The nutrient management section of Canterbury's Land and Water Regional Plan (LWRP) became operative on September 1, 2015 (Environment Canterbury, 2015a). The LWRP requires all farming operations (over five hectares) to monitor and record modelled nutrient losses. Farming activities must achieve the nutrient load limit allowance for their specific catchment (region within Canterbury) and farm operators must prepare a Farm Environment Plan (FEP) to identify and deliver on sound environmental practices across a range of farming activities (Environment Canterbury, 2015a). The LWRP requires that farming operations adopt:

> *the best practicable options to minimise the loss of nutrients from farming activities in areas where region-wide water quality outcomes are at risk of not being met, including nutrient loss management, efficient and effective use of water for irrigation, riparian management, stock movements across waterways, offal and farm rubbish pits, the storage and application of effluent and fertiliser use* (Environment Canterbury, 2015a, p. 63).

The referenced 'options' are set out in a list of industry agreed good management practices ['Matrix of Good Management' (MGM)], that all farmers are expected to operate under following Phase Two of the project targeted for completion by 2017 (Environment Canterbury, 2015c).

In the 2013-14 season, 792 farms or 72 per cent recorded full compliance with the conditions of their dairy effluent discharge consents in Canterbury (Environment Canterbury, 2014a).

Two-hundred and five (205) farms had minor non-compliance: a three per cent decrease over the previous season (Environment Canterbury, 2014b). Significant non-compliance totalled 8.8 per cent (96 farms), an increase of 1.8 per cent over the previous season (Environment Canterbury, 2014b). Non-compliance was due primarily to effluent ponding and exceeding allowed application rates (60 per cent of cases); the number of cows being milked (exceeding the number allowable on consent); overflow of effluent from storage ponds; ponds not meeting consent requirements; farms not operating in accordance with their management plans; and discharging effluent outside the consented area (Environment Canterbury, 2014b).

In the 2014-15 season, ECAN's monitoring system changed. Previously, all operating dairy farms were monitored. In the 2014-15 season, only operating farms deemed at risk or with previous poor performance were assessed: 85 per cent of all operating dairy farms in the region (Environment Canterbury, 2015b). Of these 976 farms, 627 (64 per cent) were in full compliance with their effluent consents; 282 (29 per cent) had minor non-compliance; 63 (6.5 per cent) were in significant non-compliance; and four farms (0.5 per cent) were unable to determine compliance (Environment Canterbury, 2015b). ECAN (2015b) states given a change in its monitoring system, comparing the percentages of the 2014-15 season to prior seasons is not recommended. Yet, on the assumption that the 15 per cent balance of farms not monitored were fully compliant, regional compliance would be 69.6 per cent: a decrease in compliance over the 2013-14 season of, at a minimum 2.4 per cent (Figure 1.1). Table 1.1 provides regional compliance statistics from Southland, the Bay of Plenty and Marlborough for comparison. Note that for Waikato, one of the largest milk producing regions, statistics were not easily available due to their monitoring system.

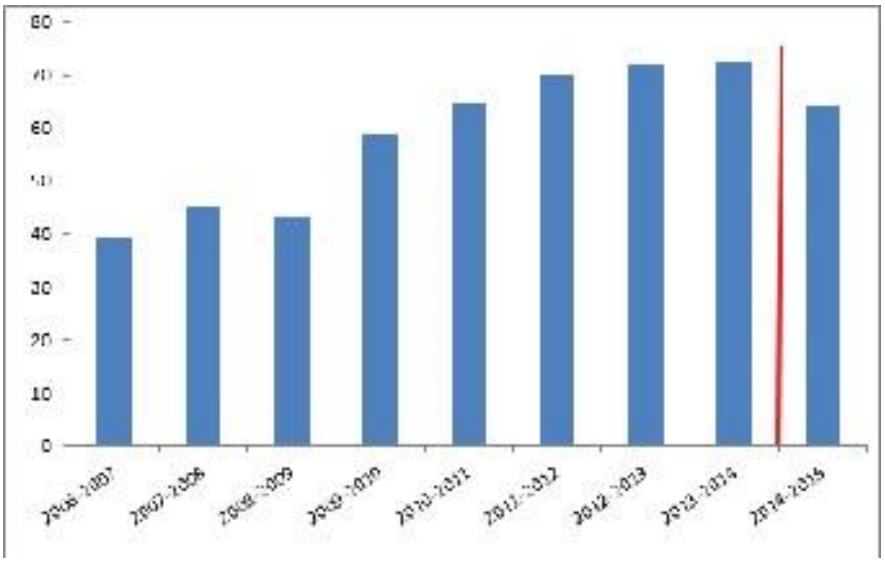


Figure 1.1 Per cent of fully compliant dairy farms in Canterbury: 2006-07 to 2014-15 (red line indicates change in monitoring system) (From: Environment Canterbury, 2015b, p. 18)

Table 1.1 New Zealand compliance rates (Marlborough District Council, 2016; Bay of Plenty Regional Council, 2015; Environment Canterbury, 2015b; Environment Southland, 2015)

Region	**Compliant**	**Minor (to marginal/ moderate) non-compliance**	**Significant/major non-compliance**
Canterbury (2014-15)	64 per cent	29 per cent	6.5 per cent
Southland (2014-15)	68 per cent	25 per cent	7 per cent
Bay of Plenty (2014-15)	72 per cent	25 per cent	2 per cent
Marlborough (2014-15)	70 per cent	16 per cent	14 per cent
Marlborough (2015-16)	73 per cent	9 per cent	18 per cent
Bay of Plenty (2014-15): Forestry	72 per cent	18 per cent	10 per cent
Bay of Plenty (2014-15): Agricultural water use	80 per cent	20 per cent	-

Compliance ratings in the Southland, Bay of Plenty and Marlborough regions are assessed differently than in the Canterbury region, ranging from a grading system with four sections (A through D) or a five-point score (one, two, five, seven and ten). For comparison, the grading systems were amalgamated into the three-point system Canterbury currently uses: compliant, minor non-compliance and significant non-compliance. Southland has the largest number of

consents out of the comparison group (912 consents). Bay of Plenty has the second largest, but almost half the size of Canterbury, at 698 consents (agricultural water use: 919; forestry: 45). Marlborough had the smallest number of effluent consents (and significantly smaller than Canterbury) at 56 farms (Marlborough District Council, 2016; Environment Southland, 2015; Bay of Plenty Regional Council, 2015).

1.2 Problem statement

The dairy industry currently faces pressure to improve environmental performance while maintaining economic competitiveness. DairyNZ Limited (2011) advised that the future of dairy farming in New Zealand depends on the sector's ability to reduce its environmental footprint, by adopting innovative techniques addressing effluent management and resource use efficiency challenges. However, research shows that the lack of adopting environmentally friendly practices stems from concerns over cost, complexity, compatibility and uncertainty of benefits (Monaghan et al., 2007). While ECAN has done significant work in creating partnerships with industry to promote environmentally sound practices (MGM is a prime example), today there is little empirical evidence of the factors on-farm influencing full resource consent compliance in the Canterbury region.

The environmental issues and consequences relating to inadequate effluent management on dairy farms are well documented in the literature (Blackett & Le Heron, 2008; Meister, Beechey, Brouwer, Fox & Jongeneel, 2012). Despite that, very little is known about the factors, their inter-relationships and ultimate significance in influencing attainment of full dairy effluent discharge consent compliance in Canterbury.

The objectives of this study are to firstly identify those factors that affect and thereby influence on-farm environmental compliance in the Canterbury region. Secondly, this study seeks to determine the impact of the identified factors on full ECAN dairy effluent discharge consent compliance. The results of the study provide recommendations to inform policy and industry stakeholders that target factors that increase compliance.

1.3 Motivation for research

A richer understanding of the motivating factors for full dairy effluent discharge consent compliance is extremely helpful for government agencies and the dairy industry as they work to guide all producers down a more sustainable production path. Non-compliance remains at approximately 30 per cent in Canterbury. Knowledge of how regulatees make decisions about compliance is a condition precedent to further development of an effective and efficient regulatory scheme. Insights gained from compliance research in Canterbury may facilitate the

design of effective systems in other regions within New Zealand. For many regions, proposed agro-environmental regulations and methods to minimise the environmental effects of nutrient losses are hotly debated (McCrone, 2015). An informed understanding how the central player – the consent holder – makes decisions about environmental compliance is a critical component in developing and evolving effectual regulatory systems nationwide.

The balance of this thesis contains the following format:

- Chapter 2 identifies and discusses theory and previous research relevant to this study, which assisted in the development of the framework used to guide this research.
- Chapter 3 provides the research objectives and questions in detail.
- Chapter 4 discusses the research methodology and design, as well as data collection and analysis.
- Chapter 5 presents the data analysis results, detailing the relationships between compliance and framework constructs.
- Chapter 6 draws on the results to present an integrated discussion, provide recommendations, outline future research opportunities and the current study limitations and conclusions.

Chapter 2

Literature review

This chapter provides an introduction to environmental legislation in New Zealand and Canterbury and the regulatory process, followed by a review of relevant theory and conceptual foundations for the study of behaviour. A review of empirical studies on the factors affecting behaviour towards a range of pro-environmental practices and compliance is provided in the chapter's final section.

2.1 Structure, features and motivation for farm environmental regulations in Canterbury

This section discusses environmental legislation in New Zealand in general and Canterbury in particular. Key features of the regulatory framework relevant to understanding the compliance process are reviewed.

2.1.1 Resource Management Act 1991

The Resource Management Act 1991 (RMA) is the central piece of national legislation for the sustainable management of New Zealand's natural resources and environment. The RMA includes land (except as managed under the Conservation Act 1987), water and air (Ministry for the Environment, 2016c). As an integrated regulatory framework for managing natural and physical resources, the RMA was one of the world's first governmental statutes incorporating the principle of sustainable management (Smith, 1997). The RMA charges regional councils and local governments with the responsibility to implement its objectives (Ministry for the Environment, 2016a).

In addition to the role a regional council plays in implementing the RMA, councils must also work with and towards the objectives and policies set in any operative National Policy Statements (NPS). NPS are set on issues deemed nationally significant. There are currently four NPS issued under the RMA – Freshwater Management, Renewable Electricity Generation, Electricity Transmission and New Zealand Coastal Policy Statement (Ministry for the Environment, 2016b). Current NPS under development include Indigenous Biodiversity and Urban Development (Ministry for the Environment, 2016b). The RMA provides a set of planning instruments for managing national resources – the hierarchy and relationship is shown in Figure 2.1.

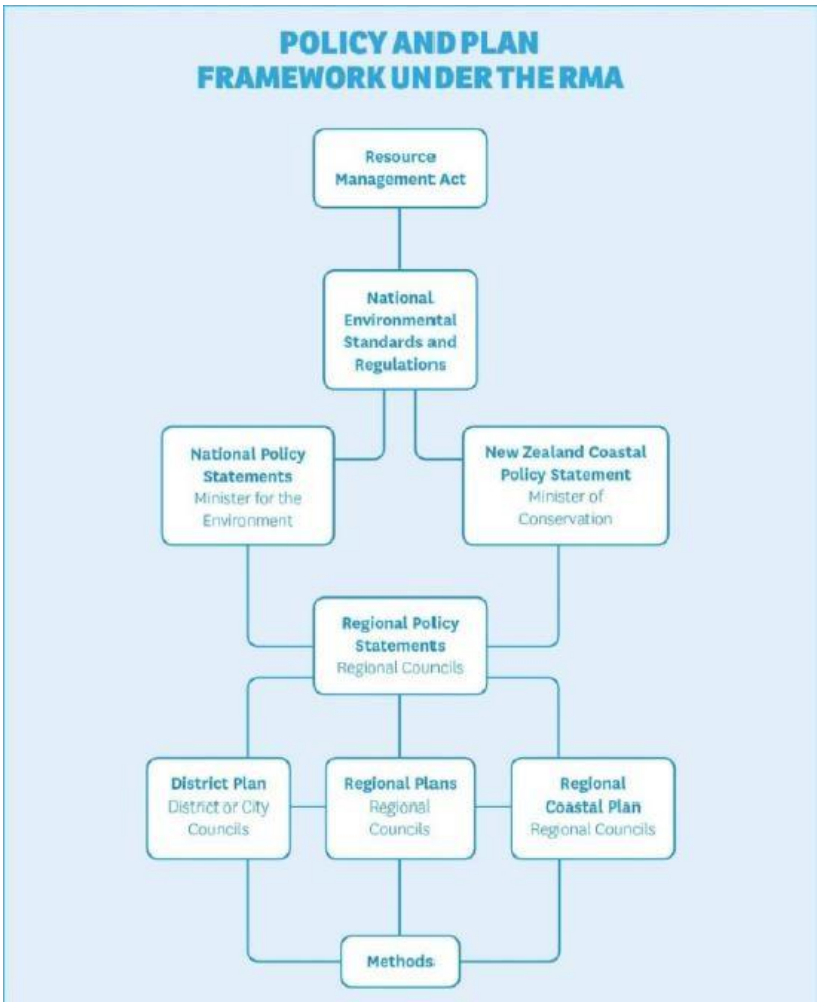


Figure 2.1 Hierarchy of planning instruments (From: Environment Canterbury, 2015a, p. 25)

2.1.2 Local government responsibilities

Local governments (regional and district councils) are given specific powers and duties they are to exercise under the RMA. Under Section 30, regional councils have functions concerning the control or use of any land for the purposes of soil conservation, water quality and quantity, ensuring the conservation of marine ecosystems, mitigating natural hazards and their consequences; and to prevent and mitigate the effects of hazardous substance use, storage, transport or disposal (Parliamentary Counsel Office, 2015). Regional councils have control over regional policy statements; identifying and monitoring contaminated land; planting decisions on river and lake margins; conservation of indigenous biological diversity; developing strategic infrastructure and land use (Parliamentary Counsel Office, 2015). Regional councils are responsible for issuing infringement and abatement notices to parties found non-compliant with the RMA and national or regional environmental statements and policies (Parliamentary Counsel Office, 2015).

Under Section 31, district councils (Canterbury has 10) have more generalised controls over the effects of land use and development and protection of land resources (Parliamentary Counsel

Office, 2015). Regional and district councils must work closely to ensure both regional and district plans are harmonised.

2.1.3 Canterbury Land and Water Regional Plan

ECAN manages an area covering 4.53 million hectares of land - the largest of all regions in the country (Statistics New Zealand, 2011). ECAN has implemented the LWRP, identifying goals for resource management in Canterbury to promote the objectives set in the RMA (Environment Canterbury, 2015b). The LWRP provides policies and rules to achieve RMA aims and provides direction for resource consent applications and compliance. The LWRP also contains catchment (district) specific policies and rules for achieving region-wide objectives (Environment Canterbury, 2015a).

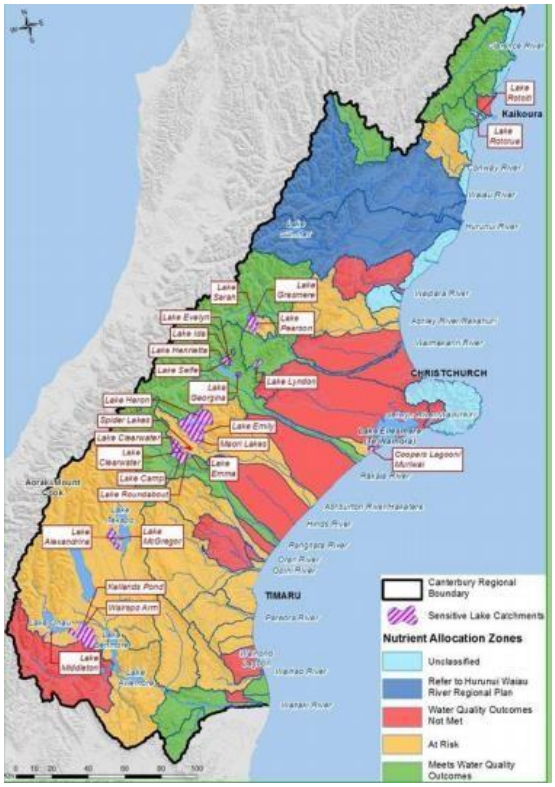


Figure 2.2 Nutrient risk map (From: Environment Canterbury, 2014b, p.2)

All Sections of the LWRP (except Rules 5.123-5.127 and 5.154-5.158) came into force December 1, 2015 (most sections operative from September 1, 2015) (Environment Canterbury, 2015a). Under the LWRP, regions are zoned for their water quality (Figure 2.2). Farm resource consents are evaluated for the amount of leaching per hectare (unless they are part of an irrigation scheme or a principal water supplier that holds a consent and if the farm is larger than 5 hectares) (Environment Canterbury, 2014b). Resource consents are required for all farming enterprises and any discharges of farm dairy effluent to land (Environment Canterbury, 2015a).

In addition to the LWRP, ECAN developed a project (MGM) that identifies good management practices (GMP) for each sector with industry partners (DairyNZ, Deer Industry NZ, NZPork, Beef + Lamb NZ, Horticulture NZ and Foundation for Arable Research) and Crown Research Institutes (AgResearch, Plant and Food Research and Landcare Research) (Environment Canterbury, 2015c). Utilising the Overseer® model, ECAN also developed an online resource (Portal), to assist farmers with their nutrient budgeting and modelling and development of farm

practices (Effectus Limited, 2016). The MGM, Overseer® model and Portal are discussed in the following two sections.

2.1.4 Matrix of Good Management

The MGM identifies expected nutrient losses under GMP to be used as a benchmarking tool (Environment Canterbury, 2016a). Using the Overseer® model, ECAN estimates nutrient losses under a variety of land uses and types to develop catchment loads. The project also provides for research to improve Overseer® model accuracy (Environment Canterbury, 2016a). The structure of the collaboration and partnerships created for the purposes of the MGM is shown below in Figure 2.3.

Figure 2.3 Partnerships and collaboration under the MGM project (From: Environment Canterbury, 2016b)

The MGM project outlines GMP for each industry involved in the process. The purpose is to provide local communities with high-quality information that helps achieve regulatory compliance and national expectations on water quality (Environment Canterbury, 2016a). In addition to benchmarking tools, the MGM project provides information to support the implementation of GMP. Phase Two (to be conducted 2015-2017) of the MGM project will incorporate the results into a regional plan and develop a database that populates the matrix with nitrogen and phosphorous footprint estimates (Environment Canterbury, 2013; Williams, et al., 2014). The aim is to eventually use the MGM project as a tool to assess compliance in the region (Environment Canterbury, 2013).

2.1.5 Overseer® and Portal

Regional councils are using outcome based approaches in environmental regulation, particularly concerning nutrient leaching. This is based on the belief that input controlled regulations stifle innovation on farm, are less effective and inflexible (Overseer, 2015). The Overseer® nutrient model is a New Zealand developed electronic tool for predicting annual losses in a farm's nutrient budget across a range of farming systems (Overseer, 2015). The tool was originally designed by the Ministry of Agriculture and Fisheries to be used for fertiliser recommendations (Selbie, Watkins, Wheeler & Shepherd, 2013). Overseer®, a publicly available software program, generates information on nutrient flows (nitrogen, phosphorous, potassium, sulphur, calcium, magnesium and sodium) and greenhouse gas emissions for farm 'blocks', accounting for changes in management or terrain type across an entire farm system (Overseer, 2015).

The model has been used to inform regulation in response to the NPS on Freshwater Management on nutrient load limits (Overseer, 2015). Monitoring activities such as nutrient budgets can be useful in measuring environmental impacts of nutrient use and the sustainability of nutrient flows on farm (Wheeler, et al., 2003). However, given the complex nature of farming systems, the model has some limits in its application (Edmeades, 2014). The use of Overseer® in regulation has caused some feelings of uncertainty and scepticism among farmers: there is active debate on some of the program updates and model output (McCrone, 2015). To build on the MGM and use of Overseer®, ECAN developed the online tool, Portal. Portal enables farmers to easily determine if they require a resource consent and to compare the nutrient losses from their current practices (using their Overseer® file) to modelled losses if their farm was operating under the GMP outlined in the MGM (Effectus Limited, 2016).

2.2 Potential advantages, disadvantages and challenges of compliance

The benefits of complying with environmental practices outlined in the MGM and utilising nutrient budgets includes an increase in farm efficiencies and a potential reduction in costs (Shober, Hochmuth & Wiese, 2011). Access to resources like Overseer®, Portal and MGM can influence management practices. Nutrient budgets can be monitored and adjusted, potentially resulting in decreased fertiliser use and subsequent reductions in both financial cost and environmental impact (Environment Southland, 2014). Operating outside regulatory limits can expose farmers to abatement or infringement notices and possible fines and court fees (Tasman District Council, 2015). Macdonald (2014), in a study of the financial costs of environmental compliance in the Waikato region, modelled four scenarios: decreasing stocking rate; building increased effluent storage and expanding application area; winter grazing; and building a

covered feed pad/housing shelter. The modelling in all scenarios demonstrated a reduction in nitrogen leaching with housing and destocking achieving the largest reductions. Investing in cow housing technology provided the greatest financial benefit – increasing farm surplus on average by 11 per cent per hectare across a range of milk prices and farm systems (low to high input) (Macdonald, 2014).

However, there can be a range of costs associated with limiting nutrient losses. A survey of Waikato dairy farmers conducted by Macdonald (2014), showed there was a real cost in environmental compliance to every farm business, either through infrastructure investment or through a financial or opportunity cost. Most of the costs incurred in the compliance process stemmed from inadequate storage or effluent treatment upgrades, resulting in an aggregated average initial capital cost of $1.03 per kilogram of milk solids (Macdonald, 2014). The Lincoln University Dairy Farm, in reducing its nitrogen loss by 17 per cent, saw a reduction in farm productivity (Pellow, 2015). This equated to $525 NZD per hectare cost or a mitigation cost of $75 NZD per kilogram of nitrogen in the 2013/14 season (Pellow, 2015).

Farmer compliance with environmental regulation in New Zealand is further complicated by uncertainties surrounding the relevant science; the use of an evolving modelling tool; and the overall regulatory environment (Purvis, Boggess, Moss & Holt, 1995; Landcare Research, 2011). The use of Overseer® as a method for monitoring compliance by many regional councils has resulted in figures for nutrient losses differing from previous estimates, in some cases because of program updates. Margins of error also occur due to model assumptions on the transfer of nutrients (Edmeades, 2014). Overseer® assumes that GMP are being followed and if they are not, can underestimate losses (Wheeler, Ledgard & Monaghan, 2007). Additionally, under the NPS on Freshwater Management, regional councils set limits based on local water quality. If quality continues to decrease, farmers believe they may face tighter restrictions on their nutrient limit load. Macdonald (2014) noted a general attitude of uncertainty among farmers surveyed in the Waikato – 22 per cent of the comments indicated that while farmers had made significant investments to become compliant, council staff could not advise them whether the farm had met, or would continue to meet, regulation(s). Lack of understanding of current regulation and ongoing uncertainty over future regulation were key themes revealed in the qualitative results of the study (Macdonald, 2014).

2.3 Relevant theories and conceptual foundations

The following section provides a discussion on theories that are used in this study. According to Etienne (2011), no central theory exists that is consistent and comprehensive enough to fully

account for myriad compliance behaviour motivators. Etienne (2011) suggests that this is due in large part to theorists' inability to build consistent models capturing the pursuit of multiple, sometimes conflicting motivations, as well as the interactions among these motivations. For the purposes of this study, the conceptual model is built on Reasoned Action Approach (RAA), discrete choice theory, and empirical findings related to the context.

2.3.1 Defining motivations for compliance behaviour

The seminal research on compliance is based on calculated motivations. Becker (1968) predicted that regulatees comply with regulation only when they conclude that the benefit of compliance outweighs the cost (cost of becoming compliant multiplied by the potential penalty of fines and other sanctions). This is modelled on a basic utility function – with the decision-maker assuming to choose the course of action (compliance versus non-compliance) associated with the highest net return. The costs associated with non-compliance are based on the likelihood of detection and speed, certainty and size of sanctions or fines (Becker, 1968). Subsequent empirical work suggests that the most important component of a regulatory system is enforcement.

However, much of the literature on compliance evolved to include normative and social motivations (Burby & Paterson, 1993; Tyler, 1990). Normative motivations develop from a regulatee's moral sense of duty and agreement with the regulation (Burby & Paterson, 1993). This moral duty is based on two considerations: first, the regulatee's sense of civic duty to obey laws. Fear of shame - a self-imposed deterrent, stems from this sense of duty (Grasmick, Bursik & Kinsey, 1991; Scholz & Pinney, 1995). The second consideration is more specific to the regulation. Regulatory rules acceptance is based on the perceived reasonableness of the rule, stemming from a recognition of harm from rule violations and how rules are enacted (Scholz & Lubell, 1998; May, 2005). Additionally, fair treatment from authorities enforcing regulations and the extent to which other community members comply fall under this consideration (Levi, 1997). Absent majority compliance resulting from these motivations, a much stronger enforcement tool would be required (Tyler, 1990).

Social motivations result from the desire of regulatees to be respected by those in their communities and networks. Social pressure can come from other regulatees, trade associations, external advocacy groups, the media or personal relationships (Grasmick & Bursik, 1990). Compliance can also be motivated through the interactions that those being regulated have with inspectors. Enforcement styles and relationships that form between regulators and regulatees

can shape social expectations. Winter and May (2001) found that the degree of formalism and the degree of coercion in these interactions can impact compliance.

Social motivations are also employed in Responsive Regulation Theory (RR). RR was presented by Ayres and Braithwaite (1992, p. 3), as a method of regulatory design that is developed through the collaboration between state and self-regulation, where self-regulation by industry is a major part of the process. Arguably, the MGM discussed in previous sections is an attempt by ECAN to use and harness social pressure. The following figure is an example of a typical RR pyramid (Ayres & Braithwaite, 1992, p. 3).

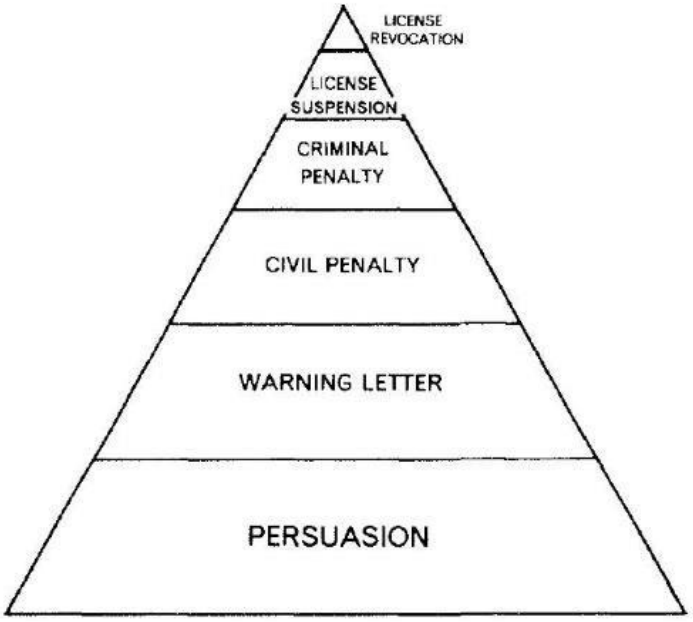


Figure 2.4 RR pyramid (From: Ayres & Braithwaite, 1992, p. 35)

At the base of the pyramid, regulators encourage compliance by appealing to an individual's sense of social responsibility. It is generally accepted that most people are willing to 'do the right thing' and so form the pyramid's foundation (Ayres & Braithwaite, 1992, p. 35). Further up the pyramid are those willing to comply but needing reminders or assistance. Higher levels of the pyramid are associated with increasingly non-compliant individuals, requiring progressively stringent regulatory approaches (Ayres & Braithwaite, 1992, p. 35). The size of each layer is broadly representative of the relative proportions of the population requiring each regulatory approach.

RR is intended to operate within frameworks that allow regulatory bodies to create binding regulations with enforceable sanctions and use a hierarchy of strategies with varying degrees of intervention. Under RR, regulatory bodies convey to their audience less intrusive

interventions at the base levels of the pyramid are preferred: they will only move to higher levels in response to industry non-compliance (Ayres & Braithwaite, 1992, p. 35). While the theory of RR attempts to address the plurality of motivations, it does not fully address the complexity of motivational behaviour. Etienne (2011) contends RR is based on two discordant ideas of consequences and appropriateness: choice results from a cost-benefit, but individuals may follow moral norms internalised in relationships built on trust.

2.3.2 Reasoned Action Approach

The RAA was developed from the Theory of Planned Behaviour and the Theory of Reasoned Action to account for each theory's limits in understanding behaviours in which people have incomplete decision making control (Ajzen, 1991). Central to understanding behaviour in RAA is the individual's intention to perform – a measure of how much effort a person is willing to exert to perform the behaviour. The stronger the intention, the more likely the behavioural performance (Fishbein & Ajzen, 2010, p. 22). However, intention can only be expressed as behaviour if the behaviour is under volitional control. The performance of most behaviours also relies on opportunities and resources available to the individual (money, skill, time, etc.), such that if enough resources are in place, and the individual intends to perform, they should succeed (Fishbein & Ajzen, 2010, p. 23). The joint action of motivation and ability on behavioural achievement has long been discussed in theory (Locke, 1965; Anderson, 1974; Sarver, 1983).

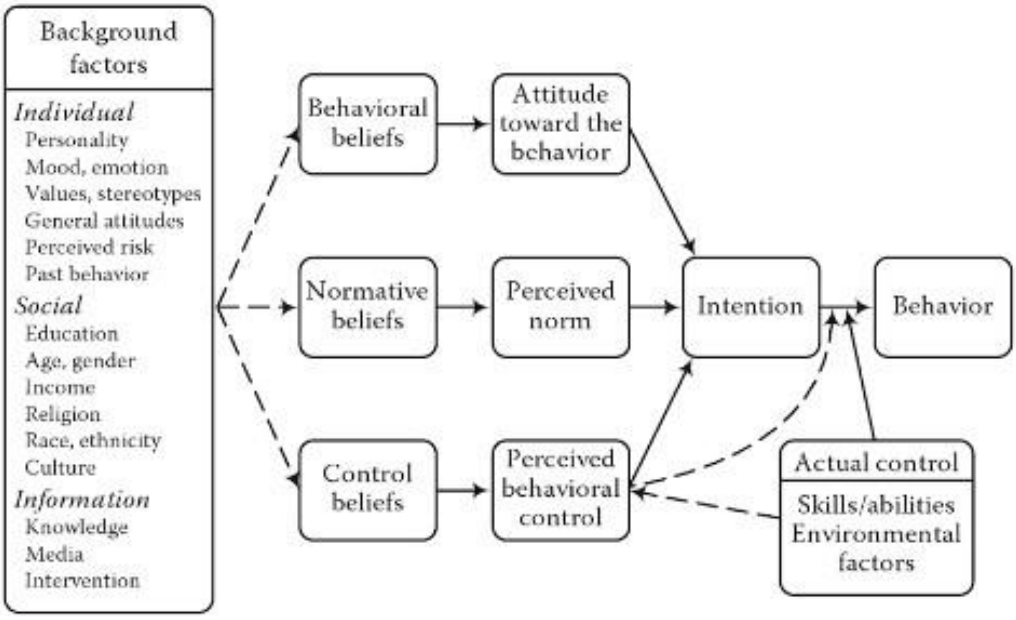


Figure 2.5 Reasoned Action Approach (From: Fishbein & Ajzen, 2010, p. 22)

Figure 2.5 presents the RAA model. While actual control (ability) is made clear, in the study of behaviour, perception of control is of greater interest. Perceived control relates an individual's perception of how difficult the performance of a particular action is – behaviour intention is

strongly influenced by their confidence in their ability (Ajzen, 1991). For accurate measurement, intentions and perceptions must be assessed in relation to the behaviour of interest. However, the impact of these variables may vary across different situations. Only one, two or all three may have a significant impact on the intention to act (Ajzen, 1991). RAA hypothesises three factors that can lead to intention: attitude, or the degree to which an individual has a favourable evaluation of the behaviour; perceived norm; and behavioural control (Ajzen, 1991). RAA is used widely in behavioural research including the adoption of agricultural techniques (Renzi & Klobas, 2008). Fishbein and Ajzen (2010, p. 331) suggest that if the impact of the variables influencing behavioural intention are known, interventions can also be made on the variables and thereby influence intention and behaviour.

Fishbein and Ajzen (2010, pp. 301-303) acknowledge the critiques of and challenges to their theory that have arisen since it was first developed. It is suggested that the theory can only account for 50-60 per cent of the variance in intention and 30-40 per cent of the variance in behaviour, which approach the limits of predictive validity (Gold, 2011). Their theory has also been considered too rational and Western culture specific. There are however a number of published papers that use RAA to successfully predict irrational behaviours (i.e. smoking) or in non-Western cultures (Ajzen & Fishbein, 2010, p. 303).

2.3.3 Discrete choice theory

Discrete choice models are used in the study of behaviour to describe, explain or predict choices between two or more distinct alternatives. The set of alternatives (the choice set) is defined so that the alternatives are mutually exclusive and exhaustive (Jeliazkov & Rahman, 2012). In this study, the choice set includes compliance and non-compliance. Models are motivated by an underlying latent variable threshold-crossing framework, and statistically relate a choice to the attributes of the choice-maker and the attributes of the alternatives (Jeliazkov & Rahman, 2012). Generally, discrete choice models are derived from a utility maximisation framework, in which decision-makers are assumed to choose options that result in the highest utility or satisfaction possible (Jeliazkov & Rahman, 2012). While analysts cannot directly observe the decision-maker's utility, they can observe their ultimate choice, as well as some of the attributes of both the alternatives and the decision-maker. The theoretical models of choice are estimated empirically by specifying a probabilistic function relating the outcome of the choice to the observable factors (Jeliazkov & Rahman, 2012).

It is important to note that in discrete choice models, the absolute value of a decision-maker's utility is not relevant. The choice behaviour is hypothesised to be driven by differences in utility

rather than its absolute value (Jeliazkov & Rahman, 2012). Discrete choice theory is utilised to help develop an empirical model for compliance, while RAA helps inform the variables measured in this study. The following sections present empirical studies on agro-environmental compliance and farm practice adoption that help identify independent variables.

2.4 Empirical studies on compliance and conservation practice adoption

The previous section showcased theory on behavioural motivations for compliance and forms part of the understanding of the factors influencing compliance. Research discussed in this section suggests that farmer behaviour regarding environmental management activities can be influenced by the characteristics of the farm, farmer and regulation or program, attitudes, perceptions and norms.

2.4.1 Traditional characteristics

There is disparate research regarding the impact of traditional farmer and farm characteristics on adoption behaviour related to conservation practices. While Carlson, Dillman and Lassey (1981) found no relationship between biological age and conservation technology adoption**,** D'Souza, Cyphers and Phipps (1993) found younger farmers tend to adopt new conservation techniques first. Abd-Ella, Hoiberg and Warren (1981) found that years of farming, not age, was positively associated with the adoption of conservation technologies. Traore, Landry and Amara (1998) conversely suggest that years of farming negatively influenced adoption of conservation technologies, as farmers become more complacent about environmental degradation issues.

There is literature reporting a positive relationship between conservation adoption and formal education (D'Souza et al., 1993; Kilpatrick, 2000). Kilpatrick (2000), found farmer education and training increased their willingness to make conservation related changes to their management. Additionally, Traore et al. (1998), Suwunnamek and Suwanmaneepong (2011), Ganpat, et al. (2014) and Zingiro, Okello and Guthiga (2014) found participation in local organisations and government programs and access to extension services was positively associated with an increase in access to information and training, leading to an increase in adoption. Compliance behaviour can only be understood if a capacity for regulatees to comply exists. Awareness of regulation and regulatory rules are key aspects of compliance (Winter & May, 2001). When regulations such as ECAN's resource consents use performance objectives, such as an amount of nutrient leaching, the means for compliance may not be well understood.

Having the financial capability to comply can also influence compliance (Winter & May, 2001). This capacity is distinct from other motivational factors, as regulatees may have intentions to

comply, but cannot (actual control in RAA model). Profitability has consistently been shown to be a critical factor in adoption. Concerns for the environment only become motivating factors once basic economic and survival needs are met (Langholz, Lassoie, Lee & Chapman 2000; Vanclay & Lawrence, 1994; Dunlap & Van Liere, 1984). Siebert, Toogood and Knierim (2006), noted in their review, that studies conducted in Finland showed that farmers saw compliance with environmental regulations was part of ensuring their farms' viability. Rogers (2003, pp. 283-288) found that farmers with higher social standings such as class, income and community status also tend to be early adopters of innovative practices. This is supported by Smit and Smithers (1992) and Furman (1997) who found high income farmers respond to conservation practices more quickly. Additionally, Zingiro, et al. (2014) in their discrete choice logit regression analysis, found that income levels affected the likelihood of farmers in Rwanda adopting practices that mitigate drought effects.

Atari, Yiridoe, Smale and Duinker (2009) studied the participation of Canadian farmers in Nova Scotia's environmental farm plan program. Unlike some of the literature referenced above, the authors found traditional farmer and farm attributes (i.e. age; formal education) were not associated with an increased level of participation. Rather, farm income, years in the industry and the type of agricultural sector involved was associated with participation.

2.4.2 Attitudes and perceptions

Compliance motivations can be influenced by attitudes and perceptions toward regulation or practice context, trust, moral sense of duty and confidence, which may not be as observable as traditional characteristics. May (2005) showed how regulatory context influenced compliance and how normative and social motivations differed in their analysis of three separate regulatory contexts: Danish farmers and environmental regulation; United States (US) homebuilders and safety; and US marine facilities and water quality. May (2005) suggests that the differences between compliance levels in these contexts stems from willingness to comply with rules, the evaluation of rules and the acceptance of governmental authority, as well as regulatory design – specifically, inspection interactions. Danish farmers had a strong sense of duty to comply and low deterrent fears resulting in the highest level of compliance of the three cases, while boatyard operators in the US had a low sense of duty and a high deterrent of fears – highlighting differing motivations (May, 2005). Differences in regimes and styles within and between countries can shape compliance motivations (Gormley & Peters, 1992; Axelrad & Kagan, 2000).

Research into farmer behaviour and conservation practice adoption has tested the RAA. Borges, Lansink, Ribeiro and Lutke (2014) found Brazilian farmers' attitudes toward improving natural

grassland, perceptions of social pressure and perceptions of capabilities, were all significantly and positively correlated with their intention to use improved natural grassland. Lynne, Casey, Hodges and Rahmani (1995) also showed actual control (financial), as well as social pressure and perceived behavioural control, were significant influencing factors in water saving technology adoption among Florida strawberry farmers. A number of studies such as: Beedell and Rehman's (1999) study of farmer hedge management in England; Wauters, Bielders, Poesen, Govers and Mathijs' (2010) study of soil conversation practices in Belgium; and Menozzi, Fioravanzi and Donati's (2014) study of Italian wheat producers' adoption of sustainable practices also contributed to the validation of RAA theoretical constructs influencing behaviour in the farming sector.

Perceived equity, too, may impact the uptake of conservation practices on farm. Environmental initiatives can create a disproportionate spread of costs and benefits, resulting in real or perceived inequalities for farmers (Jodha & Russel, 1997). When it is perceived that conservation practices are inequitable in cost and benefits sharing, communities have little incentive to adopt (Tisdell, 1998). However, the concept of equity can be quite subjective when linked to the individual farmer's perceptions and values. Measuring equitability can be difficult and only comes from an understanding of the factors stakeholders use to determine equity at the individual level (Kabii & Horwitz, 2006). Arbuckle (2013), showed a strong correlation between farmer support for pro-environmental regulation and policy and those who viewed conservation behaviour as central to their farming identity. The higher the value placed on conservation in practice, the greater the support for policy. Winter and May (2001) found social and normative motivations were as influential in creating compliance to agro-environmental regulations in Denmark as calculated motivations. Additionally, they found the use of coercion by compliance inspectors dampened, rather than fostered, compliance while a developed relationship with the inspector had a positive linear relationship with compliance (Winter & May, 2001).

Spatially and contextually, there are differences in the significance that independent variables play in conservation agriculture and innovation adoption. Knowler and Bradshaw (2007) reviewed 31 analyses drawn from 23 published studies and found that few, if any, variables were universally significant (see Appendix A). Knowler and Bradshaw (2007) note that this presents challenges for policy makers. Their findings support the view of Stonehouse (1996), who advocated that policy mechanisms must be geared to those of the locale in which they

operate or to individual farmers and operations. Table 2.1 provides a summary review of some of the studies discussed above, the method of analysis and their significant findings.

Table 2.1 Summary of empirical findings

Research details	**Variables identified as significantly related to farmer compliance**
Kilpatrick (2000): Australia; univariate and chi squared test	Education and training improves farm decision-making and farm practice change
Winter and May (2001): Denmark; Ordinary Least Squares	Awareness of rules; likelihood of detection; compliance costs; inspector formalism; attitudes; inspector coercion
Shefer, Cohen & Bekhor (2004): Israel; discrete choice and logit	Age of the settlement; farmer's tendency to consult R&D personnel; farm size; frequency of visits to R&D centre; farm investment; farmer age
Siebert, et al. (2006): European Union; meta-analysis	Attitude (interests, values, norms, problem awareness and self-perception); ability (type of farm business, area of farming, age, education etc.); social influences (direct and indirect interactions with socio-cultural, political and juridical conditions); effect of policy (instruments, content and results)
Atari, et al. (2009): Canada; chi squared tests	Commodity group (industry); region of operation; knowledge of program; years in industry; farm income
Suwunnamek and Suwanmaneepong (2011): Thailand; logistic regression	Livestock numbers; farm size; age; education; labour; membership of farmer organisation; government subsidy
Arbuckle (2013): United States; logistic regression	Conservation values linked to support for environmental policy
Ganpat, et al. (2014): Trinidad and Tobago; ANOVA test with associated post-hoc test (Tukey's b)	Land tenure, number of extension officers' visits and age

2.5 New Zealand studies

Literature on the factors influencing regulatory compliance related to nutrient losses on farm in New Zealand is limited. Most compliance related studies focused on the Waikato region, most likely because it is the largest dairy producing region (DairyNZ Limited, 2016). Local research on compliance and environmental practice adoption helps frame an understanding of the factors

involved in agro-environmental compliance in Canterbury, as there are few, if any, universally significant independent variables in conservation adoption (Knowler & Bradshaw, 2007).

In a study of the factors influencing dairy farmer effluent compliance in the Waikato region, farmers relied heavily on consultants; their own and other farmers' experiences; articles and suppliers to inform their decisions to upgrade their management systems to become compliant. They were, however, concerned about the lack of technical information and unbiased advice (Davies, Kaine & Lourey, 2007). Wang (2016) found that strong farmer-to-farmer relationships and access to information were influential determinants of the adoption of GMP in the Waikato region. Environmental performance on farm was positively influenced by geographical location and social relationships between farmers (Wang, 2016). In terms of socio-demographics, Murphy (2014), found that farmer and farm characteristics were weakly associated with innovation adoption on-farm in the Canterbury region and that compatibility and profitability of innovations used on their operations, in particular, was of primary importance.

Van Reenen (2012) conducted interviews with sheep and beef farmers in the Waikato and Bay of Plenty regions, finding that the greatest barrier to adopting environmentally sustainable practices was cost. Other barriers noted included knowledge gaps; attitudes to environmental issues; fear of regulatory rules; maintenance requirements; and lack of understanding of the benefits of environmental GMP (Van Reenen, 2012). Van Reenen (2012) reported that the motivations for undertaking environmental practices the farms currently had were generally related to management benefits, like animal health and pasture management.

2.6 Literature gap

Despite a wealth of research internationally regarding the factors critical to the adoption of conservation practices and motivations for regulatory compliance on farm, there is little empirical evidence on the factors influencing agro-environmental regulatory compliance on-farm in New Zealand. The literature lays out a multiplicity of variables that may impact compliance, but there is little information about which factors are critical. Further, there are no clear, universally significant, factors that affect adoption behaviour or motivations for regulatory compliance on farm. Given the lack of generalisation in adoption and compliance studies due to their spatial and contextual differences, there is minimal understanding of the factors leading to compliance with environmental regulations like effluent discharge consents among dairy farmers in Canterbury. Chapter 3 will present research objectives and aims to address this lacuna in the literature.

Chapter 3
Research objectives and aims

3.1 Study objectives

Given the findings and literature gap presented in Chapter 2, this research seeks to improve our understanding of effluent consent compliance on dairy farms in Canterbury. The specific objectives of this study are to:

1. Identify the factors influencing full ECAN dairy effluent discharge consent compliance

2. Determine the impact of the identified factors on full ECAN effluent consent compliance

3. Make recommendations to inform policy and industry stakeholders

3.2 Research questions

There is an array of factors that may influence consent holders' compliance decisions. These may be observable at varying levels in both compliant and non-compliant operations such as years farming, educational background and membership in producer organisations or attitudes and perceptions. Existing literature suggests control, or the capacity (chiefly financial and knowledge) to follow through with behavioural intentions, is key in conservation practice adoption and ability to comply with regulation.

The corresponding research questions are:

1. What are the factors influencing dairy effluent discharge consent compliance in the study area?

2. What are the critical factors influencing dairy effluent discharge consent compliance?

The following chapter presents the research methodology and design used to achieve the study objectives and answer the research questions.

Chapter 4

Methodology and research design

This chapter describes the research methodology and design, data collection and analysis. Section 4.1 presents the research strategy and the conceptual model. Section 4.2 details the data collection method. Section 4.3 presents the data analysis methods.

4.1 Research approach

The objectives of this study were to determine and assess the significance of factors that impact ECAN effluent consent compliance in the dairy industry. RAA provides a useful framework to guide the choice of variables that can be linked to the practical policy interventions that may ultimately influence compliance behaviour (Fishbein & Ajzen, 2010, pp. 20-22). The study utilised a largely quantitative approach with additional text analysis and dialog with policy makers for a richer understanding of complex behaviour. The research generated numerical and categorical data that could be meaningfully aggregated and summarised, and ultimately statistically analysed (Punch, 2005, p. 55).

A non-experimental survey approach was deemed an appropriate method to collect the primary data as it permits replicability and a degree of cross-case comparability (Tornatzky & Klein, 1982). The primary data required to address the research questions presented in Chapter 3 was generated from a survey in the form of an electronic questionnaire conducted with Canterbury dairy effluent discharge consent holders. To facilitate a greater understanding of attitudes of consent holders towards ECAN regulation and inspection processes, qualitative data was also collected using this questionnaire through respondents' comments on their experiences with regulation and inspections. This data was analysed using text analysis.

4.1.1 Theoretical framework for this research

Based on the literature and developed from discrete choice theory of utility maximisation and RAA, a conceptual model was specified for this study to examine the factors that influence ECAN effluent consent compliance through economic, sociological and psychological motivations (Figure 4.1).

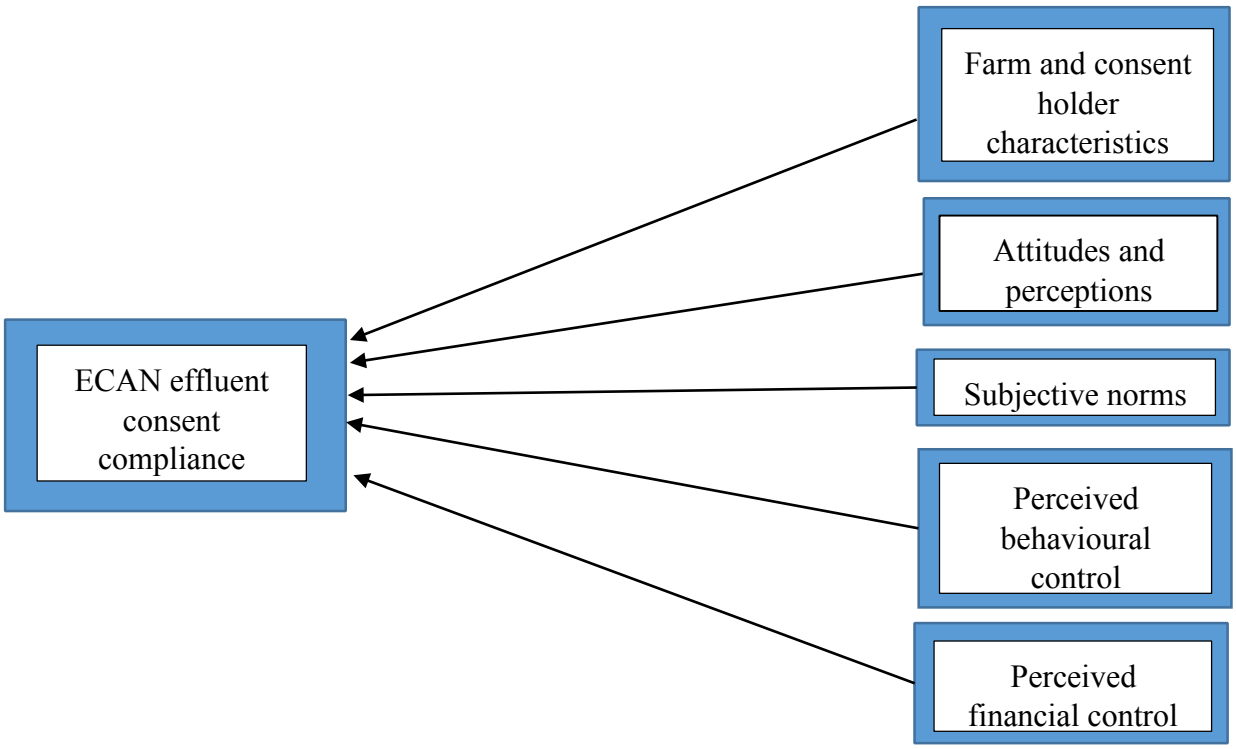


Figure 4.1 ECAN resource consent compliance model (adapted from Fishbein & Ajzen, 2010, p. 22)

The solid lines indicate a direct influence with arrows showing the direction of the relationship. Appendix B presents the variables, proxies, constructs and items used to measure these relationships and what their expected impact was based on the literature review. Farm and consent holder characteristics refer to socio-demographics and operational characteristics that can reflect individual behaviours (toward compliance) (Welch & Marc-Aurele, 2001). Attitudes and perceptions relate to factors such as values, interests, and problem awareness – dispositions associated with behaviour (Siebert, et al., 2006). For the purpose of this study, attitudes were categorised by perceptions toward the environment, the equitability of current regulation and environmental management costs and attitudes on current ECAN regulation. Included in this section was problem awareness and internal attribution. Subjective norms represented perceived social pressure – descriptive and injunctive, with regard to regulation. Perceived behavioural control referred to the perceived ease or difficulty in performing the behaviour and reflected past experiences and control over anticipated obstacles. Perceived financial control related to the perceived impact of farm financial situations and milk payout levels on compliance levels.

4.2 Data collection method

Data was collected with an electronic survey delivered to participants by email. Surveys generate information about the same variables from a number of cases to provide a structured data matrix (de Vaus, 1995, p. 3). Online surveys tend to have the lowest response rate of all

survey methods, largely due to internet connections/access, deliverability, computer literacy and online survey fatigue (Pecoraro, 2012). Typical response rates are approximately 5 – 10 per cent, which can lead to non-response bias (Semler, 2010). Consequently, this study used techniques from the literature to increase the response rate (Sauermann & Roach, 2013). For example: sending the survey on a weekday; using multiple reminders while still considering the marginal increase in response rate; ensuring reminders were sent on the same days/times (heterogeneous samples); offering a prize incentive; and changing the wording of each contact to maintain attention were all used to help achieve the highest possible response rate (Sauermann & Roach, 2013). Email surveys offer significant cost and time efficiencies over postal surveys in survey design, implementation and processing (Nulty, 2008).

4.2.1 Questionnaire background

The online questionnaire was developed to determine:

(a) the socio-demographics of effluent consent holders and their operational characteristics;
(b) their attitudes towards and perceptions of the physical environment, equitability of current regulation and the regulation and regulatory processes in place, their problem awareness and attribution;
(c) subjective norms (injunctive and descriptive);
(d) perceived behavioural control; and
(e) perceived financial control

The choice of the constructs and questions were derived from literature presented in Chapter 2 and RAA. Fisbein and Ajzen (2010, pp. 449-456) provide survey guidelines for testing behaviour. The survey utilised dichotomous and categorical questions as well as Likert scales (bipolar) – the most highly recommended techniques in the application of RAA (Ajzen, 1991).

Qualtrics, a secure online survey software application available through Lincoln University, was employed in the design and distribution of the online questionnaire. Qualtrics delivers rigorous privacy standards and account password protection with real-time data replication (Qualtrics LLC, 2016).

The questionnaire contained three main sections. The first collected quantitative and categorical data on demographic and operational characteristics including gender, ethnicity, age, dairy farming experience, highest level of education, training and workshop attendance, farm size, number of livestock being milked, ownership structure, if there were other decision-making parties on farm, catchment, use of consultants and years out of five with a positive dairy operating profit.

Section Two consisted largely of ordinal Likert scale questions related to problem awareness, attribution, perceptions of and attitudes towards the physical environment, the equitability of current regulation and responsibility for environmental management, the current regulation and regulatory processes, experiences with inspections and the regulatory process injunctive and descriptive norms, and perceived behavioural and financial control. This section also included a qualitative question regarding the ratings for inspections and the regulatory process.

The third section posed questions related to respondents' level of compliance at their last inspection and if non-compliant, the degree to which they were non-compliant (minor or significant), the reasons for their non-compliance and associated issue(s) that occurred to cause non-compliance (weather, management issue, infrastructure, etc.). A full copy of the survey is set out in Appendix C.

4.2.1.1 Ethics approval

Lincoln University has rigorous human ethics requirements in place to ensure the interests of participants, researchers and the University are protected. Any research involving human participants as sources of information must be reviewed by the Lincoln University Human Ethics Committee, a nationally accredited ethics committee (Lincoln University, 2014). Given the nature of this research, the questionnaire and an application were submitted for review and approval by the Committee. Approval was granted June 20, 2016 (Application No. 2016-31, Appendix D).

4.2.2 Sample selection and distribution

The objective of this research was to determine how effluent consent holder and operational characteristics, attitudes and perceptions, subjective norms and perceived control influence compliance with effluent consents. The survey was conducted with the assistance of ECAN and sent to all consent holders for whom ECAN held viable addresses.

The final email contact list was derived from 868 consents out of a population of 1213 current effluent consents. This resulted in 542 email addresses (as some individuals hold multiple consents). Of these addresses, 513 were active (email was deliverable). The emails were sent from an ECAN customer service email address to ensure privacy protection conditions between the consent holder and ECAN were maintained. The survey instrument was distributed during a general slow period on farm (prior to calving) in an effort increase response rates. The initial contact was emailed on June 23, 2016, mid-morning. Three reminder emails were sent at two week intervals on July 8, July 21 and August 5, 2016, during the mid-morning period. These reminder emails each contained different wording from the initial email, as research suggests

multiple contacts with varied wording can assist in achieving higher response rates (Sauermann & Roach, 2013). A total of 72 surveys were returned by August 18, 2016 survey close date representing a response rate of 14 per cent.

4.3 Data analysis

The data analysis was conducted using the statistical software package for social sciences (SPSS 23). Behavioural theorists generally use correlations and/or multiple regressions to validate the measures of various indicators or drivers of behaviour or behavioural intention (Hankins, French & Horne, 2000). Section 4.3 discusses the survey variables and analysis methods used.

4.3.1 Survey data and variables included

The electronic questionnaire consisted primarily of questions that produced categorical or ordinal data. The questionnaire contained 62 questions (generating 148 variables) covering a range of topics, with an additional 12 questions that collected both categorical data and qualitative data in the form of written comments (i.e. 'other' category selected). Sixty-one questions were categorical – being dichotomous (only two categories which may be ordered), ordinal (categories ranked in a meaningful way) or nominal (no implied order or rank) (Morgan et al., 2007, pp. 39-40). The one remaining question asked for respondents' views, providing qualitative data.

The dichotomous variables included gender of consent holder and whether there were other decision-making parties on farm. Additional nominal variables included farm ownership structure, ethnicity, catchment location, which societal group is responsible for environmental management and the best method of intervention. The remainder of the categorical variables in this analysis follow a logical order and are treated as ordinal (Morgan, Leech, Gloeckner & Barrett, 2007, p. 41). The distinctions among the variables as dichotomous, nominal or ordinal are important when selecting and evaluating statistics (Morgan et al., 2007, p. 41).

4.3.2 Statistics used in the analysis

4.3.2.1 Descriptive statistics and exploratory analysis

The univariate analysis in this study was used to develop a better understanding of the demographics of Canterbury dairy effluent discharge consent holders along with the characteristics of their farm and their attitudes and perceptions around environmental regulation. Exploratory data analysis generally involves the use of descriptive statistics to

describe a single variable through units of analysis like the mean, median, standard deviation and range (Babbie, 2010, p. 426).

4.3.2.2 Bivariate analysis

The first and second objective of this research were to determine the factors influencing the attainment of full compliance with ECAN effluent consents and which factors were strongly related to compliance. To achieve these objectives, both bivariate and multivariate analyses were used.

A bivariate analysis can be used to investigate the relationship between two variables. Such analyses can take the form of simple cross tabulation tables to explore the data, or the calculation of statistics such as correlation coefficients to provide a numerical measure of linear association for continuous data (Babbie, 2010, p. 437). Non-parametric statistics and tests can be used to analyse categorical data, or continuous data that is not normally distributed (Field, 2009, p. 691). To determine the direction, strength (effect size) and significance of the relationships between the variables, chi-square, Mann-Whitney U and/or Kendall's tau statistics were calculated – providing accepted measures of non-parametric relationships or correlations (Field, 2009, p. 181). Tau-b (τb) was used to determine direction for square tables while tau-c (τc) was used for rectangular tables, with values ranging from −1 (perfect negative association) to +1 (perfect positive association). A zero value indicates no association (Morgan et al., 2007, p. 112).

Significance tests determine the likelihood that a relationship between two or more variables is due to a chance occurrence. Low p-values typically less than 0.05 imply that we reject the null hypothesis of no association. Conversely, high p-values (typically $p>.05$) supports the opposite conclusion: chance is likely to have caused the pattern (Sweet & Grace-Martin, 2008, pp. 9699). If the p value is small, the finding is statistically significant, however, this does not necessarily translate to a strong or important relationship or reflect causality (Sweet & GraceMartin, 2008, p. 96). Morgan et al., (2007, pp. 94-95), note that the p-value must be interpreted with caution, as the choice in correlation coefficient could create differences and measures are not necessarily direct indices of the importance of the finding.

Given the question categories' size and the valid response rate, some variables combined similar categories within individual variables to provide support for the analysis and increase the possibility of discovering significant ($p<0.1$) relationships. These new variables have fewer categories with more responses in each category and were guided either by the frequency

distribution of data or by the similarities in categories (i.e. 'strongly agree' and 'agree' versus 'neutral' to 'strongly disagree'). This allowed for greater comparison of groups as, for example, large farms versus small farms and provided more manageable presentation of the data. Details of transformations can be found in Appendix E. The bivariate tests described above are used to determine relationships between compliance behaviour and various control variables. Amalgamating categories reduces the degrees of freedom and increased the ability to discover significant relationships. A number of significant relationships were found using secondary analysis, and are presented in Chapter 5.

4.3.2.3 Multivariate analysis: Logistic regression

One of the most commonly used statistical techniques in behavioural sciences is regression analysis (Hankins, et al., 1999). Regression models are appropriate for evaluating constructs and the relationship between constructs (Alavifar, Karimimalayer & Anuar, 2012). With regression models, the influence of several explanatory on the dependent variable can be determined (Hankins, et al., 1999). Utilising SPSS software commonly used in behavioural research, regression analysis methods can estimate the link between latent and observed variables (Hankins, et al., 1999). However, regression models assume multivariate normality, that may overestimate the extent to which a model fits the data (unless the sample size is very large) (Hu, Bentler & Kano, 1992).

Numerous studies on farmer behaviour use ordinary least squares (OLS) or bivariate dependent variable regressions (logit or probit), as regression analyses can offer insight into relationships between variables (Knowler & Bradshaw, 2007). In this study, consent holder and farm characteristics, attitudes, subjective norms and perceived control are the explanatory variables and the dependent variable is binary: compliance or non-compliance with effluent consents. The explanatory variables can be continuous or categorical and are used to predict the likelihood of occurrence of one of the categories of a dependent variable (Sweet & Grace-Martin, 2008, p. 175). To evaluate the conceptual model, Cronbach's α is used to test reliability – that multiple variables are adequately measuring the same major construct (Field, 2009, p. 674). The value of Cronbach's α ranges from zero to 1, with 1 indicating complete reliability ($\alpha<0.5$ is generally considered unacceptable) (Field, 2009, p. 675).

Initially, the likelihood of one of the categories occurring in the dependent variable (compliance or non-compliance) is measured without including explanatory variables. This base model provides a reference to evaluate the 'fit' of the model with explanatory variables – shown by the -2 log likelihood statistic and associated chi-square statistic (Field, 2009, p. 290). A logistic

regression generates statistics that are used to determine the fit of the models to the data, as well as coefficients for the explanatory variables. For each explanatory variable, a regression coefficient (B) is generated, measuring the direction and strength of the relationship between the explanatory variables and binary dependent variable (Sweet & Grace-Martin, 2012, p. 193). Associated Wald statistics are calculated – if the explanatory variable is significantly different from zero in this statistic, it is assumed to be making a significant contribution to the prediction of the outcome (Field, 2009, p. 287).

The strength of the relationship may be difficult to evaluate with raw coefficients as they are measured using a log scale. However, the coefficients can be transformed exponentially (Exp(B)) to indicate the change in odds resulting from a unit change in the explanatory variable (Sweet & Grace-Martin, 2012, p. 193; Field, 2009, p. 287). A value greater than one (>1) indicates that as the explanatory variable increases, the odds of the event in the dependent variable increase, while if the value is less than one (<1) this indicates that as it increases, the odds of the outcome decrease (Field, 2009, p. 271). Marginal effects can also be calculated, which provide a more direct measure of the change in the predicted probability of compliance, in this case, for a unit change in the explanatory variable (Williams, 2016). Standard errors are also reported - a measure of dispersion which may vary due to sample size or underlying data distribution (Field, 2009, p. 43).

4.4 Summary

Based on theory and insights from the empirical literature, a quantitative research approach was used to guide the research design. Data collection, consisting of a survey in questionnaire format was distributed to consent holders by email. The survey sample consisted of those identified as dairy effluent discharge consent holders from ECAN's records. The analysis of the survey data was conducted using SPSS 23 software. Exploratory data analysis initially helped describe consent holder and farm characteristics, attitudes and perceptions and compliance. Bivariate and logistic regression analysis were then applied to evaluate constructs and their relationship with compliance. Results from the analysis are reported in Chapter 5.

Chapter 5
Results

5.1 Introduction

This chapter presents the analysis of the survey data. It is directed by research question one: What are the factors influencing dairy effluent discharge consent compliance in the study area; and research question two: What are the critical factors influencing dairy effluent discharge consent compliance?

Section 5.2 describes the sample population of dairy effluent discharge consent holders in terms of the major constructs presented in the conceptual model. Level of compliance at last inspection is presented in Section 5.3. This is followed by an exploration of the results from the bivariate analysis – relationships between the major constructs and compliance level. Section 5.4 presents a text analysis of the open ended question proposed to respondents about their ratings of inspections and the regulatory process. Section 5.5 presents a regression analysis of the relationships between the major constructs and compliance level. Section 5.6 summarises of the results.

5.2 Univariate analysis

5.2.1 Consent holder characteristics

5.2.1.1 Gender, age and ethnicity

Of the 72 responses to the questionnaire, 63 reported their gender. Eighty-one per cent of those identified as male. Ninety-six per cent of respondents reported their ethnicity as European New Zealander, with the balance consisting of European and American ethnicity. The majority of consent holders fell within the 46-55 and 56-65 year old age categories (Table 5.1).

Table 5.1 Age of consent holder

Position n = 67	**Per cent**
26-35 years old	6
36-45 years old	16.5
46-55 years old	31
56-65 years old	31
66-75 years old	13.5
76+ years old	2
Total	**100**

5.2.1.2 Education level and years in the industry

Forty-eight per cent of respondents hold an undergraduate degree or higher. This is well above the New Zealand average: 22 per cent of New Zealanders aged 25 to 64 have attained a tertiary education at degree level or higher (Ministry of Education, 2009). Thirty-two per cent held a Primary ITO, Polytechnic education or a University diploma. Of the remaining 20 per cent, 18 per cent had a high school education or the equivalent. Overall, 80 per cent of respondents had some form of post-secondary education. Nearly 60 per cent of respondents had over 20 years dairy industry experience, with under 10 per cent having less than 5 years industry experience (Table 5.2).

Table 5.2 Number of years actively involved in dairy farming in New Zealand

Position n = 66	**Per cent**
1-2 years	1.5
3-5 years	7.5
6-10 years	6
11-15 years	10.5
16-20 years	15
21-25 years	20
26+ years	39.5
Total	**100**

5.2.1.3 Training attendance and consultant use

Over 65 per cent of respondents reported attending training or workshop sessions at least once a year (Figure 5.1). With respect to consultancy services, just over 60 per cent of respondents reported using consultancy services for their operation at least once a year (Table 5.3).

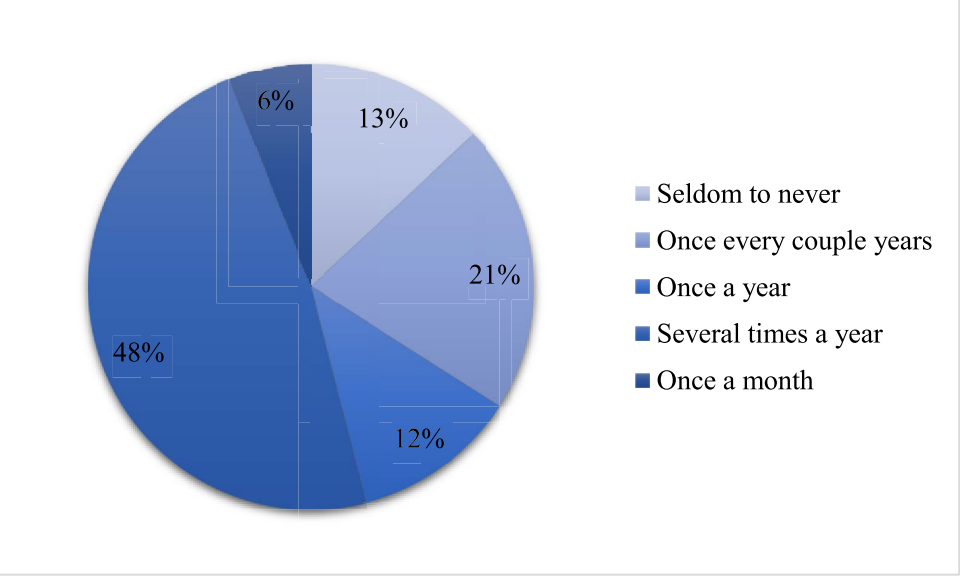


Figure 5.1 Frequency of attendance to training workshops or farm group meetings

Table 5.3 Frequency of consultant use for farm planning

Position n = 66	**Per cent**
Seldom to never	17
Once every couple years	22.5
Once a year	3
Several times a year	57.5
Total	**100**

5.2.2 Farm characteristics

5.2.2.1 Farm size and livestock numbers

Nearly 80 per cent of respondents were milking over 500 animals – with 31 per cent milking over 1,000 animals (Figure 5.2). The most common farm size is 250-500 hectares with over 85 per cent of respondents operating farms less than 500 hectares (Table 5.4). The average farm size is 207 hectares – slightly under the DairyNZ (2014) Canterbury average estimate of 231.5 hectares.

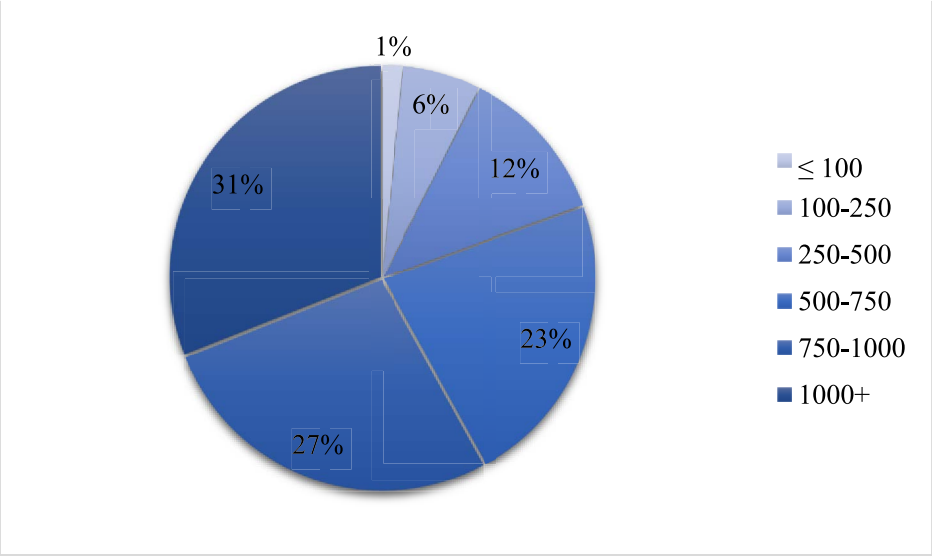


Figure 5.2 Number of animals being milked

Table 5.4 Farm size (hectares)

Position n = 68	**Per cent**
<100	6
100-250	38
250-500	42.5
500-750	7.5
750-1000	4.5
1000+	1.5
Total	**100**
	Hectares
Mean	207 (Value=2.71)
Median	250-500 (Value=3)

5.2.2.2 Ownership structure and decision-making parties

The most common form of farm ownership is the corporation/company structure (Table 5.5). Just under 80 per cent of respondents reported having at least one other decision-maker for the operation (Table 5.6). This group includes a wide range from family members to sharemilkers to farm managers to advisors (Figure 5.3). The most common decision-making partners were immediate family members.

Table 5.5 Ownership structure

Position n = 66	**Per cent**
Sole proprietorship	14
Partnership	14
Corporation/Company	50.5
Trust	17
Maori Trust	1.5
Limited partnership	1.5
Mix (Limited Liability Company and Trust)	1.5
Total	**100**

Table 5.6 Decision-making parties on farm

Position n = 71	**Per cent**
Multiple other decision-making parties	28
One other decision-making party	51
No other decision-making parties	21
Total	**100**

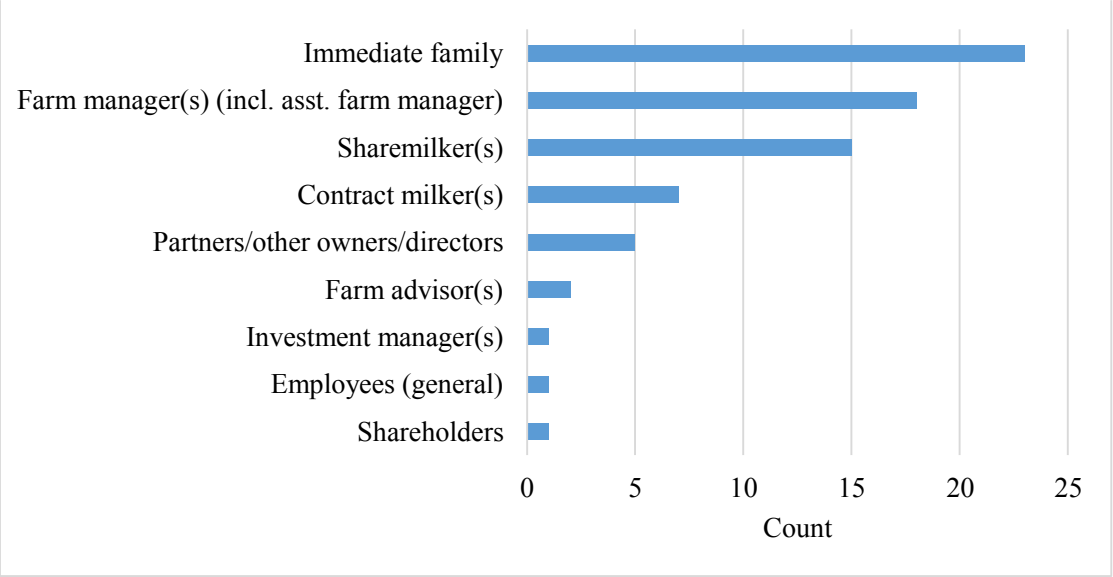


Figure 5.3 Decision-making parties

5.2.2.3 Catchment location

The majority of farms are primarily in the Ashburton zone, followed by the Selwyn-Waihora zone (Table 5.7). This is representative of ECAN statistics for the largest dairy catchments for the 2014-2015 season, showing 34 per cent and 19 per cent of herds in the Ashburton and Selwyn-Waihora zones respectively (Environment Canterbury, 2015).

Table 5.7 Primary catchment of operation

Position n = 70	**Per cent**
Huruni-Waiau	10
Waimakariri	10
Selwyn-Waihora	18.5
Ashburton	38.5
Orari-Opihi-Pareora	13
Lower Waitaki	7
Upper Waitaki	1.5
Kaikoura	1.5
Total	**100**

5.2.2.4 Dairy operating profit

The most common and average number of years respondents have had positive dairy operating profit outcomes is three in the past five years (Table 5.8).

Table 5.8 Years of positive dairy operating profit

Position n = 69	**Per cent**
None	1.5
1	7
2	17.5
3	36
4	16
5	22
Total	**100**
Mean	3.23 years
Median	3 years
Standard deviation	1.262
Interquartile range	2

5.2.3 Attitudes and perceptions

5.2.3.1 Problem awareness

Respondents were presented with four statements related to their awareness of current water quality issues and their consequences. Respondents were asked to rate their agreement with the statements on a 5-point Likert scale. The first question, "dairy farming impacts surface and ground water quality" saw 50 per cent of respondents either strongly agree or agree; approximately 32 per cent were neutral; and 18 per cent either disagreed or strongly disagreed. The respondents were presented with three statements regarding the effects of water quality on human, livestock and crop/pasture health. The majority of respondents agreed water quality does impact human health and livestock health at 84 per cent and 75 per cent respectively agreeing or strongly agreeing, while 49 per cent agreed or strongly agreed that water quality impacts crop and/or pasture health (Figure 5.4).

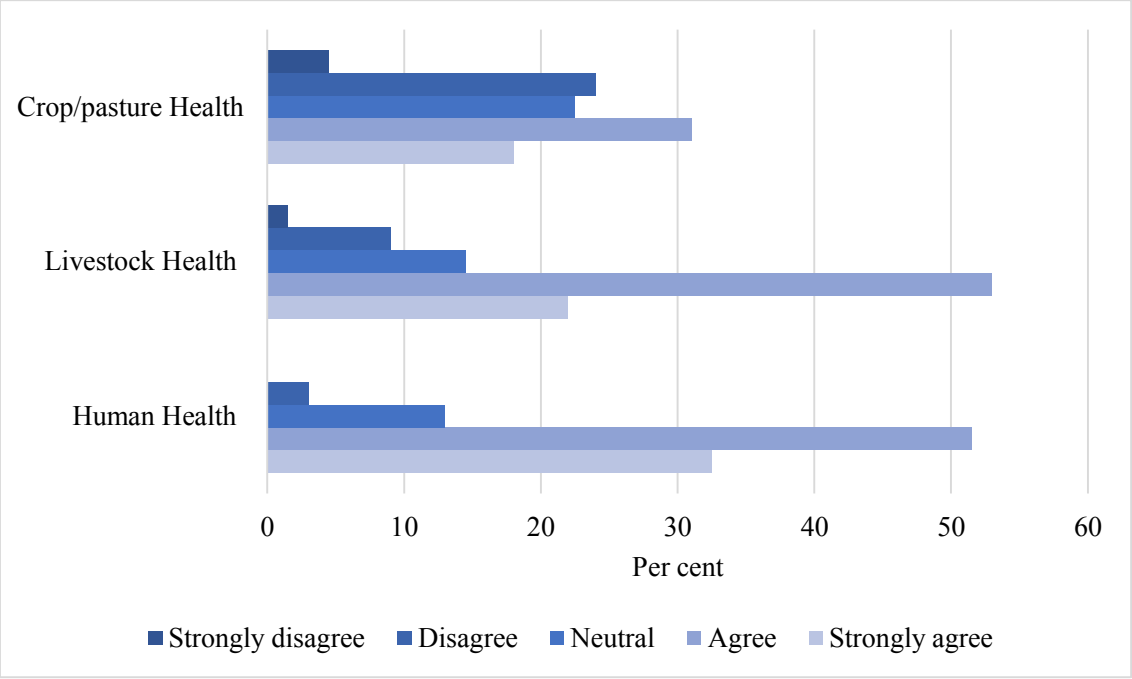


Figure 5.4 Problem awareness responses

5.2.3.2 Attribution

Two statements (as well as the first statement discussed in section 5.2.3.1) were posed to respondents on whether they believed their farming practices and industry contributed to the need for environmental regulation and if regulation on farm was a necessary action to improve local water quality. While the majority of respondents (65 per cent) either strongly agreed or agreed that environmental regulation on farm was necessary, only 16 per cent agreed that their farming practices contributed to the need for environmental regulation on farm (Table 5.9).

Table 5.9 Attribution responses

	Per cent: Regulation necessary to improve water quality Position n = 68	**Per cent: My farming practices did not contribute to the need for environmental regulation Position n = 68**
Strongly agree	9	16
Agree	56	35
Neutral	25	33
Disagree	6	16
Strongly disagree	4	0
Total	**100**	**100**

5.2.3.3 Environmental perceptions

Respondents were asked to rate their level of concern about practices impacting the natural environment due to the potential consequences for native birds, plants, animals and fish on a

5point Likert scale. Respondents were also asked how threatening degraded soil health, weeds, poor water quality, water quantity and adverse weather conditions were to the physical environment. Taken as an average of their rating, these statements related to feelings of biospheric concern and environmental risks respectively. Approximately 65 per cent of respondents rated practices impacting the natural environment on the concerning side of neutral to very concerning (Table 5.10). Just under 75 per cent felt that environmental risks were on the threatening side of neutral to very threatening (Table 5.11).

Table 5.10 Biospheric concern

Position n = 67	**Per cent**
Not very concerning	1.5
Not concerning	12
Neutral	21
Neutral-concerning	9
Concerning	49
Concerning-very concerning	4.5
Very concerning	3
Total	**100**

Table 5.11 Environmental risks

Position n = 67	**Per cent**
Not very threatening	1.5
Not threatening	3
Not threatening – neutral	3
Neutral	18
Neutral – threatening	18
Threatening	40
Threatening – very threatening	10.5
Very threatening	6
Total	**100**

5.2.3.4 Equity perceptions

Four statements and one question were posed to respondents regarding the equitability of current regulation on-farm in Canterbury. The statements asked respondents to rate their agreement on a 5-point Likert scale whether: “Canterbury farmers are unfairly impacted by environmental regulation”; “Nitrate limits are fairly applied to all farmers”; “Environmental regulation in Canterbury has a fair and equitable impact on all farmers”; and “The cost of environmental protection is equitable across society in Canterbury.” The question asked respondents, “What group in society should have primary responsibility for looking after the environment in a sustainable manner?”

The majority of respondents felt that Canterbury farmers are unfairly impacted by environmental regulation (53 per cent) and nitrate limits are not applied fairly to all farmers (58 per cent) (Table 5.12). This is further confirmed with 63.5 per cent of respondents disagreeing, to varying degree, that environmental regulation is fair to all farmers (Table 5.13). Moreover, 73.5 per cent of respondents felt the costs associated with environmental protection are not equitably distributed across society (Table 5.13). The majority of respondents felt that 'everyone' in society is responsible for ensuring that the environment is managed in a sustainable manner (Figure 5.5).

Table 5.12 Fair application of regulation responses

	Per cent: Canterbury farmers are unfairly impacted by environmental regulation Position n = 68	**Per cent: Nitrate limits are fairly applied to all farmers Position n = 67**
Strongly agree	16	1.5
Agree	37	18
Neutral	26.5	22.5
Disagree	20.5	43
Strongly disagree	0	15
Total	**100**	**100**

Table 5.13 Equitability and cost spread responses

	Per cent: Environmental regulation in Canterbury has a fair and equitable impact on all farmers Position n = 68	**Per cent: The cost of environmental protection is equitable across society in Canterbury Position n = 68**
Strongly agree	1.5	1.5
Agree	17.5	9
Neutral	17.5	16
Disagree	48.5	50
Strongly disagree	15	23.5
Total	**100**	**100**

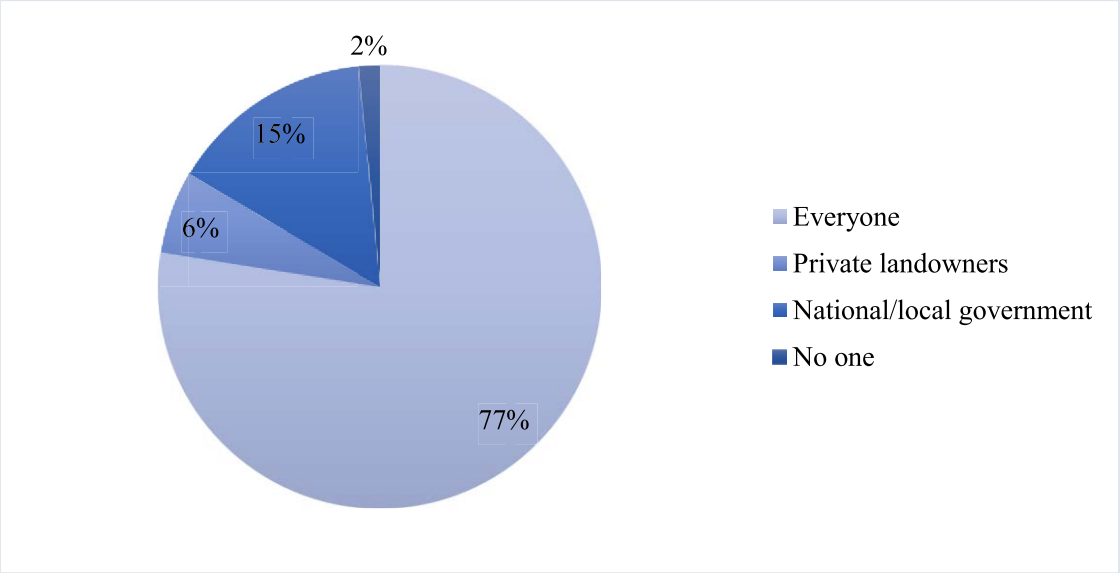


Figure 5.5 Response to the group in society responsible for environmental management

5.2.3.5 Regulatory perceptions

Ten statements and three questions were posed to respondents regarding current environmental regulation and the regulatory process. The statements asked respondents to rate their agreement on a 5-point Likert scale. The average respondent was neutral on whether ECAN makes it easy to understand why farmers should be compliant, but the majority agreed they had easy access to information on compliance requirements and are informed on environmental regulation on farm (Figure 5.6).

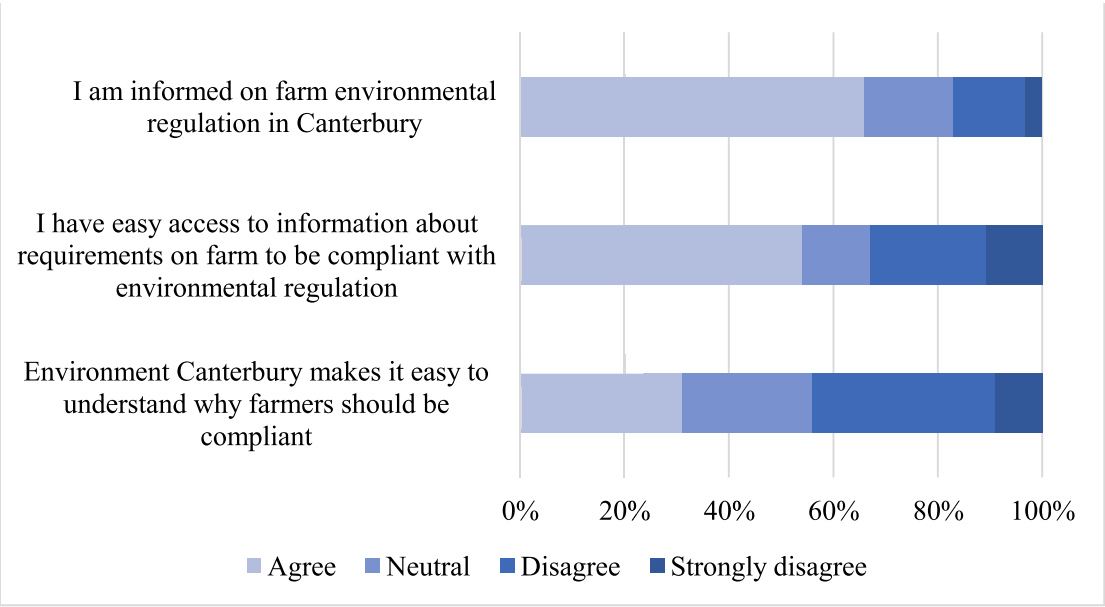


Figure 5.6 Access to information on regulation perceptions

When asked if achieving and maintaining environmental compliance is resource exhausting in terms of time and money spent, over 80 per cent of respondents agreed compliance required a lot of their time and over 85 per cent felt it required a lot of financial resources (Figure 5.7).

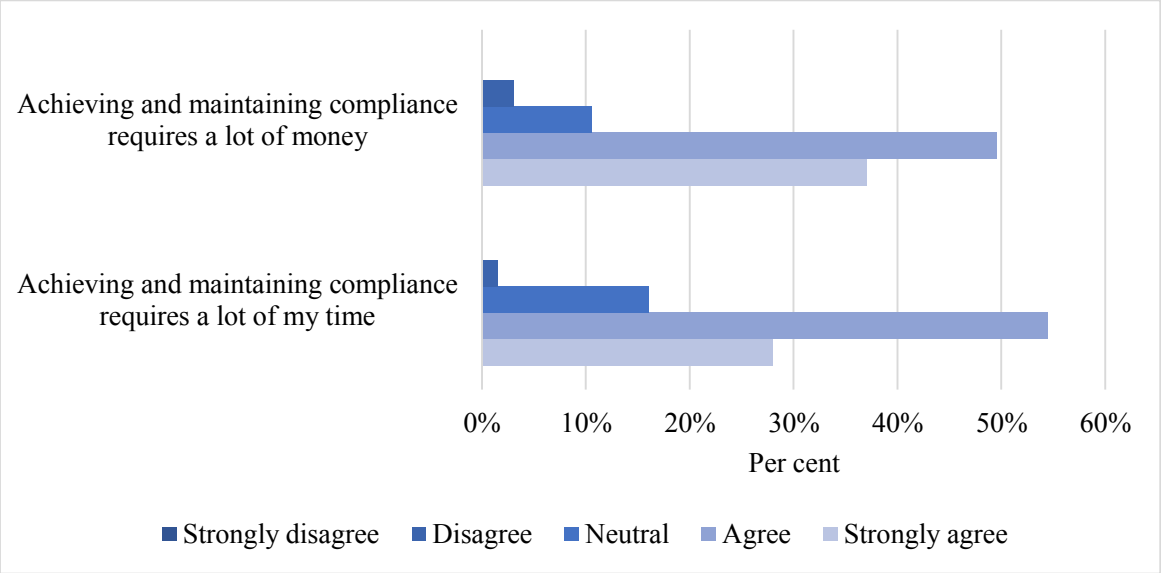


Figure 5.7 Compliance costs response

Almost 70 per cent felt yearly inspections performed by Environment Canterbury staff were frequent enough to deter the majority of farmers from violating their consents. Over 75 per cent intended to be compliant with their consent conditions due to the potential for a penalty, should they be caught operating outside of their consent conditions (Figure 5.8).

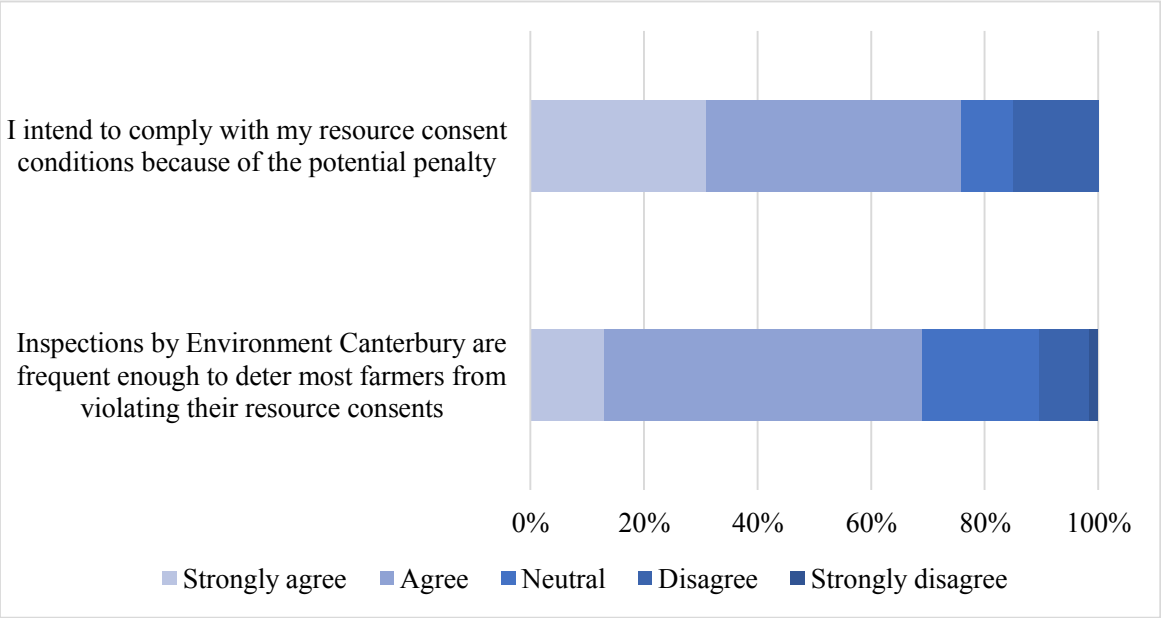


Figure 5.8 Impact of penalty scheme for non-compliance

Despite strong agreement that yearly inspections are frequent enough to largely deter noncompliance, only 40 per cent of respondents felt it was easy for ECAN to detect noncompliance, while almost 40 per cent felt it was neither easy nor difficult. However, if a

farmer were detected not complying with their consent, over 60 per cent of respondents felt that they would be penalised for it (Figure 5.9).

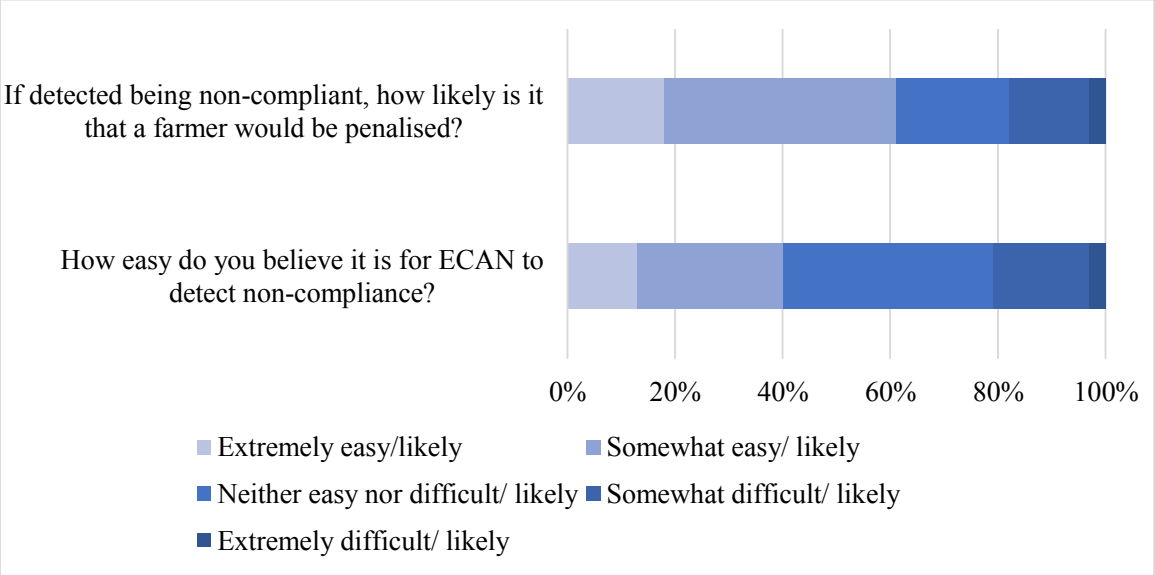


Figure 5.9 Non-compliance detection and penalties response

Respondents were asked to rate their interactions with ECAN inspections and the regulatory process to date. The responses were largely on the positive end of the scale, with 70 per cent of respondents rating their experiences with inspections as good to excellent, and over 80 per cent rating the regulatory process as average or better (Table 5.14).

Table 5.14 Rating of interactions with ECAN

	Per cent: Rate your experience with ECAN inspections Position n = 67	**Per cent: Rate your experience with ECAN regulatory process Position n = 67**
Excellent	16.5	6
Good	53.5	35.75
Average	19.5	10.5
Poor	7.5	10.5
Terrible	3	6
Total	**100**	**100**
Mean	Good (Value = 2.27)	Average (Value = 2.75)
Median	Good (Value = 2)	Average (Value = 3)
Standard deviation	0.931	0.943
Interquartile range	1	1

The majority of respondents – over 70 per cent – agreed to varying degrees that they felt uncertain about future regulatory restrictions farmers may face (Figure 5.10). Sixty-eight per cent of respondents felt some mix of voluntary and market driven initiatives with government

regulation provides the best results for reducing nitrate leaching on farm, while 32 per cent felt that either voluntary or market driven, or a mix of the two (without government involvement) would provide optimum results.

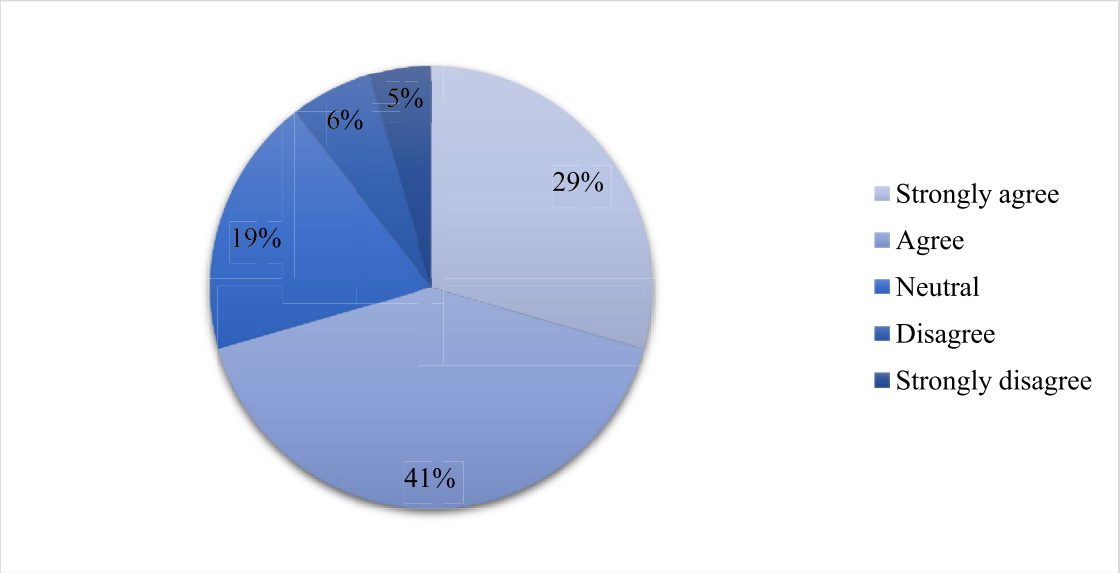


Figure 5.10 Feelings of uncertainty over future regulation

5.2.4 Subjective norms

5.2.4.1 Injunctive social norms

The majority of respondents felt public pressure to comply with their effluent consent. Over 85 per cent felt that their public reputation would be harmed if they were not compliant, and over 70 per cent reported operating the way the public expects them to regarding their effluent consent was important to them (Figure 5.11).

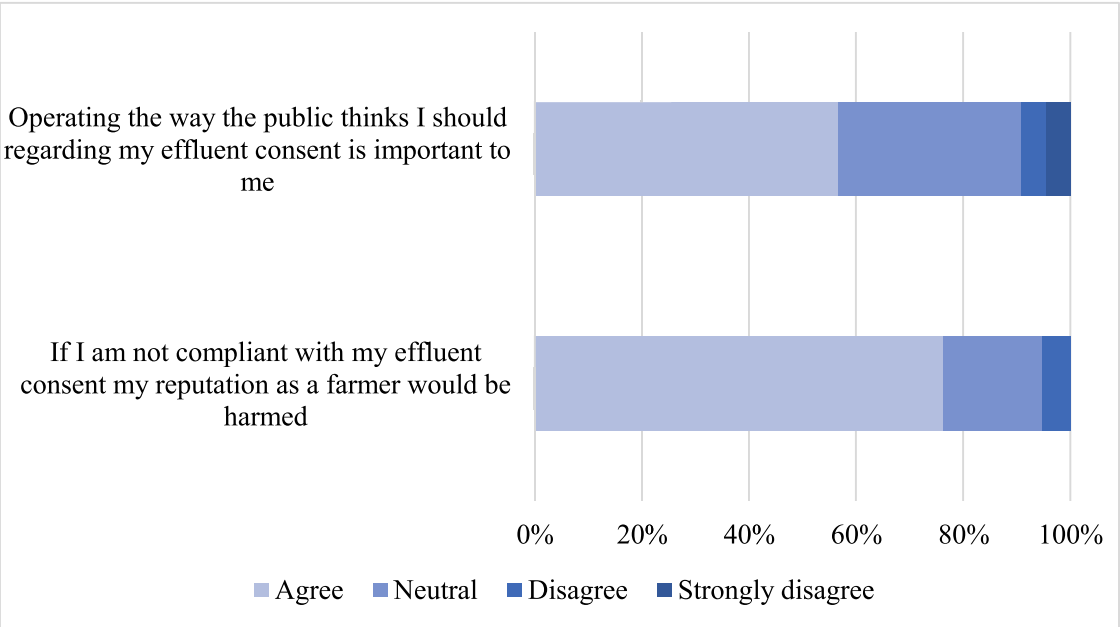


Figure 5.11 Public pressure

Respondents also experienced pressure from the farming community to comply with their consent conditions. Eighty-five per cent of respondents agreed other farmers would disapprove of them if they were not complying with their consents, and almost 60 per cent reported they felt pressure from the farming community at large to be compliant with their consents (Table 5.15). Additionally, over 80 per cent agreed they felt their family and friends (people important to them) would disapprove if they were not compliant – only three per cent disagreed.

Table 5.15 Community pressure

	Per cent: Other farmers would disapprove if I was not compliant with my effluent consent Position n = 66	**Per cent: I feel pressure from the farming community to comply with environmental regulations Position n = 67**
Strongly agree	27.5	21
Agree	57.5	38.75
Neutral	10.5	32.75
Disagree	4.5	7.5
Strongly disagree	0	0
Total	**100**	**100**

5.2.4.2 Descriptive social norms

Over 95 per cent of respondents agreed that the majority of New Zealand farmers are usually compliant with their effluent consents, and among the farmers they know, over 90 per cent agreed they are compliant most of the time (Table 5.16). However, 40 per cent agreed that occasional non-compliance with effluent consents was common – 31.5 per cent disagreed and 28.5 per cent were neutral.

Table 5.16 Perceptions of other farmers' compliance behaviour

	Per cent: The majority of farmers in New Zealand usually comply with their effluent consents Position n = 67	**Per cent: Among the farmers I know, most are compliant most of time Position n = 67**
Strongly agree	36	46.25
Agree	59.5	46.25
Neutral	4.5	6
Disagree	0	0
Strongly disagree	0	1.5
Total	**100**	**100**

5.2.5 Perceived behavioural control

Despite a strong percentage of respondents feeling uncertainty about future regulatory restrictions, all respondents felt confident they would be compliant at the time of their next inspection and all intended to be, with the majority in strong agreement with both statements (Table 5.17). When asked if in the past five seasons (or seasons since consent application approval) they had been compliant with their effluent consents, 54.5 per cent strongly agreed; 29 per cent agreed; six per cent were neutral; and 10.5 per cent disagreed.

Table 5.17 Expectations of compliance level at next inspection

	Per cent: I am confident that I will be compliant with my effluent discharge consent at my next inspection Position n = 66	**Per cent: I intend to be compliant at the time of my inspection Position n = 66**
Strongly agree	69.5	76
Agree	30.5	24
Neutral	0	0
Disagree	0	0
Strongly disagree	0	0
Total	**100**	**100**

When asked if respondents felt the fate of their farm was determined by factors outside their control - an indication of their belief in their internal locus of control - just over 40 per cent disagreed, while more than 30 per cent felt neutral on whether they could influence events and outcomes that would affect the fate of their farm (Figure 5.12).

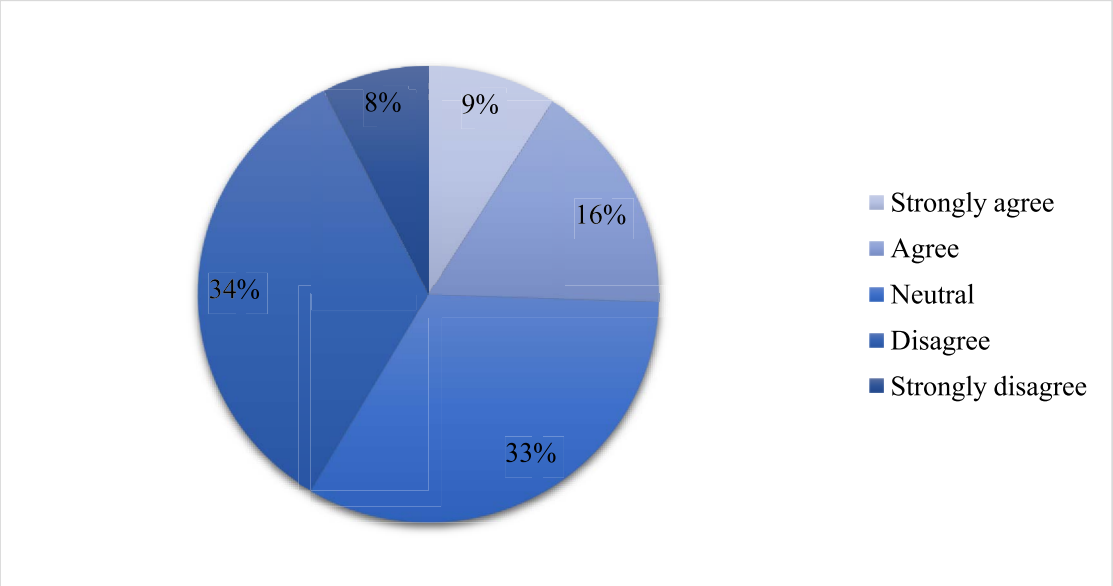


Figure 5.12 Locus of control

5.2.6 Perceived financial control

Despite respondents stating that achieving and maintaining compliance costs a lot of money, they largely agreed a low milk payout situation would not influence compliance. Moreover, respondents felt the state of farm finances did not impact their or other farmers' ability to comply with effluent consent conditions. Almost 75 per cent agreed a low payout would not lead to lower compliance rates and over 50 per cent disagreed that the ability to comply relied heavily on the state of farm financials (Table 5.18).

Table 5.18 Financial standing and compliance perceptions

	Per cent: In a low payout situation, I am less likely to be able to comply with my effluent consent than in a high or average payout Position n = 67	**Per cent: The ability of farmers to comply with effluent consents relies heavily on farm financial situations Position n = 67**
Strongly agree	7.5	9
Agree	10.5	19.5
Neutral	7.5	18
Disagree	47.5	35.5
Strongly disagree	27	18
Total	**100**	**100**

5.3 Compliance level and bivariate analysis

5.3.1 Introduction

This section provides an analysis of self-reported level of compliance with effluent consents at last inspection and a bivariate analysis of the survey data. A bivariate analysis helps to

determine the existence of an empirical relationship – in this case, a bivariate analysis is performed between the level of self-reported compliance and the survey items. Sections 5.3.3 to 5.3.7 utilise cross tabulated to present the results of the relationships between compliance and consent holder and farm characteristics; attitudes and perceptions; subjective norms; perceived behavioural control; and perceived financial control respectively. Cross tabulation was used to further explore significant relationships (see Appendix F). Secondary bivariate analysis used new categorical variables to further the identification of significant relationships, detailed in Appendix E.

5.3.2 Compliance levels

Respondents were asked to self-report their level of compliance (compliant, minor noncompliance or significant non-compliance) at the time of their last inspection and if applicable, the reasoning for their non-compliance and what type of management or other issue occurred to cause non-compliance. Of those who responded, 89.5 per cent reported as fully compliant and 10.5 per cent reported minor non-compliance at their last inspection (Table 5.19). The types of non-compliance varied across the sample as did the issues that caused non-compliance (Table 5.20).

Table 5.19 Compliance level at last inspection

Position n = 67	**Per cent**
Compliant	89.5
Minor non-compliance	10.5
Significant non-compliance	0
Total	**100**

Table 5.20 Type of non-compliance and reasoning

Position n = 7	**Count**	**Associated reasoning**
Ponding of effluent	1	Weather
Administrative	2	Management oversight
Exceeding the number of milking cows	1	Management oversight
Discharge of effluent outside buffer zone	1	Financial constraints
Blocked overflow pipe	1	-
Exceeding application rate	1	Limited infrastructure

5.3.3 Consent holder and farmer characteristics

5.3.3.1 Consent holder characteristics

Consent holder characteristics examined in this study include gender; age; highest level of formal education; years of experience in the New Zealand dairy industry; use of a farm consultant; and farm training or workshop and farm group meeting attendance.

Table 5.21 Relationship between compliance and consent holder characteristics

		Compliance
Gender (2)	n	63
	x^2	0.055
	Sig.	0.814
Age (6)	n	67
	U	167.5
	Sig.	0.366
Education (2)	n	65
	x^2	1.119
	Sig.	0.290
Experience (7)	n	66
	U	187.5
	Sig.	0.680
Consultant use (2)	n	66
	x^2	0.384
	Sig.	0.535
Training (2)	n	67
	x^2	4.086
	Sig.	**0.043***

[a] Parenthesis denotes number of categories
*($p<0.05$)

There is no evidence suggesting a statistical relationship between compliance level and consent holder age, gender, education, years of experience or the use of a farm consultant (Table 5.21). However, there is evidence to support a positive relationship between non-compliance and farm group meetings, workshops or training attendance under a secondary analysis between infrequent (less than once a year) and frequent (once a year or more) attendance ($x^2 = 4.086$, df = 1, $p<0.05$; $\tau_b = 0.247$, $p <0.05$).

5.3.3.2 Farm characteristics

Farm characteristics include the number of livestock being milked on farm; effective farm size in hectares; farm ownership structure; primary catchment location; whether there are other parties that make decisions on-farm; and the number of years of positive dairy operating profit in the last five years.

Table 5.22 Relationship between compliance and farm characteristics

		Compliance
Livestock milked (2)	n	67
	x^2	6.453
	Sig.	**0.011***
Farm size (2)	n	65
	x^2	5.535
	Sig.	**0.019***
Ownership (6)	n	67
	x^2	1.119
	Sig.	0.290
Decision-making parties (2)	n	67
	x^2	0.026
	Sig.	0.872
Catchment (7)	n	67
	x^2	9.641
	Sig.	0.210
Profit (6)	n	66
	U	144.5
	Sig.	0.166

[a] Parenthesis denotes number of categories
*($p<0.05$)

There is no evidence suggesting a relationship between compliance levels and ownership structure, decision-making parties on farm, catchment location or profit (Table 5.22). However, there is evidence to support a positive relationship between non-compliance and the number of livestock milked when a secondary analysis is performed at less than 1000 and more than 1000 cows milked ($x^2 = 6.453$, df = 1, $p<0.02$; $\tau_b = 0.295$, $p<0.02$). There is also evidence of a relationship when categories are not re-coded ($U = 116.5$, N1 = 610, N2 = 7, $p<0.05$). There is evidence of a positive relationship between non-compliance and farm size in hectares at a secondary analysis between less than 500 hectares and more than 500 hectares ($x^2 = 5.535$, df = 1, $p<0.02$; $\tau_b = 0.292$, $p = 0.02$).

5.3.4 Attitudes and perceptions

5.3.4.1 Problem awareness and attribution

Problem awareness was measured through four statements; respondents reported the degree to which they agreed: “Dairy farming impacts surface and ground water quality”; “Water quality affects human health”; “Water quality affects livestock health”; and “Water quality affects pasture/crop health”. Attribution included two statements: “My farming practices did not contribute to the need for environmental regulation on farm”; and “Environmental regulation on farm was necessary to improve water quality”. Statement responses were

coded for analysis using two categories: strongly agree to agree; and neutral to strongly disagree.

Table 5.23 Relationship between compliance and problem awareness and attribution

		Compliance
Dairy impacts (2)	n	66
	x^2	0.128
	Sig.	0.721
Water quality: human health (2)	n	66
	x^2	0.026
	Sig.	0.872
Water quality: livestock health (2)	n	66
	x^2	0.396
	Sig.	0.529
Water quality: pasture/crop health (2)	n	65
	x^2	1.438
	Sig.	0.230
Practices contributing to need for regulation (2)	n	66
	x^2	1.755
	Sig.	0.185
Regulation required to improve water quality (2)	n	66
	x^2	0.168
	Sig.	0.682

[a] Parenthesis denotes number of categories

There is no evidence in this analysis suggesting any significant relationships between compliance level and problem awareness or attribution survey items (Table 5.23).

5.3.4.2 Environmental perceptions

Environmental perceptions included two averages taken from four questions relating to biospheric concern and five questions relating to threat of environmental risks – Cronbach's α suggested that the questions had enough reliability to be taken as an average (biospheric concern $\alpha = 0.91$; environmental risks $\alpha = 0.79$). Both classifications were analysed using two categories: very threatening to neutral-threatening; and neutral to not very threatening for environmental risks and very concerning to neutral-concerning; and neutral to not very concerning for biospheric concern.

Table 5.24 Relationship between compliance and environmental perceptions

		Compliance
Biospheric concern (2)	n	66
	x^2	1.017
	Sig.	0.313
Environmental risks (2)	n	66
	x^2	0.903
	Sig.	0.342

[a] Parenthesis denotes number of categories

There is no evidence to suggest any significant relationships between compliance level and biospheric concern and environmental risk perceptions (Table 5.24).

5.3.4.3 Equity perceptions

Equity perceptions included four statements whereby respondents reported the degree to which they agreed: that "Canterbury farmers are unfairly impacted by environmental regulation"; "Nitrate limits are applied fairly to all farmers"; "Environmental regulation is fair to all farmers"; and that "The cost of environmental protection is equitably spread across society". Statement responses were coded for secondary analysis using two categories: strongly agree to agree; and neutral to strongly disagree. Respondents were also asked to choose which group in society should have the primary responsibility of managing the environment in a sustainable manner.

Table 5.25 Relationship between compliance and equity perceptions

		Compliance
Canterbury farmers unfairly impacted (2)	n	66
	x^2	0.985
	Sig.	0.321
Nitrate limits applied fairly (2)	n	66
	x^2	0.145
	Sig.	0.703
Regulation fair to all farmers (2)	n	66
	x^2	0.131
	Sig.	0.718
Equitable cost spread (2)	n	65
	x^2	0.123
	Sig.	0.726
Group responsible for environmental protection (3)	n	66
	x^2	11.669
	Sig.	**0.009****

[a] Parenthesis denotes number of categories

**($p<0.01$)

There is no evidence suggesting a statistically significant relationship between compliance level and the Likert scale statements on equity perceptions. However, there is evidence that suggests a significant relationship between compliance level and the response to which group in society should have the primary responsibility to manage the environment sustainably (Table 5.25). A larger percentage of non-compliant respondents felt the responsibility fell more on national or local governments than did compliant respondents (29 versus 14 per cent); a larger percentage of the non-compliant felt the responsibility fell on private landowners than did compliant respondents (14 versus five per cent); one non-compliant respondent felt the responsibility belonged to no one. A larger percentage of compliant respondents felt the responsibility belonged to everyone than did non-compliant respondents (81 versus 43 per cent).

5.3.4.4 Regulation perceptions

Regulatory perceptions included 12 Likert scale statements relating to respondents' understanding of regulation; beliefs about future regulatory restrictions; compliance costs; inspections; and the regulatory process. Eight statements had their responses coded for secondary analysis using two categories: strongly agree to agree; and neutral to strongly disagree. Respondents were also asked to choose which method of intervention they felt provides the best results in reducing nitrate leaching. This was coded between with and without the use of government legislation.

Table 5.26 Relationship between compliance and regulation perceptions

		Compliance
Easy to understand need for compliance (2)	n	66
	x^2	0.483
	Sig.	0.487
Easy access to information (2)	n	66
	x^2	10.738
	Sig.	**0.001*****
I am informed on regulation (2)	n	66
	x^2	0.841
	Sig.	0.359
Future regulation uncertainty (2)	n	66
	x^2	0.912
	Sig.	0.340
Compliance takes a lot of time (2)	n	66
	x^2	0.118
	Sig.	0.731
Compliance takes a lot of money (2)	n	65
	x^2	0.245
	Sig.	0.621
Inspections frequent enough to deter violations (2)	n	66
	x^2	0.028
	Sig.	0.867
I intend to comply due to potential penalty (2)	n	65
	x^2	0.152
	Sig.	0.696
Method that provides best results (2)	n	65
	x^2	1.165
	Sig.	0.280
Ease for ECAN to detect non-compliance (5)	n	66
	U	124
	Sig.	**0.065***
Likelihood of receiving penalty (5)	n	66
	U	157.5
	Sig.	0.257
Experience with ECAN inspections (5)	n	66
	U	125.5
	Sig.	**0.058***
Experience with regulatory process (5)	n	66
	U	118.5
	Sig.	**0.046****

[a] Parenthesis denotes number of categories

*(p<0.10), **(p<0.05), ***(p<0.01)

There is no evidence suggesting a statistically significant relationship between compliance level and 10 of the survey items relating to regulatory perceptions (Table 5.26). There is evidence to suggest a strong positive relationship between non-compliance and the perception of the ease of access to information on regulatory and compliance requirements ($\tau_b = 0.4$, $p = 0.001$). All non-compliant respondents fell in the neutral to strongly disagree category on whether they felt they had easy access to information, while the majority of compliant respondents (63 per cent) agreed that they did have easy access to information. There is evidence at the $p<0.1$ level, to suggest a relationship between non-compliance and the likelihood of ECAN detecting noncompliance (a measure of fear over the probability of being caught), in that non-compliance is positively associated with a feeling that it is difficult for ECAN to detect non-compliance ($U = 124$, $N1 = 60$, $N2 = 7$, $p<0.1$, $T_c = 0.153$). There is evidence to suggest a relationship between compliance level and experience with the regulatory process. The rating respondents provided for the regulatory process decreased with non-compliance ($U=118.5$, $N1=60$, $N2=7$, $p<0.05$). There is also evidence suggesting a weak significant relationship between compliance level and experience with the inspections. The rating respondents provided for the inspections decreased with non-compliance at the $p<0.1$ level.

5.3.5 Subjective norms

5.3.5.1 Injunctive social norms

Injunctive social norms included five Likert scale statements whereby respondents reported the degree to which they agreed: whether if non-compliant, their reputation would be harmed; if operating the way the public expects them to regarding their consents was important; whether other farmers would disapprove if they were non-compliant and if they felt pressure from the farming community to comply; and whether people close to them would be disappointed if they were not compliant.

Table 5.27 Relationship between compliance and injunctive social norms

		Compliance
Reputation (2)	n x^2 Sig.	67 1.541 0.215
Operating the way the public expects (2)	n x^2 Sig.	67 0.000 0.989
Other farmers would disapprove (2)	n x^2 Sig.	66 1.097 0.295
Pressure from farming community (2)	n x^2 Sig.	67 0.021 0.884
Friends and family would disapprove (2)	n x^2 Sig.	67 0.420 0.517

[a] Parenthesis denotes number of categories

There is no evidence to suggest any significant relationships between compliance level and injunctive social norms (Table 5.27).

5.3.5.2 Descriptive social norms

Descriptive social norms included three statements whereby respondents reported the degree to which they agreed: that the majority of New Zealand farmers are usually compliant with their consents; most farmers they know personally are usually compliant; and that occasional noncompliance is a common phenomenon.

Table 5.28 Relationship between compliance and descriptive social norms

		Compliance
Majority of farmers usually comply (2)	n x^2 Sig.	67 0.366 0.545
Most farmers I know are compliant (2)	n x^2 Sig.	67 0.630 0.427
Occasional non-compliance common (2)	n x^2 Sig.	67 1.057 0.304

[a] Parenthesis denotes number of categories

There is no evidence to suggest any significant relationships between compliance level and descriptive social norms (Table 5.28).

5.3.6 Perceived behavioural control

Perceived behavioural control included four statements whereby respondents reported the degree to which they agreed: whether they were confident and intended to be compliant at their next inspection; the nature of their historical compliance; and their internal locus of control.

Table 5.29 Relationship between compliance and perceived behavioural control

		Compliance
Confident in achieving compliance at next inspection (2)	n x^2 Sig.	66 11.384 **0.001****
Intend to be compliant (2)	n x^2 Sig.	66 9.493 **0.002****
Historical compliance (2)	n x^2 Sig.	66 9.237 **0.002****
Locus of control (2)	n x^2 Sig.	67 0.562 0.454

[a] Parenthesis denotes number of categories
**($p<0.01$)

Three of the perceived behavioural control items appeared to be related to compliance level. There was no relationship between locus of control and compliance (Table 5.29). All respondents agreed they were confident in achieving compliance and intended to be compliant at next inspection. However, those who were compliant felt more strongly about their intention and confidence in being compliant at their next inspection. Additionally, more compliant respondents had strong historical compliance compared with non-compliant respondents in the past five seasons.

5.3.7 Perceived financial control

Perceived financial control included two statements whereby respondents reported the degree to which they agreed with: whether a lower milk payout would affect compliance and whether compliance relies heavily on farm financial circumstances.

Table 5.30 Relationship between compliance and perceived financial control

		Compliance
Payout affecting compliance (2)	n	67
	x^2	1.262
	Sig.	0.261
Compliance relies on finances (2)	n	67
	x^2	0.372
	Sig.	0.542

[a] Parenthesis denotes number of categories

There is no evidence suggesting any significant relationships between compliance level and perceived financial control (Table 5.30).

5.4 Text analysis

5.4.1 Introduction

This section provides an analysis of the open-ended question posed to respondents asking them for a few sentences on their ratings of ECAN inspections and the regulatory process. The responses were coded for analysis based on the overall tone of the comment – be it negative, positive, neutral, or containing positive and negative elements. This was further broken down by positive and negative comments regarding inspections, regulation and implementation of regulation. Section 5.4.2 presents some of the responses received based on their tone and topic (a full catalogue of responses can be found in Appendix G). Section 5.4.3 presents the bivariate analysis of the text with the ratings for inspections and the regulatory process and compliance levels.

5.4.2 Responses to open-ended question regarding ECAN inspections and regulation

5.4.2.1 Positive responses

Of respondents who rated their experiences with ECAN inspections and the regulatory process, 48 provided comments on the reasoning for their ratings. There were no positive comments regarding regulation itself; two positive comments about the regulatory implementation process; 18 comments regarding inspections; and two other positive comments. A selection of comments is set out in Table 5.31. Notably, approximately 28 per cent of the positive comments regarding inspections used language suggesting that experiences were not consistently positive.

Table 5.31 Positive comments on ECAN inspections and regulation

Tone and topic	Comment
Positive: Regulation implementation process Count = 2	- *"So far getting consents through and advice on native planting season and plans have been well looked after and pretty straight forward."* - *"Had a non-compliance on water take, which was handled well by ECAN."*
Positive: Inspections Count = 18	- *"Fair and reasonable assessment, good dialogue with assessor prior to final report, collaborative approach."* - *"In most cases the standard and competency of the audits and auditors was good."* - *"Very friendly and understanding staff."* - *"On most occasions staff have been thorough and polite and offered good advice on any minor compliance issues."* - *"For the most part, ECAN inspections of effluent and water use have been good."* - *"ECAN staff that have visited our farms have always been courteous, interested in what we are doing and ready to offer advice if sought."*
Positive: Other Count = 2	- *"No problems with ECAN."* - *"Helpful easy to understand."*

5.4.2.2 Negative responses

For negative comments concerning the ratings, there was a total of 11 comments on regulation; 11 comments regarding the regulatory implementation process; and 12 comments regarding inspections. A few of the comments are set out in Table 5.32.

Table 5.32 Negative comments on ECAN inspections and regulation

Tone and topic	Comment
Negative: Regulation Count =11	- *"ECAN is going through the motion ticking the boxes. They are not interested in science measurement on farm." "Confusing rules and changing goals all the time."* - *"Regulatory process moves too slowly and needs to be based on good science."* - *"ECAN takes everything very black and white. There is not much experience with different type of farming systems (i.e. free stall)."*
Negative: Regulation implementation process Count = 11	- *"They come around once a year, we have always been reasonably compliant and so never have a problem, but I know of farmers who do not practice best practice and nothing is ever done."* - *"I was recently (previous season) fined for significant noncompliance. The process was very stressful and totally out of context to the offence."* - *"Poor communication from ECAN to farmers of policy, regulations and amended requirements."* - *"Regulatory process has at various times been very protracted, appearing wasteful of time and monetary resources, to achieve the same outcome as was initially applied for. Very expensive to justify any changes to a resource consent, and difficult to keep up with environmental changes that occur during a consent change process."*
Negative: Inspections Count = 12	- *"Dealing with some staff difficult due to their inexperience. Seems to be high turnover of staff."* - *"The approach of trying to catch farmers out with short notice inspections is very threatening. Experience from other authorities suggests that there is better engagement where inspectors are working with rather than against consent holders."* - *"The monitoring staff are young and inexperienced and on the right side of environmentalism i.e. not neutral."* - *"An aggressive attitude of inspectors with very poor practical skills. Consenting staff also lack common sense."*

5.4.2.3 Other responses

There were four comments with a tone implying inspections and the regulatory process have improved or where the tone could not be discerned from the comment provided. Comments can be seen in full in Table 5.33.

Table 5.33 Other comments on ECAN inspections and regulation

Tone	Comment
Improving Count = 2	- *"They have changed from being only regulatory and somewhat unhelpful to being very helpful."* - *"Attitudes of ECAN staff have improved over the last few years, able to work with the consent holder."*
Other Count = 2	- *"Limited interactions."* - *"They only did what was necessary."*

5.4.3 Bivariate analysis of text

Section 5.4.3 presents the bivariate analysis of the text by tone and topic with the ratings for inspections and the regulatory process and compliance levels.

5.4.3.1 Positive comments

Analysis of positive comments included comments with an overall positive tone; positive regulatory implementation process and positive inspection comments. Table 5.34 presents the results of an analysis among positive comments and regulatory process and inspection ratings and compliance level.

Table 5.34 Positive comments analysis

		Regulatory process rating	Inspection rating	Compliance
Overall positive comments (13)	n	35	35	48
	U/ x^2	16.5	51.5	4.236
	Sig.	**0.000****	**0.001****	0.120
Regulatory implementation process (2)	N	48	48	48
	U/ x^2	11	6	0.298
	Sig.	0.057	**0.025***	0.585
Inspections (18)	n	48	48	48
	U/ x^2	215.5	124.5	1.270
	Sig.	0.221	**0.001****	0.260

[a] Parenthesis denotes number of comments
*($p<0.05$), **($p<0.01$)

There is no evidence of a relationship between positive comments and compliance level. There is evidence of significant relationships between overall positive comments and the rating of the regulatory process and inspections. All respondents who had positive comments about inspections and the regulatory process rated their experience with both as excellent or good. The inspection rating also had significant relationships with positive comments regarding the regulatory implementation process and inspections.

5.4.3.2 Negative comments

Analysis of negative comments included comments with an overall negative tone; negative regulation, regulatory implementation process, and inspection comments. Table 5.35 presents the results of an analysis between comments and regulatory process and inspection ratings and compliance level.

Table 5.35 Negative comments analysis

		Regulatory process rating	**Inspection rating**	**Compliance**
Overall negative comments (22)	n	35	35	48
	U/ x^2	16.5	51.5	4.236
	Sig.	**0.000****	**0.001****	0.120
Regulation (11)	n	48	48	48
	U/ x^2	130	192	2.039
	Sig.	0.057	0.759	0.153
Regulatory implementation process (11)	n	48	48	48
	U/ x^2	103.5	191	4.003
	Sig.	**0.001****	0.172	**0.045***
Inspections (12)	n	48	48	48
	U/ x^2	136.5	52.5	0.957
	Sig.	0.278	**0.000****	0.328

[a] Parenthesis denotes number of comments

*($p<0.05$), **($p<0.01$)

There is evidence of a significant relationship between the overall tone of comments and the rating of the regulatory process and inspections. Negative comments had lower ratings than positive comment ratings. The only significant relationship for compliance was with comments on the regulatory implementation process. The majority of non-compliant respondents had negative comments about the implementation process, while the majority of compliant respondents did not. There is also evidence of significant relationships between the ratings for inspections and comments on inspections; and ratings for the regulatory process and comments on the implementation process.

5.5 Regression analysis

5.5.1 Evaluation of the conceptual model: Logistic regression analysis

The variables representing the major constructs of perceived control, norms and attitudes and perceptions within the conceptual model presented in Chapter 4 were evaluated for their reliability in measuring the same constructs using Cronbach's α (Appendix H). Consent holder and farm characteristics included in the regression were age; years in the dairy industry; education level; information source point usage (workshop attendance and consultant use); farm

size (hectares and number of milking livestock); and years of dairy operating profit. An average for attitudes and perceptions covered equity; regulation; physical environment; problem awareness; and attribution. Subjective norms included descriptive and injunctive norms and an average was calculated for perceived behavioural control (minus locus of control) and perceived financial control.

The results of the binary logistic regression evaluating the conceptual model showed an acceptable goodness of fit (Nagelkerke = 0.749, Hosmer and Lemeshow p-value = 0.992). However, it only revealed one statistically significant variable – farm size at $p<0.1$. This is likely due to a multi-collinearity issue among the indices. There are a few options available when faced with multi-collinearity. First, to do nothing, which has been supported by Conlisk (1971), Blanchard (1987) and Kennedy (1992, p. 181). Alternatively, for this study, additional information could be incorporated either by expanding the sample size or by dropping a variable: this strategy allowed for perceived behavioural control to become significant at $p<0.1$ when the age variable was omitted (Kennedy, 1992, pp. 181-182). However, omitting variables can lead to model misspecification (Kennedy, 1992, p. 184). It is difficult to make any definitive statements about the impact of variables in this model on compliance given that little significance among the variables was offered. Full results from this logistic regression are available in Appendix I.

5.5.2 Final logistic regression

Given the issues presented by the evaluation of the conceptual model, a regression was performed with a smaller set of variables. The predictor variables included in the second logistic regression were selected based on the significant relationships identified in the bivariate analysis and the major constructs of the conceptual model to further explore, and give a better indication of, the effects of significant relationships. The variables are described in Table 5.36. The results of the logistic regression analysis are provided in Table 5.37.

Table 5.36 Logistic regression variables

Name	Definition	Associated construct	Range of values
PBC	Confidence in ability to be compliant at next inspection	Perceived behavioural control	Strongly agree (1) to strongly disagree (5)
SN	Non-compliance would harm the respondents' reputation	Subjective norms	Strongly agree (1) to strongly disagree (5)
AP1	Ease of access to information on requirements to be compliant with effluent regulation	Attitudes and perceptions	Strongly agree (1) to strongly disagree (5)
AP2	Ease for ECAN to detect noncompliance	Attitudes and perceptions	Very easy (1) to very difficult (5)
FFC	Number of animals being milked on farm	Consent holder and farm characteristics	Less than 250 (1) to 1000+ (5)

Table 5.37 Logistic regression results

n = 66		B	Standard Error	Wald	Sign.	Exp(B)	95% C.I. Exp(B)	
							Lower	Upper
Threshold	Const.	-18.630	7.706	5.846	0.016	0.000		
Location	PBC	3.969	1.629	5.939	**0.015****	52.936	2.175	1288.331
	SN	1.501	0.848	3.131	**0.077***	4.487	0.851	23.663
	AP1	1.790	0.651	7.571	**0.006*****	5.990	1.674	21.438
	AP2	-2.249	2.345	.920	0.337	0.105	0.001	10.451
	FFC	1.035	0.647	2.557	0.110	2.814	0.792	10.002
Pseudo R^2 statistics: Cox and Snell = 0.341; Nagelkerke = 0.693								

*(p<0.1), **(p<0.02), ***(p<0.01)

The signs of the coefficients indicated the direction of the relationship between the dependent variable – compliance, and the independent variables. The estimated coefficients show the level of increase or decrease in the predicted log odds of non-compliance associated with a one-unit increase or decrease in the predictor variable (or the presence of a binary variable), holding other predictors constant (Sweet & Grace-Martin, 2012, p. 193). While the absolute values of these coefficients are cumbersome to interpret, their signs are meaningful. The odds of noncompliance in this model increase with a decrease in confidence; a decrease in agreement that a farmer's reputation will be harmed if found non-compliant; an increase in feeling that they do not have easy access to the information required to be compliant; and an increase in the number of livestock on farm. The odds of non-compliance decrease with a decrease in fear about the probability of being caught non-compliant (decrease in the ease of ECAN detecting noncompliance).

Although controversial, the pseudo R^2 values are often used to assist in determining the overall fit of the model. In this case, the Nagelkerke value (0.693) suggested that the final model represents a reasonable improvement over the base model (with no independent variables). The Hosmer and Lemeshow statistic indicates that the model is a good fit for the observed data with an associated p value of 0.955 (>0.05).

In this model there are three statistically significant variables: confidence in achieving full compliance at the next inspection (a measure of perceived behavioural control); ease of access to information (a measure of attitudes and perceptions); and beliefs about how non-compliance would affect the respondents' reputation (a measure of subjective norms). Holding all other independent variables at their mean, the marginal effect of these variables on the probability of non-compliance can be determined (Table 5.38).

Table 5.38 Marginal effects of significant variables

Variable	Marginal effect
PBC	0.064539778
AP1	0.15579527
SN	0.008116

As there are only two categories chosen for confidence (very confident and confident), it can be determined that for individuals with average values for other predictor variables, the predicted probability of non-compliance is 0.065 greater for an individual that is confident than for an individual who is very confident.

The impact of access to information on the probability of non-compliance depends on how much access the consent holders perceive they have to information. The largest marginal effect for access to information, when holding all other predictors at their means, is from neutral to disagree, where the predicted probability of non-compliance is 0.032 greater for an individual who disagrees that they have easy access to information than for an individual who is neutral. The other largest marginal effect for access to information, when holding all other predictors at their means, is from disagree to strongly disagree (Table 5.38), where the predicted probability of non-compliance is 0.156 greater for an individual who strongly disagrees that they have easy access to information than for an individual who disagrees. Finally, the probability of noncompliance is 0.008 less for an individual who strongly agrees that their reputation as a farmer would be harmed if they were found non-compliant over an individual who does not strongly agree.

5.6 Summary

The data analysis presented in this chapter was directed by research questions one and two. The univariate analysis, which used descriptive statistics to characterise single variables, was utilised to develop a 'profile' of dairy effluent consent holders and their farm characteristics; their attitudes toward and perceptions of the environment, equity and regulation; their subjective norms; and perceived control. The bivariate analysis was used to explore potential relationships between the above noted categories and compliance level. The text analysis section analysed the qualitative data collected from responses as to the reasoning for respondent's rating of ECAN inspections and regulation. A multivariate analysis was utilised to evaluate the conceptual model and determine the relationship between multiple explanatory variables and compliance.

5.6.1 Significant findings

The bivariate analysis revealed 11 statistically significant relationships between explanatory variables and compliance with environmental regulation. For consent holder and farm characteristics, there is evidence to suggest the existence of a positive relationship between workshop training and/or farm group meeting attendance and non-compliance and a strong positive relationship between non-compliance and farm size and the number of livestock being milked on farm.

For equity perceptions, there is evidence to suggest a significant relationship between compliance level and the response to which group in society should have the primary responsibility to sustainably manage the environment. A larger percentage of non-compliant respondents felt that the responsibility falls more on national or local governments than compliant respondents (29 versus 14 per cent) and a larger percentage of compliant respondents felt the responsibility belongs to everyone than non-compliant respondents (81 versus 43 per cent).

On attitudes toward regulation, there is evidence to suggest a strong relationship between ease of access to information on the requirements of compliance and compliance status: noncompliance was associated with increasing disagreement that they had easy access to information. There is evidence suggesting a relationship between the ease with which respondents felt ECAN could detect non-compliance – with non-compliance associated with a belief that it is more difficult for non-compliance to be detected. There is also a relationship between the rating given for the regulatory process and inspections and non-compliance – noncompliance being associated with a decrease in the rating. Lastly, non-compliance was

correlated with confidence in respondents' ability and intention to comply at the next inspection and historical non-compliance: compliance was associated with stronger agreement on feeling confident and intention and a stronger history of compliance.

The text analysis contained 22 positive comments toward the regulatory implementation process, inspections; 34 negative comments toward the regulation, regulatory implementation process and inspections; and two comments suggesting inspections and the regulatory implementation process had improved over the past several years.

The logistic regression was used to evaluate the conceptual model and explore the relationships between explanatory variables selected based on the significant relationships identified in the bivariate analysis and the major constructs of the conceptual model and compliance. The predictor variables in the final regression included: number of animals being milked on farm; ease of access to information about requirements on farm to be compliant with environmental regulation; how easy respondents felt it is for ECAN to detect non-compliance; whether noncompliance would harm their reputation; and confidence that they will be compliant at their next inspection. Three variables from this regression were found to be significant: access to information (an explanatory variable related to attitudes and perception), how respondents felt non-compliance would affect their reputation and confidence (an explanatory variable representing perceived behavioural control). The odds of non-compliance in this model increased with a decrease in confidence, decreased with a feeling that their reputation would be harmed if non-compliant and an increase in feeling that they do not have easy access to the information required to be compliant. Chapter 6 will discuss the key findings presented in this chapter relative to the literature presented in Chapter 2.

Chapter 6
Discussion and recommendations

6.1 Introduction

The two primary research objectives in this study were to determine what factors influence full compliance with diary effluent discharge consents in Canterbury and which of those factors are critical in influencing compliance. The previous chapter presented the results from the quantitative and text analyses. In this chapter, those findings will be integrated into a discussion. The significant findings associated with compliance are explored in relation to the literature presented in Chapter 2.

Section 6.2 presents the major findings of this study. This is followed by a discussion of each of the findings and answers research questions one and two: "What are the factors influencing dairy effluent discharge consent compliance in the study area?" and "what are the critical factors influencing dairy effluent discharge consent compliance?" This section will also evaluate the conceptual model presented in Chapter 4.

Section 6.3 provides a discussion on compliance and addresses the third research objective to: "Make recommendations to inform policy and industry stakeholders." Key recommendations include opportunities to increase access to information, hedge feelings of uncertainty and promote engagement.

Section 6.4 will discuss some of this study's limitations, contributions and future research opportunities. Section 6.5 will present conclusions.

6.2 Discussion of significant findings

6.2.1 Significant findings

The results indicate that 11 variables are significantly related to compliance behaviour in the bivariate analysis, and four variables were significant predictors of the log-odds of noncompliance in the logistic regression. This section discusses the variables in detail, in order of their relative significance: access to information; confidence; intention and historical compliance; societal group responsible for environmental management; the number of milking livestock on farm; farm size; training and workshop attendance; rating of regulatory processes and inspections; fear of the likelihood of being caught and reputation in relation to the literature presented in Chapter 2.

6.2.2 Access to information

The results of the bivariate and multivariate analyses both showed a strong relationship between perceived access to information on compliance requirements and compliance. Non-compliance was associated with an increase in the perception that information was difficult to access. In the bivariate analysis, access to information was significantly related to non-compliance at the $p=0.001$ level and in the multivariate analysis, significant at $p<0.01$.

In a study of dairy effluent consent compliance by Davies, et al. (2007) in the Waikato region, farmers were concerned over a perceived lack of access to technical information and unbiased advice. Other research points to knowledge gaps as barriers to achieving compliance, as well as adopting environmentally sustainable practices (Van Reenen, 2012; Winter & May, 2001). In this study, access to information did not have a significant relationship with the use of consultants for environmental planning and performance. However, only eight per cent of respondents who reported using consultant services, used them for environmental advice. This lack of use may reflect a similar concern voiced by the Waikato farmers. Davies, et al. (2007), found that farmers in Waikato relied heavily on consultants, their own and other farmers' experiences, articles and suppliers to inform their decisions about management related to compliance. Whether consent holders in Canterbury use the same breadth of resources to make compliance decisions is unknown, but may account for some of the perception that information on the specific requirements to maintain compliance is difficult to obtain, particularly when there is a general feeling of uncertainty over future regulatory restrictions among the sample as a whole.

6.2.3 Confidence, intention and historical compliance

The results of the bivariate and multivariate analyses both indicate that non-compliance is related to confidence in the respondents' ability to comply with their consent conditions at their next inspection. In the bivariate analysis, confidence was significantly related to noncompliance at the $p=0.001$ level and in the multivariate analysis, significantly associated at $p<0.05$. All respondents agreed that they felt confident in their ability to comply; however, noncompliance was associated with feeling confident to a lesser degree. A similar result was shown in the bivariate analysis regarding intention to comply at the next inspection: non-compliance was significantly associated with intention at the $p<0.01$ level. All respondents also agreed that they intended to comply; however, they intended to a lesser degree. Historical compliance was also related to non-compliance at the $p<0.01$ level.

Both confidence and intention are integral parts of RAA theory. Confidence is part of an individual's capacity in perceived behavioural control and can influence an individual's

intention to perform a certain behaviour (Fishbein & Ajzen, 2010, p. 22). Capacity is related to how confident an individual is in their capability to perform a behaviour and that they have control over the behaviour. Perceived behavioural control can influence behaviour directly or indirectly through intention (Fishbein & Ajzen, 2010, p. 22). Intention is determined largely by attitudes, norms and perceived behavioural control. Perceived behavioural control can influence intention, as it reflects limiting or encouraging factors that could affect behaviour (Beedell & Rehman, 1999). Confidence and intention are significantly associated in this study at the $p<0.01$ level, which is consistent with results presented by Borges et al. (2014) and Lynne et al. (1995), but is in contrast to Menozzi et al. (2014) and Wauters et al. (2010) who found perceived behavioural control to be not significant. Theory and empirical observations help account for the lack of consistency in significant findings within the indirect influences on intention, in that the literature suggests the effect attitudes, norms and perceived behavioural control have may fluctuate depending on the behaviour being examined (Fishbein & Ajzen, 2010, p. 22).

Menozzi et al. (2014), in their study of farmers' motivations to adopt sustainable agricultural practices, found that historical behaviour had a positive impact on intentions to adopt sustainable practices. That finding is confirmed in this study, where historical non-compliance is associated at $p<0.01$ with a lower intention rating. However, it is important to note that intention and perceived behavioural control are not necessarily the cause of a behaviour. Both theory and empirical results show that even if the intention to perform a behaviour is present, the behaviour may not be performed (Ajzen & Fishbein, 2010; Borges et al., 2014). RAA assumes that intention is one of the most important predictors of behaviour, however, it is also recognised that individuals may not have sufficient control over the behaviour (actual control may over-ride intention) to act on their intentions: they may not have the technical know-how, or environmental factors may inhibit their ability to act (Fishbein & Ajzen, 2010, p. 22), as also discussed in the findings presented by Borges et al. (2014).

6.2.4 Societal group responsible for environmental management

Beliefs around the group in society responsible for managing the environment in a sustainable manner was a significant variable in the bivariate analysis at the $p<0.01$ level. A larger percentage of non-compliant respondents felt the responsibility fell more on national or local governments than compliant respondents (29 versus 14 per cent); and a larger percentage of non-compliant consent holders felt the responsibility fell on private landowners (14 versus five per cent). A larger percentage of compliant respondents than non-compliant respondents also felt the responsibility belonged to everyone (81 versus 43 per cent).

In a discussion on the regulatory arrangements with Danish farmers, US homebuilders and boatyard operators in the US, May (2005) highlights the differences between regulation as a societal contract and a 'typical' regulatory arrangement. The result of this study, with a larger percentage of non-compliant consent holders feeling that private landowners should have the primary responsibility of sustainable environmental management, seems contradictory. It portrays a sense of duty among non-complaint respondents to ensure they are operating in a sustainable manner. Compliance with environmental regulation would be considered the 'bare minimum' of environmentally sustainable management. This exhibits a key part of a societal contract: farmers feel obligated to fulfil their responsibilities.

Conversely, respondents as a whole largely felt their farm practices did not contribute to the need for regulation and that current regulation is inequitable. This may represent a feeling that government-driven influence on farm management decisions is an intrusion. A larger percentage of compliant respondents feeling that everyone is responsible may also reflect a societal contract. Compliant farmers are fulfilling their responsibilities by complying with environmental regulation (while others in society may not be pulling their weight), despite respondents as a whole largely feeling that the costs are not spread equitably across society (cost spread was not associated with compliance).

6.2.5 Farm size and number of milking livestock

As farm size in hectares generally increases with an increase in the number of milking livestock on farm to support the operation, size in both will be discussed jointly in this section. In the bivariate analysis, there was a positive relationship between the number of livestock being milked on farm and farm size and non-compliance at the $p<0.02$ and at the $p<0.1$ level in the regression model which evaluated the conceptual model.

In the innovation adoption literature, Yule and Eastwood (2011) suggest larger farms have a greater need for technological innovations due to management complexities and a scarcity of skilled labour. Whether the positive relationship between farm size and non-compliance found here is in part caused by the same issues Yule and Eastwood (2011) cite for a greater need for innovation is uncertain. However, almost half of the respondents who reported being noncompliant did reference management issues as a reason for their non-compliance. In a review of farm-level adoption of conservation practices, Knowler and Bradshaw (2007) reported that most of the empirical studies found farm size to be insignificant with respect to conservation behaviour.

6.2.6 Training and workshop attendance

The results from the bivariate analysis showed that attending training workshops and farm group meetings was significantly related to non-compliance. In the bivariate analysis, training workshop and farm group meeting attendance was positively associated with non-compliance at the $p<0.05$ level.

While this is in contrast to literature presented by Traore et al. (1998), Suwunnamek and Suwanmaneepong (2011), Ganpat et al. (2014) and Zingiro et al. (2014), a possible explanation for the counter-intuitive result may come from the relationship ECAN has with the milk companies that collect from consent holders. Subsequent discussions with ECAN revealed that it shares consent data with milk processors, enabling processors to then target non-compliant farmers for training and workshop sessions (Richard Purdon, personal communication, October 18, 2016).

6.2.7 Rating of regulatory processes and inspections

The results of the bivariate analysis showed that the rating of the regulatory process and inspections were related to non-compliance, as non-compliance was associated with a lower rating of the regulatory process at the $p<0.05$ level and inspections at the $p<0.10$ level. This is consistent with literature on compliance from the agricultural and natural resources sector (May, 2005; Tyler, 1990).

For regulation to be effective, it is important that regulatees acknowledge their responsibility to comply. Even with enforcement actions in place, absent a majority of regulatees obeying due to their sense of duty to adhere to the rules, a much stronger enforcement tool would be required (May, 2005; Tyler, 1990). This sense of duty is based on a moral obligation to comply; an agreement that there is a need for regulation; and that the approach taken is appropriate (Scholz & Pinney, 1995; Winter & May 2001; May 2005). Acceptance of a regulatory approach is dependent on the perceived reasonableness, degree of trust in the organisations promulgating rules and the perceived extent to which other contemporaries are doing their part (Scholz & Lubell, 1998; May, 2005). In this case, respondents largely felt there was a need for regulation and that on an industry level, there was general acknowledgement of the negative effects of dairy farming on the environment and a need for regulation. Additionally, as shown in the univariate analysis section, respondents felt pressure from within the agricultural community and the broader public to comply with effluent regulation. However, the qualitative responses (examples shown below) regarding regulation and the regulatory implementation process, show

these are largely perceived as not reasonable and that their contemporaries are not doing their part:

"Very unfair when we have neighbours both above and below us seemingly on different rules regarding stock in waterways with beef cattle and dairy grazing operations."

"They come around once a year, we have always been reasonably compliant and so never have a problem, but I know of farmers who do not practice best practice and nothing is ever done."

"Regulations need to be based on real science, not assumed science. More research needed, not using assumptions."

The qualitative responses provided context for the rating of the regulatory process and rating of inspections. Here non-compliance may be associated with a poor rating of the regulatory process as among most respondents, particularly those who were non-compliant, there was not a universal acceptance that the regulation was reasonable or equitable (see Section 5.2.3.4 for further elaboration).

The rating of inspections was also associated with non-compliance, although more weakly related than ratings of the regulatory process. The negative comments pointed to perceived inexperience and poor attitudes of inspectors (Appendix G). Interactions between inspecting agencies and regulated bodies can be an important pre-cursor of compliance behaviour (Winter & May, 2001; May, 2005). Inspection interactions that promote joint problem-solving between inspectors and regulatees and develop relationships between the two bodies can have a positive effect on compliance (Winter & May, 2001; May, 2005).

6.2.8 Fear of detection and reputation

There was evidence at the $p<0.1$ level suggesting a relationship between non-compliance and the likelihood of ECAN detecting non-compliance (a measure of fear over the probability of being caught). Compliance is positively associated with a feeling that it is easier for ECAN to detect non-compliance. Deterrent fears have had a variable impact on compliance in previous empirical studies. This is largely due to the differences in regulatory situations and the structure of compliance relationships which can occur because of differences in culture or styles of regulation (Gormley & Peters, 1992; Axelrad & Kagan, 2000; May, 2005).

The results of this study are in contrast to May (2005) and Winter and May (2001), in which respondents had a relatively high sense of civic duty and relatively high deterrent fears. For Danish farmers, May (2005) suggests that the regulatory environment is framed as a societal contract – an emphasis is placed on the obligations of farmers to comply and in return, enforcement takes an accommodating approach. This is reinforced by the involvement of

farmers' unions and organisations in setting guidelines and rules and negotiating regulatory implementation (Winter & May, 2001). The difference between Danish farmers and Canterbury effluent consent holders about deterrent fears may stem from the perception that enforcement is not overly accommodating in the New Zealand context, as seen in some of the comments regarding negative experiences with the regulatory implementation process:

"They do an okay job now after doing a poor regulatory job for years...They are now catching up which is good, but being a bit too officious and probably need to work with farmers rather than against us, which is disappointing."

"We had a massive problem with ECAN regarding a water consent which cost us many thousands of dollars with a lawyer and stress which impacted on my farming operation."

Additionally, only in the past few years did ECAN launch the MGM and Portal system in conjunction with industry organisations. Higher deterrent fears may have resulted from a lack of involvement of producer organisations at the onset. With little opportunity for consent holders to negotiate over the terms of compliance, this would have represented a more officious regulatory environment.

There was also evidence at the $p<0.1$ level in the final regression analysis to suggest a relationship between feeling that non-compliance would harm the respondents' reputation and non-compliance. Compliance is positively associated with a strong feeling that non-compliance harms their reputation. Reputation is inherently tied to a sense of duty. This finding conforms to literature suggesting a relatively high sense of duty among respondents is an important contributing factor in achieving compliant behaviour (Grasmick, Bursik & Kinsey, 1991; Scholz & Pinney, 1995; Winter & May, 2001).

6.2.9 Evaluation of the conceptual model

The conceptual model laid out in Chapter 4 was tested in the study and is presented below. The solid lines indicated a direct influence with arrows showing the assumed direction of the relationship. Consent holder and farmer characteristics referred to socio-demographics and operational characteristics. Attitudes and perceptions related to factors such as values and interests, categorised by perceptions towards the environment, equity, ECAN regulation, problem awareness and internal attribution. Subjective norms represented perceived social pressure – descriptive and injunctive. Perceived behavioural and financial control referred to the perceived ease or difficulty in performing the behaviour and reflected past experiences, control over anticipated obstacles and the perceived impact of farm financial situations.

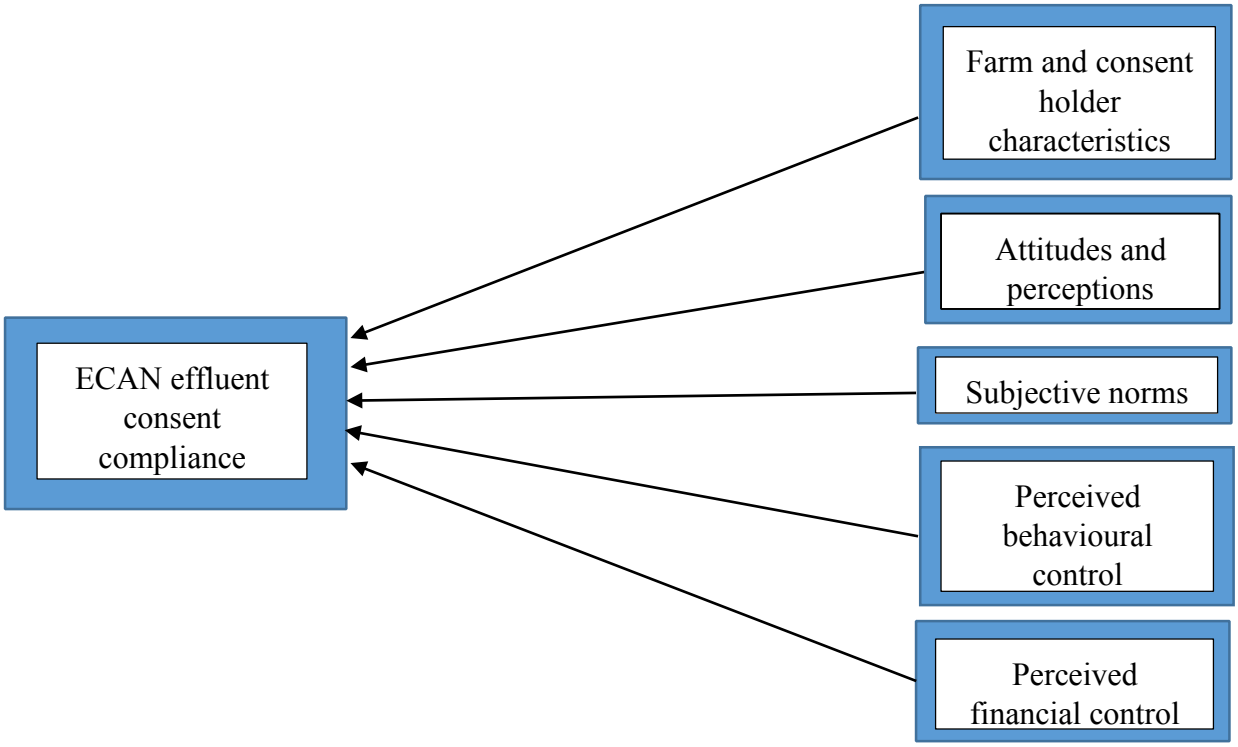


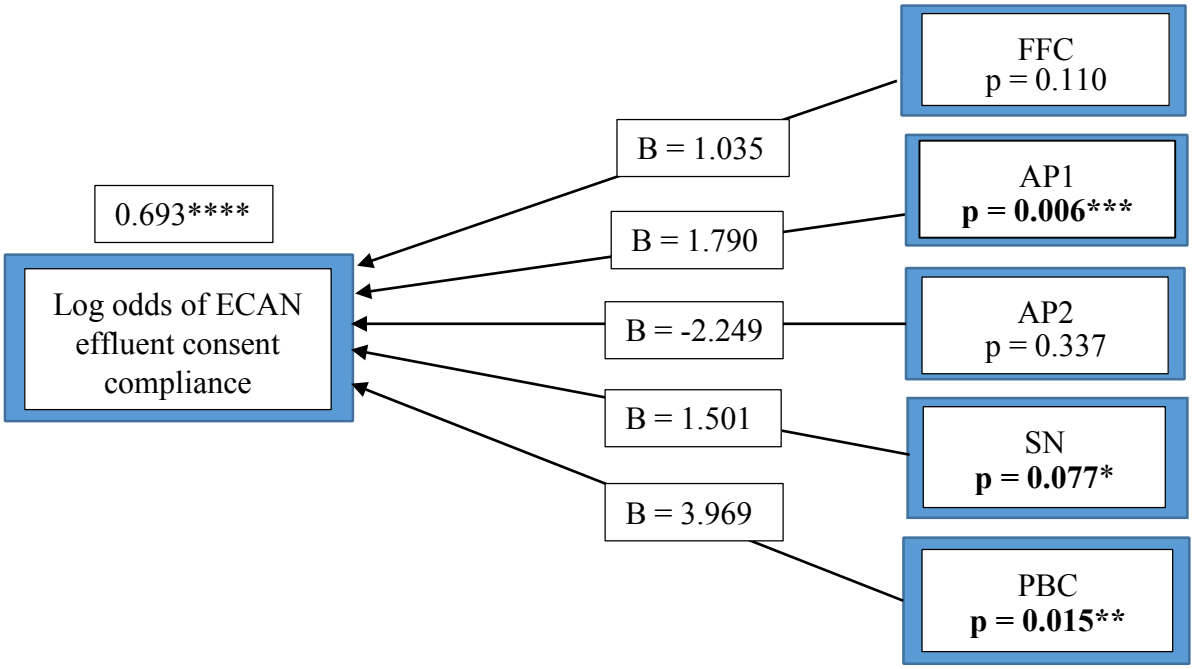
Figure 6.1 Conceptual model (adapted from Fishbein & Ajzen, 2010, p. 22)

The literature presented in Chapter 2 revealed disparate findings in the impact of socio-demographics on compliance behaviour, thereby increasing the value of contextual empirical studies such as this. The bivariate analysis presented in Chapter 5 tested the significance of variables within the five major constructs of the model in the New Zealand context. The results suggest that only training and farm group meeting attendance were significant predictors of non-compliance behaviour. Similarly, only two farm characteristics were related to compliance in the bivariate analysis: farm size and the number of livestock being milked. Five variables representing attitudes and perceptions were found to be significantly related to compliance: access to information, rating of the regulatory process and inspections, probability of detection and the group in society responsible for environmental management - with access to information being significantly related to compliance in the multivariate analysis. Three of the variables in perceived behavioural control were significantly related to compliance: confidence in ability to comply, intention to comply and historical compliance. None of the variables in perceived financial control or subjective norms were found to be significant in the bivariate analysis. The results from perceived financial control were surprising, given that the literature placed a strong emphasis on financial capability as a factor influencing compliance behaviour. Respondents also largely agreed that compliance was a financially exhaustive process. That they largely did not feel their farm financial situations or the milk payout level influenced compliance may suggest consent holders view the costs of compliance as a cost of doing

business: the benefits of being allowed to continue to operate without facing penalties outweigh the costs.

Multivariate analyses were then performed using indices tested by Cronbach's α for four major constructs: perceived financial control, behavioural control, subjective norms, and attitudes and perceptions. Six consent holder and farm characteristics variables were included in the model: age; years in the dairy industry; education level; information source usage index (workshop attendance and consultant use); farm size index (hectares and milking livestock numbers); and years of positive dairy operating profit. While the model had an acceptable fit, only farm size was found to be significant - weakly related to non-compliance at the $p<0.1$ level (see Section 5.5 rationale for final model).

The final model used a smaller set of categorical predictor variables based on the significant relationships identified in the bivariate analysis to gain a better indication of the effect these variables had on the probability of non-compliance. The variables included: number of animals being milked on farm (FFC); ease of access to information about requirements on farm to be compliant with environmental regulation (AP1); how easy respondents felt it is for ECAN to detect non-compliance (AP2); non-compliance would harm the respondents' reputation (SN); and respondents' confidence that they will be compliant at their next inspection (PBC). The graphical representation of the output from this analysis is depicted below:



*(p<0.1), **(p<0.02), ***(p<0.01); ****Nagelkerke R^2

Figure 6.2 Graphical depiction of logistic regression

The numerical values on the arrows are the standardised regression coefficients (B) and the values within the construct boxes represent their associated significance. The model in Chapter 5 indicates that three factors are statistically significant with respect to compliance behaviour: access to information (a measure of attitudes and perceptions), confidence in their ability to comply at the next inspection (a measure of perceived behavioural control) and that noncompliance would harm the respondents' reputation (a measure of subjective norms). The pseudo R^2 of 0.693 and Hosmer and Lemeshow p-value (0.955) indicate an acceptable overall fit.

This model was adjusted from the conceptual model by removing any measures of perceived financial control, as the survey outcome was not consistent with *a priori* expectations that financial control would have a significant positive affect on compliance. The model is not generalisable to other environmental regulation (see Chapter 2 regarding contextual and spatial differences in regulation and compliance). The model does, however, offer insight into compliance with effluent discharge consents on dairy farms in the Canterbury region and provides for a better understanding of the effect of the predictor variables (see Section 6.4) on the probability of non-compliance.

6.2.10 Canterbury consent holders 'profile'

Survey results suggest most dairy effluent consent holders in the Canterbury region would sit at the bottom of the enforcement pyramid presented in RR introduced in Chapter 2: persuasion. The descriptive statistics showed consent holders have a strong sense of civic duty and are aware of the impacts of dairy farming on the environment. The results presented a cohort who largely understand the issues at hand and are willing, and intend, to fulfil their obligations through regulatory compliance.

This profile suggests that 'low-level' instruments (such as providing easier access to information) would be more effective in increasing compliance and resonate with consent holders. This is consistent with results from the logistic regression and the text statements.

Section 6.3 presents possible 'low-level' avenues that would be most effective.

6.3 Recommendations

This section provides policy and industry stakeholder recommendations to deliver on the third research objective. First, a discussion on Canterbury compliance rates is benchmarked against other regions, along with a discussion on different types of milking livestock. This is followed

by specific recommendations for policy and industry to help ensure compliance rates continue to increase.

6.3.1 Compliance benchmarking

When compared to other regions and industries, Canterbury had the lowest percentage of full compliance at first inspection, but is still in a similar range of compliance levels with effluent consents in other regions in New Zealand (see Table 1.1 in Chapter 1). Importantly, Canterbury had one the lowest rates of significant non-compliance for effluent consents in the 2014-15 season (Bay of Plenty had the lowest at two per cent). This is important: significant noncompliance is what environmental agencies are trying to reduce, as it represents serious issues on-farm that have the potential to negatively impact the physical environment, whereas minor non-compliance relates more to administrative and minor technical issues. Significant noncompliance involves a much smaller sub-set of the population of consent holders. These are individuals generally at the top of the RR pyramid, that are more difficult to reach, and were not included in this study's sample. Overall, Canterbury effluent consent compliance statistics are not dissimilar to other regions and regulations.

6.3.2 Livestock types

Currently, ECAN reports dairy effluent consents as a single group with emphasis placed on bovine dairy impacts. However, the survey revealed that at least one of the respondents had an effluent consent for a sheep dairy operation. Dairy goat and sheep milking operations are growing in New Zealand with successful niche market opportunities, however, most small ruminant dairies currently operate on the North Island or in Southland (Dairy Goat Cooperative, 2016; Landcorp Farming Ltd., 2016; New Zealand Sheep Milk Co., 2014).

Statistics on the number of small ruminants currently milked in New Zealand, let alone the Canterbury region, are difficult to come by likely due to the relatively small size and emerging nature of the industry. However, what is known, is that nutrient losses (like phosphorous and nitrogen) from sheep are lower than from cows, as there is less concentration in individual urine patches (Menneer, Ledgard & Gillingham, 2004). There has been interest in sheep milking documented among Canterbury farmers, as sheep milk sells for approximately four times the price of cow milk (The Agribusiness Group, 2015; FieldNotes, 2015). As the industry continues to gain attention and grow, it may be beneficial to distinguish livestock type from a reporting and regulating standpoint, given the differences in environmental impacts.

6.3.3 Policy recommendations

This section provides recommendations for policy makers and industry stakeholders to help ensure that compliance rates continue to increase. It will always be difficult for a region to achieve 100% compliance at first inspection, as weather and unpredictable machinery breakdowns may impact on compliance. However, there are methods to ensure that compliance rates are upheld if not increased.

6.3.3.1 Compliance rating system

Most other regulatory agencies rely on a system to evaluate compliance that expands beyond compliance, minor non-compliance and significant non-compliance. It may provide value for ECAN to develop a rating system more similar to that of Environment Southland which rates compliance on a five-point scale. A stronger emphasis on the ability to comply and a priority rating system for risk within significant non-compliance - similar to that of Waikato Regional Council could also assist those rated significantly non-compliant to move towards a compliant status (Environment Southland, 2015; Cantley, 2014).

One comment from a respondent highlights how some forms of minor non-compliance - such as those related to administrative detail rather than environmental impact - may adversely impact the reputation of consent holders when reported:

"Tendency to focus on minor issues (e.g. failure to display consent) resulting in misleading levels of published non – compliance."

ECAN states that this example - having the consent document in a prominent place - ensures that information is, "readily accessible in the dairy shed as a constant reminder, particularly if key staff are not available when issues arise" (Environment Canterbury, 2015, p. 26). It may be more appropriate for inspectors to use their discretion so that when a consent *"falls off the wall"*, as one respondent reported as their reasoning for non-compliance, it is not considered an automatic failure. Further, inspectors could promote briefing of farm staff during training on consent conditions, where to find consent documents and how to manage issues as they arise and who to contact. As ECAN states, "some farms (inspected) where employees were questioned about the requirements of the consent conditions, they did not know anything about them even though this information was on the wall" (Environment Canterbury, 2015, p. 26).

Some comments on, and reasons given for, non-compliance suggested that applying for new consents, rather than updating existing consents is an issue:

"We were non-compliant because we were irrigating more land than our consent which is good. Instead of just rewriting the consent, we had to do a whole new one that cost time and money."

As regulations and consent conditions continue to evolve, it is recommended that a system allowing for more fluidity when updating consents is adopted, so that consent holders do not feel that the process is wasteful of their time and monetary resources or that the process is protracted, may also provide work efficiencies for ECAN.

6.3.3.2 Email contacts

As is evident from the survey distribution, ECAN head office does not possess a full list of consent holder email addresses. Approximately 72 per cent of consents had an associated email address. With perceived access to information seen as a significant variable related to compliance, it is recommended that ECAN source a complete and frequently updated list of emails and fully leverage the use of electronic media by, on a consistent basis, producing pertinent general or region specific updates respecting regulation and proposed changes. This may also help alleviate uncertainty around future regulatory impacts felt by a large percentage of respondents in this research.

Currently, ECAN is active on and leveraging the use of Twitter and Facebook (https://twitter.com/ecan; https://www.facebook.com/EnvironmentCanterbury/). However, given the age demographics of consent holders in this research and other research within the Canterbury region and as farmers are not usually known as technological enthusiasts, the use of these social media platforms as primary points of contact may not be reaching the majority of the intended audience (Murphy, 2014; Van Dalsem, 2011; Barbassa, 2010).

6.3.3.3 Enforcement action

During follow-up discussions, ECAN suggested that enforcement actions against significant non-compliant consent holders (primarily repeat offenders) may increase in future, as consent holders have, arguably, had a lot of time to ensure they consistently operate within their consent conditions (Richard Purdon, personal communication, October 18, 2016). However, Winter and May (2001) and May (2005), suggest that increasing deterrence measures, chiefly enforcement actions, may have an adverse impact on compliance. Given the profile of those surveyed and where they sit in the RR pyramid, penalisation may not be the appropriate response. Additionally, respondents voiced the view that compliance could be achieved through alternate engagement strategies:

"The approach of trying to catch farmers out with short notice inspections is very threatening. Experience from other authorities suggests that there is better engagement where inspectors are working with rather than against consent holders."

The Waikato Regional Council rates significant non-compliance on a priority rating system, focused on the distance from achieving compliance. They also provided letters in advance to notify consent holders that their farm will be visited sometime within the season, providing an opportunity for consent holders to start thinking about their systems and take remedial action where required (Cantley, 2014).

Cantley (2014) suggests that Councils are restricted to only two levers of action: education and enforcement. In the Waikato, an emphasis was placed on engaging with consent holders who were significantly non-compliant, particularly during site visits. Opportunities for discussions were leveraged beyond a written compliance letter. Based on the risk rating, either a requirement for, or recommendation of, an improvement plan was specified with the understanding that the onus is on the consent holder to ensure plans are undertaken (Cantley, 2014). This strategy provides an opportunity to work with the consent holders and may provide, as Winter and May (2001) suggest, an opportunity to increase compliance without increasing enforcement action.

6.4 Study limitations, contributions and future research

This section will discuss some of the limitations of this study, contributions and options for future research in the dairy effluent consent compliance sphere on Canterbury dairy farms.

6.4.1 Study limitations

There are several limitations to the findings in this study. One of the main limitations is to generalise of the findings to the wider New Zealand dairy farmer population. Different regions use different approaches toward the implementation of the RMA and NPS. Further, this study may overestimate or underestimate the variables impacting on effluent consent compliance in the Canterbury region. The sample, particularly in terms of non-compliant consent holders, was not representative of statistics presented by ECAN. Significantly non-compliant respondents may have been deterred from completing the survey because of the effect of subjective norms related to compliance, which would result in a non-response bias. Additionally, that only 48 of the 72 respondents commented on their reasons for their ratings of inspections and the regulatory process may pose a limitation.

Other limitations relate to the survey collection method. The use of an email based survey excluded consent holders whose email addresses were unknown to ECAN (approximately 72 per cent of consents had known email addresses). Also excluded were consent holders who may have changed their email addresses – 29 of the emails were undeliverable, or due to email settings, may have directed some emails to spam and/or auto-delete folders.

6.4.2 Study contributions

This study probed the attitudes and perceptions of dairy effluent discharge consent holders and revealed several variables that are related to compliance status in the Canterbury region. An important part of the regulatory and legislative process to ensure there is connectedness between the regulated and regulating bodies. This research contributes to the body of knowledge and the literature on environmental regulatory compliance behaviour on farm, which is often disparate or conflicting given spatial and contextual differences. The findings should create opportunities to increase compliance in the Canterbury region by addressing the predictor variables of noncompliance.

6.4.3 Future research

Suggestions for future research include performing in-depth interviews with consent holders known to consistently apply best practice methods and with significantly or repeat offender non-compliant consent holders. An in-depth qualitative study could develop an understanding of the RR pyramid apex and further inform appropriate enforcement actions for significantly non-compliant individuals. This would help develop a deeper understanding of the motivations and influencing factors on compliance and behaviour. Key findings could be further investigated through a comparative look at other regions in New Zealand. As regulatory processes differ, there may be lessons to be learned from how other regulatory agencies interact with consent holders. There is scope to further research the impact of confidence, public pressure and access to information. Chiefly, what are the predictors of confidence and how do information sources impact on the perceived ease of access to information?

6.5 Conclusions

The study results showed that an investigation into the factors influencing agro-environmental compliance on this particular sub-group should not focus exclusively on socio-demographics or operational characteristics, but should include in-depth considerations of attitudes and perceptions, subjective norms and perceived behavioural control. Results indicated that access to information and perceived behavioural control variables like confidence and intention to comply were strongly associated with compliance. Only a handful of significant relationships existed between other major constructs and compliance. Respondents' comments indicated that current regulation and its related processes lack engagement with the dairy farming community and experiences with inspections are varied. Recommendation options to increase access to information, ameliorate feelings of uncertainty and promote engagement between consent holders and regulators were provided, which may help ensure compliance levels continue to increase and remain comparable to other regions in New Zealand.

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Appendix A
Variables affecting conservation practice adoption on farm from Knowler and Bradshaw (2007) review

Knowler and Bradshaw (2007): Frequency analysis from 31 agriculturally related conservation practice adoption analyses

Variable	sig (+)	sig (−)	Insignificant	Total	Status
Education	7	3	11	21	
Age	3	5	10	18	
Farm size	6	2	10	18	
Tenure (1 = leased)	2	2	11	15	
Off-farm activities/income	3	4	4	11	
Rainfall	5	2	3	10	
Experience	4	0	5	9	*
Area Planted	3	1	5	9	
Extension/technical assistance	4	1	4	9	
Slope	3	3	3	9	
Attitudes towards conservation	2	0	5	7	*
Source of information	2	0	5	7	*
Income	4	1	1	6	
Importance of livestock	3	1	2	6	
Program participation	4	0	2	6	*
Well-drained soil	1	0	5	6	*
Family labour	1	0	4	5	*
Hired labour	0	0	5	5	**
Gross farm income	3	0	2	5	*
Ease of obtaining information	2	1	2	5	
Management knowledge/skills	3	0	2	5	*
Soil erosion rate	0	1	4	5	*
Temperature	2	0	3	5	*
Farm profitability	2	0	2	4	*
Concern for erosion	2	0	2	4	*
Awareness of environmental threats	4	0	0	4	***
Debt (level ratio)	0	1	3	4	*
Farm/field type	3	0	1	4	*
Proportion of hectares irrigated	0	2	2	4	*
Conventional tillage equip/animals	0	2	2	4	*
Perceived health threat agrochemicals	0	1	2	3	*
Output prices	0	1	2	3	*
Emphasis on grain farming	1	0	2	3	*
Importance of crop revenues in income	1	1	1	3	
Availability of machinery	2	0	1	3	*

Wealth indicators	0	0	3	3	**
Pesticides applied	2	0	1	3	*
Cropping system/crop rotation	0	0	3	3	**
High productivity soil	0	3	0	3	***
Highly erodible land (yes = 1)	2	0	1	3	*
Length of growing season	2	0	1	3	*
Distance to paved road	0	2	1	3	*
Kin as partners	1	0	2	3	*
Membership in organizations	2	0	1	3	*
Concern for groundwater pollution	0	0	3	3	**
Impact of CA on production costs	0	0	3	3	**

(*) indicates mix of insignificant and significant, but always the same sign when significant;

(**) indicates variable is always insignificant;

(***) indicates variable is always significant and same sign.

Appendix B
Constructs and proxies of conceptual model

Explanatory variables	*Description*	*Expected impact*
Farm and farmer characteristics		
Ownership structure	Structure of farm ownership: sole proprietor, partnership, corporate etc.	(+)/(-)
Age	Biological age	(+)/(-)
Ethnicity	Ethnic identity	(+)/(-)
Gender	Dummy variable for male (0) and female (1)	(+)/(-)
Years in industry	Number of years farming	(+)/(-)
Education	Level of formal education	(+)
Access to information	Use of consultant for farm planning; attendance to training activities and workshops; use of extension (DairyNZ) services	(+)
Dairy operating profit (Farm Economic Surplus)	Years' operating in a surplus	(+)
Farm size	Farm size in hectares of land	(+)
Herd size	Number of cows being milked	(+)
Catchment	Water quality issues vary by district: identify which catchment the respondent is operating in	(+)/(-)
Attitudes and perceptions		
Environment	Pro-environmental perceptions	(+)
Equity	Equity perceptions on spread of cost burden and fairness	(+)
Regulation	Perceptions of regulatory complexity, structure and uncertainty	(+)
Problem awareness	Awareness of water quality issues and agricultural linkages	(+)
Internal attribution	Perception of farm role in water quality issues	(+)
Subjective norms		
Descriptive social norm	Perceptions of behaviours approved by others	(+)
Injunctive social norm	Perceptions of how other people are actually behaving	(+)
Perceived behavioural control		
PBC	Belief in ability to succeed, control over behaviour and past experience	(+)
Perceived financial control		
Payout and financial situations	Perceptions of ability to comply in different payout levels and financial situations	(+)

Appendix C
Online questionnaire

Q1 Farm ownership structure (please tick appropriate box)

❍ Sole proprietorship (1)
❍ Partnership (2)
❍ Corporation/Company (3) ❍ Trust (4)
❍ Māori Trust/Incorporation (5) ❍ Other (6)

Answer If: Farm ownership structure (please tick appropriate box) other please specify: Is Selected Q1.1 Please specify other ownership structure Q2 Gender (please tick appropriate box)

❍ Male (1)
❍ Female (2)

Q3 Age (please tick appropriate box)

❍ Less than 25 years old (1)
❍ 26-35 years old (2)
❍ 36-45 years old (3)
❍ 46-55 years old (4)
❍ 56-65 years old (5)
❍ 66-75 years old (6)
❍ 76+ years old (7)

Q4 Ethnicity (please tick appropriate box)

❍ European New Zealander (1)
❍ Māori (2)
❍ Asian (3)
❍ Pacific (4)
❍ Other (5)

Answer If: Ethnicity (please tick appropriate box) Other Is Selected
Q4.1 Please specify ethnicity

Q5 Number of years actively involved in dairy farming in New Zealand (please tick appropriate box)

❍ 1-2 years (1)
❍ 3-5 years (2)
❍ 6-10 years (3)
❍ 11-15 years (4)
❍ 16-20 years (5)
❍ 21-25 years (6)
❍ 26+years (7)

Q6 Highest level of formal education achieved (please tick appropriate box)

- ❍ High school or equivalent (1)
- ❍ Primary ITO/Polytechnic/Diploma (2)
- ❍ Undergraduate degree (3)
- ❍ Post-Graduate degree (4)
- ❍ Other (5)

Answer If: Highest level of formal education achieved (please tick appropriate box) Other Is Selected

Q6.1 Please specify highest level of formal education

Q7 Are there any other parties with significant involvement in farm-decision making regarding effluent management (i.e. partner, children, farm manager etc.)?

- ❍ Yes (1)
- ❍ No (2)

Answer If: Are there any other parties with significant involvement in farm-decision making regarding effluent management? Yes Is Selected

Q7.1 Please specify the other parties

Q8 Which catchment do you primarily operate in (please tick appropriate box)?

- ❍ Hurunui-Waiau (1)
- ❍ Waimakariri (2)
- ❍ Christchurch - West Melton (3)
- ❍ Banks Peninsula (4)
- ❍ Selwyn - Waihora (5)
- ❍ Ashburton (6)
- ❍ Orari-Opihi-Pareora (7)
- ❍ Lower Waitaki (8)
- ❍ Upper Waitaki (9)
- ❍ Kaikoura (10)

Q9 Number of cows milked on farm (please tick appropriate box)

- ❍ Less than 100 (1)
- ❍ 100-250 (2)
- ❍ 250-500 (3)
- ❍ 500-750 (4)
- ❍ 750-1000 (5)
- ❍ 1000+ (6)

Q10 Approximate farm size in hectares

❍ Less than 100 (1)
❍ 100-250 (2)
❍ 250-500 (3)
❍ 500-750 (4)
❍ 750-1000 (5) ❍ 1000+ (6)

Q11 How often do you attend training workshops or farm group meetings?

❍ Seldom to never (1)
❍ Once every couple of years (2)
❍ Once a year (3)
❍ Several times a year (4)
❍ Once a month (5)

Q12 How often do you use consultancy and/or extension services (DairyNZ consulting) for your farm planning?

❍ Never (1)
❍ Once every couple years (2)
❍ Once a year (3)
❍ Several times a year (4)

Answer If: How often do you use consultancy and/or extension services (DairyNZ consulting) for your farm planning? Never Is Not Selected Q12.1 Please indicate which of the following services your consultant(s) provide (can be more than one)

❍ Regular farm supervision and week to week management advice (1)
❍ Periodic feed budgeting (2)
❍ Whole farm strategic output (3)
❍ Financial/farm business advice (4)
❍ Environmental performance (5)
❍ Other (6)

Answer If: Please indicate which of the following services your consultant(s) provide (can be more than one) Other Is Selected Q12.2 Please specify what services your consultant(s) provide

Q13 Over the past 5 seasons, approximately how many times has your dairy operating profit been positive?

❍ None (1)
❍ 1 (2)
❍ 2 (3)
❍ 3 (4)
❍ 4 (5)
❍ 5 (6)

Q14-31 Please indicate whether you STRONGLY AGREE, AGREE, are NEUTRAL, DISAGREE or STRONGLY DISAGREE with the following statements

	Strongly agree (1)	Agree (2)	Neutral (3)	Disagree (4)	Strongly disagree (5)
Canterbury farmers are unfairly impacted by environmental regulation.	❍	❍	❍	❍	❍
Nitrate limits are fairly applied to all farmers.	❍	❍	❍	❍	❍
Environmental regulation in Canterbury has a fair and equitable impact on all farmers.	❍	❍	❍	❍	❍
The cost of environmental protection is equitable across society in Canterbury.	❍	❍	❍	❍	❍
Environment Canterbury makes it easy to understand why farmers should be compliant.	❍	❍	❍	❍	❍
I have easy access to information about requirements on farm to be compliant with environmental regulation.	❍	❍	❍	❍	❍
I am informed on farm environmental regulation in Canterbury.	❍	❍	❍	❍	❍
I feel uncertain about future regulatory restrictions on my farm.	❍	❍	❍	❍	❍
Achieving and maintaining compliance requires a lot of my time.	❍	❍	❍	❍	❍
Achieving compliance costs a lot of money.	❍	❍	❍	❍	❍

Inspections by Environment Canterbury are frequent enough to deter most farmers from violating their resource consents.	❍	❍	❍	❍	❍
My farming practices did not contribute to the need for environmental regulation on farm.	❍	❍	❍	❍	❍
I intend to comply with my resource consent conditions because of the potential penalty.	❍	❍	❍	❍	❍
Water quality can impact on human health.	❍	❍	❍	❍	❍
Water quality can affect the quality of my pasture and/or crops.	❍	❍	❍	❍	❍
Water quality can affect the health of my livestock.	❍	❍	❍	❍	❍
Dairy farming impacts surface and ground water quality.	❍	❍	❍	❍	❍
Environmental regulation on farm was necessary to do something about water quality.	❍	❍	❍	❍	❍

Q32-35 Please state how concerned you are about practices that impact the natural environment because of potential consequences for the following:

	Not very concerning (1)	Not concerning (2)	Neutral (3)	Concerning (4)	Very concerning (5)
Native animals	❍	❍	❍	❍	❍
Native plants	❍	❍	❍	❍	❍
Native birds	❍	❍	❍	❍	❍
Native fish	❍	❍	❍	❍	❍

Q36-40 Please state how threatening the following problems are to the physical environment:

	Not very threatening (1)	Not threatening (2)	Neutral (3)	Threatening (4)	Very threatening (5)
Degraded soil health	❍	❍	❍	❍	❍
Weeds	❍	❍	❍	❍	❍
Poor water quality	❍	❍	❍	❍	❍
Limited water supply	❍	❍	❍	❍	❍
Adverse weather conditions	❍	❍	❍	❍	❍

Q41 What group in society should have primary responsibility for looking after the environment in a sustainable manner (please tick ONE answer that most suits you)

❍ National or local government (1)
❍ Business and industry (2)
❍ Private landowners (3)
❍ Environmental groups (4)
❍ Everyone (government, industry, landowners, the public, etc.) (5)
❍ No one (6)
❍ Other (7)

Answer If: What group in society should have primary responsibility for looking after the environment in a sustainable manner (please tick ONE answer that most suits you) Other Is Selected

Q41.1 Please specify what group in society should have primary responsibility for looking after the environment in a sustainable manner

Q42 What method of intervention provides the best results in reducing nitrate leaching on farm?

❍ Voluntary (farmer-driven) (1)
❍ Market-driven (2)
❍ Mix of voluntary and market-driven (3)
❍ Mix of voluntary and government regulation (4)
❍ Mix of market-driven and government regulation (5)
❍ Mix of voluntary, market and government regulation (6) ❍ Government regulation with penalties for non-action (7)

Q43 How easy do you believe it is for ECAN to detect non-compliance?

❍ Extremely easy (1)
❍ Somewhat easy (2)
❍ Neither easy nor difficult (3)
❍ Somewhat difficult (4) ❍ Extremely difficult (5)

Q44 If detected being non-compliant, how likely is it that a farmer would be penalised?

- ❍ Extremely likely (1)
- ❍ Somewhat likely (2)
- ❍ Neither likely nor unlikely (3)
- ❍ Somewhat unlikely (4)
- ❍ Extremely unlikely (5)

Q45 Please rate your experience with ECAN inspections.

- ❍ Excellent (1)
- ❍ Good (2)
- ❍ Average (3)
- ❍ Poor (4)
- ❍ Terrible (5)

Q46 Please rate your experience with the ECAN regulatory process.

- ❍ Excellent (1)
- ❍ Good (2)
- ❍ Average (3)
- ❍ Poor (4)
- ❍ Terrible (5)

Q47 Please provide a few sentences on what influenced your rating in the previous TWO questions.

Q48-61 Please indicate whether you STRONGLY AGREE, AGREE, are NEUTRAL, DISAGREE or STRONGLY DISAGREE with the following statements

	Strongly agree (1)	Agree (2)	Neutral (3)	Disagree (4)	Strongly disagree (5)
The majority of farmers in New Zealand usually comply with their effluent consents.	❍	❍	❍	❍	❍
Among the farmers I know, most are compliant most of time.	❍	❍	❍	❍	❍
Occasional noncompliance is common.	❍	❍	❍	❍	❍
If I am not compliant with my effluent consent my reputation as a farmer would be harmed.	❍	❍	❍	❍	❍
Operating the way the public thinks I should regarding my effluent consent is important to me.	❍	❍	❍	❍	❍
Other farmers would disapprove if I was not compliant with my effluent consent.	❍	❍	❍	❍	❍
I feel pressure from the farming community to comply with environmental regulations.	❍	❍	❍	❍	❍
People who are important to me, like friends and family, would disapprove if I was not compliant.	❍	❍	❍	❍	❍
I am confident that I will be compliant with my effluent discharge consent at my next inspection.	❍	❍	❍	❍	❍

I intend to be compliant at the time of my inspection.	❍	❍	❍	❍	❍
In the past 5 seasons (or seasons since application approval for consent) I have been compliant.	❍	❍	❍	❍	❍
The fate of the farm is mostly determined by factors outside of my control.	❍	❍	❍	❍	❍
In a low payout situation, I am less likely to be able to comply with my effluent consent than in a high or average payout.	❍	❍	❍	❍	❍
The ability of farmers to comply with effluent consents relies heavily on farm financial situations	❍	❍	❍	❍	❍

Q62 Effluent consent compliance level at time of last inspection (please tick appropriate box)

❍ Compliant (1)
❍ Minor non-compliance (2)
❍ Significant non-compliance (3)

Answer If: Effluent consent compliance level at time of last inspection (please tick appropriate box) Compliant Is Not Selected

Q62.1 Type of non-compliance

❍ Ponding of effluent (1)
❍ Exceeding application rate (2)
❍ Exceeding number of cows being milked (3)
❍ Storage pond not meeting requirements (4) ❍ Other (5)

Answer If: Type of non-compliance Other Is Selected

Q62.2 Please specify type of non-compliance Answer If: Effluent consent compliance level at time of last inspection (please tick appropriate box) Compliant Is Not Selected

Q62.3 Please comment on reason for non-compliance (i.e. equipment issues, management, weather, etc.)

Appendix D
Lincoln University Human Ethics Committee approval

Research and Innovation

T 64 3 423 0817
PO Box 85084, Lincoln University
Lincoln 7647, Christchurch
New Zealand
www.lincoln.ac.nz

20 June 2016

Application No: 2016- 31

Title: Factors influencing agro-environmental regulatory compliance behaviour on Canterbury dairy farms.

Applicant: M MacNamara

The Lincoln University Human Ethics Committee has reviewed the above noted application.
Thank you for your response to the questions which were forwarded to you on the Committee's behalf.

I am satisfied on the Committee's behalf that the issues of concern have been satisfactorily addressed. I am pleased to give final approval to your project.

Please note that this approval is valid for three years from today's date at which time you will need to reapply for renewal.

Once your field work has finished can you please advise the Human Ethics Secretary, Alison Hind, and confirm that you have complied with the terms of the ethical approval.

May I, on behalf of the Committee, wish you success in your research.

Yours sincerely

Grant Tavinor
Chair, Human Ethics Committee

PLEASE NOTE: The Human Ethics Committee has an audit process in place for applications. Please see 7.3 of the Human Ethics Committee Operating Procedures (ACHE) in the Lincoln University Policies and Procedures Manual for more information.

Appendix E
Details of variable transformations

E.1 Details of consent holder and farm variable transformations

Note the original variables are on the left of each table. Parentheses denotes the number of categories or groups and n is the number of respondents.

Table E.1 Education

Education (5)	**n**	**Education (2)**	**n**
None	1	Polytech or lower	38
High school or equivalent	15	Undergraduate or higher	31
Polytech/Diploma/Primary ITO	22		
Undergraduate degree	27		
Post-graduate degree	4		

Table E.2 Consultant use

Consultant use (4)	**n**	**Consultant use (2)**	**n**
Never	11	Seldom	26
Once every couple years	15	Often	42
Once a year	4		
Several times a year	38		

Table E.3 Training

Training (5)	**n**	**Training (2)**	**n**
Seldom to never	9	Seldom	23
Once every couple years	14	Often	46
Once a year	9		
Several times a year	34		
Once a month	3		

Table E.4 Livestock milked

Livestock milked (6)	**n**	**Livestock milked (2)**	**n**
Less than 100	1	Less than 750	31
100-250	5	More than 750	39
250-500	9		
500-750	16		
750-1000	18		
1000+	21		

Table E.5 Farm size

Farm size (6)	n	Farm size (2)	n
Less than 100	4	Less than 500	59
100-250	26	More than 500	9
250-500	29		
500-750	5		
750-1000	3		
1000+	1		

E.2 Attitudes and perceptions

Table E.6 Dairy impacts

Dairy impacts (5)	n	Dairy impacts (2)	n
Strongly agree	8	Agree	34
Agree	26	Neutral/Disagree	34
Neutral	22		
Disagree	9		
Strongly disagree	3		

Table E.7 Water quality: Human health

Water quality: Human health (4)	n	Water quality: Human health (2)	n
Strongly agree	22	Agree	57
Agree	35	Neutral/Disagree	11
Neutral	9		
Disagree	2		

Table E.8 Water quality: Livestock health

Water quality: Livestock health (5)	n	Water quality: Livestock health (2)	n
Strongly agree	15	Agree	51
Agree	36	Neutral/Disagree	17
Neutral	10		
Disagree	6		
Strongly disagree	1		

Table E.9 Water quality: Pasture/crop health

Water quality: Pasture/crop health (5)	**n**	**Water quality: Pasture/crop health (2)**	**n**
Strongly agree	12	Agree	33
Agree	21	Neutral/Disagree	34
Neutral	15		
Disagree	16		
Strongly disagree	3		

Table E.10 Regulation required to improve water quality

Regulation required (5)	**n**	**Regulation required (2)**	**n**
Strongly agree	6	Agree	44
Agree	38	Neutral/Disagree	24
Neutral	17		
Disagree	4		
Strongly disagree	3		

Table E.11 Biospheric concern

Biospheric concern (7)	**n**	**Biospheric concern (2)**	**n**
Not very concerning	1	Not very concerning - Neutral	23
Not concerning	8	Neutral-concerning – very concerning	35
Neutral	14		
Neutral-concerning	6		
Concerning	33		
Concerning-very concerning	3		
Very concerning	2		

Table E.12 Environmental risks

Environmental risks (8)	n	Environmental risks (2)	n
Not very threatening	1	Not very threatening – neutral	17
Not threatening	2	Threatening	50
Not threatening -neutral	2		
Neutral	12		
Neutral-threatening	12		
Threatening	27		
Threatening – very threatening	7		
Very threatening	4		

Table E.13 Canterbury farmers unfairly impacted

Canterbury farmers unfairly impacted (4)	n	Canterbury farmers unfairly impacted (2)	n
Strongly agree	11	Agree	36
Agree	25	Neutral/Disagree	32
Neutral	18		
Disagree	14		

Table E.14 Nitrate limits applied fairly

Nitrate limits applied fairly (5)	n	Nitrate limits applied fairly (2)	n
Strongly agree	1	Agree	13
Agree	12	Neutral/Disagree	54
Neutral	15		
Disagree	29		
Strongly disagree	10		

Table E.15 Regulation fair to all farmers

Regulation fair to all farmers (5)	n	Regulation fair to all farmers (2)	n
Strongly agree	1	Agree	13
Agree	12	Neutral/Disagree	55
Neutral	12		
Disagree	33		
Strongly disagree	10		

Table E.16 Equitable cost spread

Equitable cost spread (5)	n	Equitable cost spread (2)	n
Strongly agree	1	Agree	7
Agree	6	Neutral/Disagree	61
Neutral	11		
Disagree	34		
Strongly disagree	16		

Table E.17 Easy to understand need for compliance

Easy to understand need for compliance (5)	n	Easy to understand need for compliance (2)	n
Strongly agree	5	Agree	38
Agree	34	Neutral/Disagree	30
Neutral	8		
Disagree	14		
Strongly disagree	7		

Table E.18 Easy access to information

Easy access to information (5)	n	Easy access to information (2)	n
Strongly agree	5	Agree	47
Agree	34	Neutral/Disagree	21
Neutral	8		
Disagree	14		
Strongly disagree	7		

Table E.19 I am informed on regulation

I am informed on regulation (5)	n	I am informed on regulation (2)	n
Strongly agree	4	Agree	57
Agree	42	Neutral/Disagree	11
Neutral	11		
Disagree	9		
Strongly disagree	2		

Table E.20 Future regulation uncertainty

Future regulation uncertainty (5)	n	Future regulation uncertainty (2)	n
Strongly agree	20	Agree	61
Agree	28	Neutral/Disagree	7
Neutral	13		
Disagree	4		
Strongly disagree	3		

Table E.21 Compliance takes a lot of time

Compliance takes a lot of time (4)	n	Compliance takes a lot of time (2)	n
Strongly agree	19	Agree/Neutral	61
Agree	37	Disagree	1
Neutral	11		
Disagree	1		

Table E.22 Compliance takes a lot of money

Compliance takes a lot of money (4)	n	Compliance takes a lot of money (2)	n
Strongly agree	25	Agree/Neutral	65
Agree	33	Disagree	2
Neutral	7		
Disagree	2		

Table E.23 Inspections frequent enough to deter violations

Inspections frequent enough to deter violations (5)	n	Inspections frequent enough to deter violations (2)	n
Strongly agree	9	Agree	47
Agree	38	Neutral/Disagree	21
Neutral	14		
Disagree	6		
Strongly disagree	1		

Table E.24 I intend to comply due to potential penalty

I intend to comply due to potential penalty (4)	n	I intend to comply due to potential penalty (2)	n
Strongly agree	21	Agree	51
Agree	30	Neutral/Disagree	16
Neutral	6		
Disagree	10		

Table E.25 Method that provides best results

Method that provides best results (5)	n	Method that provides best results (2)	n
Voluntary	6	With legislation	44
Market-driven	2	Without legislation	21
Mix of voluntary and market driven	13		
Mix of voluntary and government	15		
Mix of market and government	4		
Mix of all three	25		

E.3 Subjective norms

Table E.26 Reputation

Reputation (4)	n	Reputation (2)	n
Strongly agree	29	Agree	58
Agree	29	Neutral/Disagree	9
Neutral	7		
Disagree	2		

Table E.27 Operating the way the public expects

Operating the way the public expects (5)	n	Operating the way the public expects (2)	n
Strongly agree	23	Agree	48
Agree	25	Neutral/Disagree	19
Neutral	15		
Disagree	2		
Strongly disagree	2		

Table E.28 Other farmers would disapprove

Other farmers would disapprove (4)	n	Other farmers would disapprove (2)	n
Strongly agree	18	Agree	56
Agree	38	Neutral/Disagree	10
Neutral	7		
Disagree	3		

Table E.29 Pressure from farming community

Pressure from farming community (4)	n	Pressure from farming community (2)	n
Strongly agree	14	Agree	40
Agree	26	Neutral/Disagree	27
Neutral	22		
Disagree	5		

Table E.30 Friends and family would disapprove

Friends and family would disapprove (5)	n	Friends and family would disapprove (2)	n
Strongly agree	19	Agree	54
Agree	35	Neutral/Disagree	13
Neutral	11		
Disagree	1		
Strongly disagree	1		

Table E.31 Majority of farmers usually comply

Majority of farmers usually comply (3)	n	Majority of farmers usually comply (2)	n
Strongly agree	24	Agree	64
Agree	40	Neutral	3
Neutral	3		

Table E.32 Most farmers I know are compliant

Most farmers I know are compliant (4)	n	Most farmers I know are compliant (2)	n
Strongly agree	31	Agree	62
Agree	31	Neutral/Disagree	5
Neutral	4		
Strongly disagree	1		

Table E.33 Occasional non-compliance common

Occasional non-compliance common (5)	n	Occasional non-compliance common (2)	n
Strongly agree	2	Agree/Neutral	46
Agree	25	Disagree	21
Neutral	19		
Disagree	18		
Strongly disagree	3		

E.4 Perceived behavioural control

Table E.34 Historical compliance

Historical compliance (4)	n	Historical compliance (2)	n
Strongly agree	36	Agree	55
Agree	19	Neutral/Disagree	11
Neutral	4		
Disagree	7		

Table E.35 Locus of control

Locus of control (5)	n	Locus of control (2)	n
Strongly agree	6	Agree/Neutral	39
Agree	11	Disagree	28
Neutral	22		
Disagree	23		
Strongly disagree	5		

E.5 Perceived financial control

Table E.36 Payout

Payout (5)	n	Payout (2)	n
Strongly agree	5	Agree/Neutral	17
Agree	7	Disagree	50
Neutral	5		
Disagree	32		
Strongly disagree	18		

Table E.37 Farm financial situation

Farm financial situation (5)	n	Farm financial situation (2)	n
Strongly agree	6	Agree/Neutral	31
Agree	13	Disagree	36
Neutral	12		
Disagree	24		
Strongly disagree	12		

Appendix F
Cross tabulations of significant relationships

Table F.1 What group in society should have the primary responsibility of looking after the environment sustainably?

		Effluent consent compliance level at time of last inspection		
		Compliant	Non-compliant	Total
	National or local government	8	2	10
	Private landowners	3	1	4
	Everyone	49	3	52
	No one	0	1	1
Total		60	7	67

Table F.2 Workshop/training attendance

		Effluent consent compliance level at time of last inspection		
		Compliant	Non-compliant	Total
	Seldom	23	0	23
	Often	37	7	44
Total		60	7	67

Table F.3 Farm size in hectares

		Effluent consent compliance level at time of last inspection		
		Compliant	Non-compliant	Total
	Less than 500	52	4	56
	More than 500	6	3	9
Total		58	7	65

Table F.4 Number of livestock being milked

	Effluent consent compliance level at time of last inspection		
	Compliant	Non-compliant	Total
Less than 100	1	0	1
100-250	5	0	5
250-500	8	0	8
500-750	13	2	15
750-1000	18	0	18
1000+	15	5	20
Total	60	7	67

Table F.5 I Easy access to information

	Effluent consent compliance level at time of last inspection		
	Compliant	Non-compliant	Total
Agree/Neutral	45	1	46
Disagree	15	6	21
Total	60	7	67

Table F.6 Historical compliance

	Effluent consent compliance level at time of last inspection		
	Compliant	Non-compliant	Total
Agree	52	3	55
Neutral/Disagree	7	4	11
Total	59	7	66

Table F.7 Intention

	Effluent consent compliance level at time of last inspection		
	Compliant	Non-compliant	Total
Strongly agree	48	2	50
Agree	11	5	16
Total	59	7	66

Table F.8 Confidence

	Effluent consent compliance level at time of last inspection		
	Compliant	Non-compliant	Total
Strongly agree	45	1	46
Agree	14	6	20
Total	59	7	66

Table F.9 Rating of experience with ECAN inspections

	Effluent consent compliance level at time of last inspection		
	Compliant	Non-compliant	Total
Excellent	11	0	11
Good	33	3	36
Average	11	2	13
Poor	3	2	5
Terrible	2	0	2
Total	60	7	67

Table F.10 Rating of experience with the ECAN regulatory process

	Effluent consent compliance level at time of last inspection		
	Compliant	Non-compliant	Total
Excellent	4	0	4
Good	23	1	24
Average	25	3	28
Poor	5	2	7
Terrible	3	1	4
Total	60	7	67

Table F.11 ECAN's ease at detecting non-compliance

	Effluent consent compliance level at time of last inspection		
	Compliant	Non-compliant	Total
Extremely easy	8	1	9
Somewhat easy	18	0	18
Neither easy nor difficult	24	2	26
Somewhat difficult	8	4	12
Extremely difficult	2	0	2
Total	60	7	67

Appendix G
Qualitative responses

Table G.1: Positive comments on ECAN inspections and regulation

Tone and topic	Comment
Positive: Regulation implementation process Count = 2	• "So far getting consents through and advice on native planting season and plans have been well looked after and pretty straight forward." • "Had a non-compliance on water take which was handled well by ECAN."
Positive: Inspections Count = 18	• "We have got on good with the inspectors as we try our best to do the job right." • "Fair and reasonable assessment, good dialogue with assessor prior to final report, collaborative approach." • "Respectful staff." • "Always have had good discussion with inspecting officers on farm." • "In most cases the standard and competency of the audits and auditors was good." • "Overall good experience." • "I have never had any problems in dealing with inspectors." • "Farm inspections are thorough and professional." • "Generally the people involved have good interpersonal skills. ECAN are using a mix of carrot and stick." • "Very friendly and understanding staff." • "Never had a problem with effluent inspections." • "On most occasions staff have been thorough and polite and offered good advice on any minor compliance issues." • "ECAN staff have always been good to deal with." • "For the most part, ECAN inspections of effluent and water use have been good." • "Nice inspectors, no nonsense." • "Fairly good to deal with." • "Individual inspectors have generally been very good, but there can be variation between their personal approaches." • "ECAN staff that have visited our farms have always been courteous, interested in what we are doing and ready to offer advice if sought."
Positive: Other Count = 2	• "No problems with ECAN." • "Helpful, easy to understand."

Table G.2: Negative comments on ECAN inspections and regulation

Tone and topic	Comment
Negative: Regulation Count =11	• "ECAN is going through the motion ticking the boxes. They are not interested in science measurement on farm." • "Not based on sound science." • "Confusing rules and changing goals all the time." • "Regulations need to be based on real science not assumed science. More research needed, not using assumptions." • "I feel that they are still trying to have a one system fits all policy going, however, this just isn't the case." • "Regulatory process moves to slowly and needs to be based on good science." • "Keep moving the goalposts." • "Understanding what ECAN is after: The goalposts are shifting all the time, no consistency." • "ECAN has been over-reactive concerning use of accretion land." • "ECAN takes everything very black and white. There is not much experience with different type of farming systems (i.e. free stall)." • "Regulatory processes are fine but very unfair when we have neighbours both above and below us seemingly on different rules regarding stock in waterways with beef cattle and dairy grazing operations."
Negative: Regulation implementation process Count = 11	• "They come around once a year, we have always been reasonably compliant and so never have a problem, but I know of farmers who do not practice best practice and nothing is ever done." • "We were non-compliant because we were irrigating more land than our consent which is good. Instead of just rewriting the consent, we had to do a whole new one that cost time and money." • "They do an okay job now after doing a poor regulatory job for years, this has led to poor compliance that is now biting them back. They are now catching up which is good, but being a bit too officious and probably need to work with farmers rather than against us, which is disappointing." • "We had a massive problem with ECAN regarding a water consent which cost us many thousands of dollars with a lawyer and stress which impacted on my farming operation." • "I was recently (previous season) fined for significant non-compliance. The process was very stressful and totally out of context to the offence." • "Tendency to focus on minor issues (e.g. failure to display consent) resulting in misleading levels of published non – compliance." • "A lot of cost and time taken to get/renew consents." • "The regulatory process is somewhat complicated." • "Poor communication from ECAN to farmers of policy, regulations and amended requirements." • "Admin at ECAN is terrifyingly inefficient and therefore expensive to the rating base." • "Regulatory process has at various times been very protracted, appearing wasteful of time and monetary resources, to achieve the

	same outcome as was initially applied for. Very expensive to justify any changes to a resource consent, and difficult to keep up with environmental changes that occur during a consent change process."
Negative: Inspections Count = 12	• "Dealing with some staff difficult due to their inexperience. Seems to be high turnover of staff." • "Last inspection didn't even bother to go to the effluent irrigator. Information very slow in coming and mixed messages." • "The inspectors have been extremely pedantic in classifying farms as non-compliant for very small offences." • "Individuals could be more customer focused and helpful." • "Terrible because of incompetence of inspector." • "The approach of trying to catch farmers out with short notice inspections is very threatening. Experience from other authorities suggests that there is better engagement where inspectors are working with rather than against consent holders." • "The monitoring staff are young and inexperienced and on the right side of environmentalism i.e. not neutral." • "A bit of common sense needed with inspections." • "An aggressive attitude of inspectors with very poor practical skills. Consenting staff also lack common sense." • "Regulatory process turned very, very expensive for me on our recent conversion. Generally, I think we have a great relationship with ECAN, but unfortunately red tape just seems to get more and more expensive." • "Have been totally compliant on both farms for years, yet still get treated like a criminal with no notice given for annual checks." • "Inspectors could often be more knowledgeable, seem to look to tick boxes rather than looking deeper into how systems are operated."

Table G.3: Other comments on ECAN inspections and regulation

Tone	Comment
Improving Count = 2	• "They have changed from being only regulatory and somewhat unhelpful to being very helpful." • "Attitudes of ECAN staff have improved over the last few years, able to work with the consent holder."
Other Count = 2	• "Limited interactions." • "They only did what was necessary."

Appendix H
Constructs Cronbach's α

Table H.1 Cronbach's α values

Construct	**Cronbach's α**
Information access source usage	0.631
Size	0.785
Attitudes	0.564
Subjective norms	0.713
Perceived behavioural control	0.734
Perceived financial control	0.808

Appendix I
Logistic regression evaluation of conceptual model

Table I.1 Logistic regression results of conceptual model

	B	S.E.	Wald	df	Sig.	Exp(B)
AGE	-1.259	1.357	.860	1	.354	.284
YEARS IN INDUSTRY	-.572	.922	.384	1	.535	.564
EDU LEVEL	-2.152	2.735	.619	1	.431	.116
SIZEAVG	3.014	1.799	2.807	1	**.094***	20.376
INFOAVG	-.437	1.727	.064	1	.800	.646
PROFIT	1.891	2.044	.856	1	.355	6.624
ATTITUDEAVG	10.203	9.434	1.170	1	.279	26986.516
SNAVG	2.557	2.502	1.044	1	.307	12.893
PBCAVG	4.869	3.777	1.661	1	.197	130.169
PFCAVG	-1.798	1.488	1.459	1	.227	.166
Constant	-43.105	27.428	2.470	1	.116	.000

*p<0.1

-2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
12.535	.347	.749