Dairy Farmers' Responses to Water Quality Interventions:

A Case Study in the Manawatu-Wanganui Region of New Zealand

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Abstract

New Zealand freshwater quality has declined, and dairy farming is one identified contributor to this decline. This research provides insight into dairy farmers responses to the water quality interventions introduced to mitigate diffuse pollution, and the socio-cultural dynamics that shaped their responses. Putnam's (2000) social capital theory was the theoretical framework used to explore how and why New Zealand dairy farmers responded to water quality interventions and the role of social capital in shaping dairy farmers' responses. A single qualitative case-study research design was undertaken in one Water Management Zone of the Manawatu-Wanganui Region. Data was drawn from semi-structured interviews with dairy farmers and key informants, and from documents.

Farmer response is identified as a multi-dimensional rather than a uni-dimensional phenomenon. The dairy farmers responded to water quality interventions as individuals and collectively, and these responses were linked and interwoven. Individual farmer awareness and understanding, emotion and behaviour changed. Collectively, resistance, social learning, formation of a farmer-led action group and changes in accepted farming practices occurred. In addition, social interactions through social networks, trust, social norms and being a 'good' farmer that uses 'best' farm practice (farmer identity) emerged as key influencers of the dairy farmers' individual and collective responses to water quality interventions.

The socially constructed collective agreements on accepted behaviour, or cultural, personal and practice norms, influenced farmers' individual and collective responses to interventions. The identified cultural norms associated with private property ownership, equity and fairness, social responsibility and relationships, and personal norms associated with the stewardship of land and water, reflected the farming culture of the farmers interviewed and the broader group to which they belong. A broad collective change in what farmers believe are the expected farm management practices around farming and water quality (practice norms) influenced individual farm practice change. In addition, informal farmer sanctioning of practice norm violation was found to be a key part of the process by which farm practices that had a negative effect on water quality were challenged, and new practice norms were fostered. The collective farmer resistance to regulation and the actions of a farmer-led collective action group were in fact resistance to an intervention that was perceived to challenge their social norms, their identity as 'good farmers' and to disregard their local knowledge; not resistance to practice changes that will improve water quality.

Dairy farm management practice change is a social process of exchanging information and knowledge, questioning, challenging current practice and reinforcing what is considered accepted practice around farming and water quality. This understanding provides a valuable contribution to the design and implementation of environmental policy interventions.

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I am an off-road endurance runner and off-road triathlete. I love mountains, the bush, the sea and being in the back country. Training for and competing in long distance endurance events was an integral part of my PhD. Endurance training, racing, and doing a PhD all require the same mental and physical endurance that keeps you going on the tough days, and makes your heart sing on the good days. A PhD is just like running an ultramarathon or doing an ironman – one foot in front of the other until you reach the finish line.

Table of Contents

List of Figures and Tables

List of figures

List of tables

Abbreviations and Symbols

AES	Agri-environment scheme
CAP	Common Agricultural Policy
cm	centimetre
DCSA	Dairying and Clean Streams Accord
EU	European Union
FDE	Farm dairy effluent
FDEA	Farm Dairy and Environmental Assessment
GPS	Global Positioning System
GST	Goods and services tax
ha	hectare
kg	kilogram
km	kilometre
km^2	area measurement
LAWF	Land and Water Forum
l	litre
LUC	Land use capability
MS	Milk solid
M	million
m	metre
m^3	volume measurement
mg	milligram
mm	millimetre
NPS	National policy statement
NPSFM	National Policy Statement Freshwater Management
NZ	New Zealand
NVZ	Nitrate Vulnerable Zone
N	Nitrogen
NIWA	National Institute of Water and Atmospheric Research
OAD	Once a day
OECD	The Organisation for Economic Co-operation and Development
PCE	Parliamentary Commissioner for the Environment
PKE	Palm kernal extract
P	Phosphorous
POP	Proposed One Plan
QCONZ	Quality Consultants New Zealand Ltd
RMA	Resource Management Act 1991
RPS	Regional policy statement
SDWA	Sustainable Dairying Water Accord
SOE	State of the Environment
SMP	Supplementary Minimum Price
TAD	Twice a day

TCEIS	Tararua Community Economic Impact Society
WMZ	Water management zone
WMSZ	Water management sub-zone
yr	Year
®	Registered trademark
™	Unregistered trademark

Chapter One
Introduction

Introduction

The impact of intensive agriculture on water quality is the focus of ongoing discussion and debate, and a discussion that is not unique to New Zealand. Governments, industry and organisations internationally have introduced water quality interventions to influence farmer behaviour and farm management practices, in order to improve water quality outcomes for individuals and society. As Blackstock, Ingram, Burton, Brown, and Slee (2010, p.5634) contend, ‘individual farmer decisions and actions do not take place in a social vacuum, but are shaped by ideas and practices negotiated by the social groups in which they are necessarily embedded.’ Dairy farmers’ responses to water quality interventions, and the socio-cultural dynamics that shaped these responses, are of fundamental focus in this thesis. As such, the words of American Rabbi, David Wolpe, set the scene for this thesis:

> ‘*People do not move singly through the world. We are in a web of connections, changed by the actions of others and affecting them in turn…We shape each other’s lives*.’ (16 September, 2015)

Chapter One is an introductory chapter. This chapter introduces New Zealand’s dairy industry, the impact of dairying on freshwater quality, water quality interventions, and the rationale for exploring dairy farmers’ responses to these interventions. The research aim and questions are presented, and this chapter concludes with the structure of this thesis.

An introduction to New Zealand’s dairy industry

Dairying is a significant and growing part of the New Zealand economy. In 2016, the dairy industry earned NZ$12.16 billion from the export of dairy and casein products which contributed some 17% of total export receipts (Statistics New Zealand, 2016). Based on these statistics, the dairy sector is the largest contributor to New Zealand’s total exports. The dairy sector’s contribution to the national economy has increased in recent years, for example, dairy export receipts (year end June) increased from NZ$5.19 billion in 2010 (Statistics New Zealand, 2010) to NZ$12.16 billion in

2016 (Statistics New Zealand, 2016). Future land-use modelling by Anastasiadis and Kerr (2013), predicts that the dairy industry will continue to grow and intensify (kg MS/ha), and as such, is expected to continue to be a significant contributor to the New Zealand economy.

The New Zealand dairy industry has expanded and intensified[1] in response to a strong global demand for milk products. International studies (Alexandratos & Bruinsma, 2012; Godfray et al., 2010; OECD, 2013a) suggested factors that have contributed to this strong global demand for milk products, including: structural changes in diet (increased consumption of livestock products), and an increasingly wealthy, more urbanised population in some developing countries. Expansion (a shift from traditional dairying areas), land use change (predominantly sheep and beef to dairy), and an intensification of existing dairy systems, have contributed to the increased dairy production in New Zealand. Intensification has largely occurred through a gradual shift from low input pastoral based systems, to higher off-farm input based systems, including inputs such as bought-in supplementary feed, nitrogenous fertiliser and irrigation in some areas (MacLeod & Moller, 2006; Parliamentary Commissioner for the Environment, 2004). Intensification has led to an increased average herd size, increased stocking rate (average cows/ha) and increased per cow production (kg MS/cow) since the mid-1970s (LIC, 2013).

An introduction to freshwater quality

The Prime Minister's Chief Science Adviser, Sir Peter Gluckman, initiated and guided a recent review of the values, state and trends of New Zealand's freshwater resources (Gluckman, 2017). This report described New Zealand's freshwater[2] as a 'taonga', or a 'treasure of great cultural, environmental, social and economic significance' (Gluckman, 2017, p.xviii). Human activity over time, and in particular, pressure from the rapid expansion of pastoral farming, urban development and industrial use, has changed the state (typically a decline) of New Zealand's freshwater quality (Gluckman, 2017). Water quality is defined as 'the physical, chemical and biological characteristics of a water body' (Gluckman, 2017, p. xxv). Water quality monitoring assesses these characteristics, and the wide range of indicators used reflects the multiplicity of factors that can affect water quality, and the multiple uses that water is put to. Freshwater quality and quantity is predominantly monitored by regional councils and the National Institute of Water and

[1] Intensification of agricultural practices in a New Zealand context is defined as 'any increase in farm inputs or farm production off-takes per unit area of land' (Moller et al., 2008, p.254).
[2] Freshwater is defined as streams, rivers, lakes, wetlands and groundwater resources (aquifers) (Ministry for the Environment, 2015).

Atmospheric Research (NIWA), and regional water quality state and trend[3] data is displayed on the Land and Water Aotearoa (LAWA) website. Monitoring data indicates that the overall current state of New Zealand's freshwater quality is variable: catchments with urban and pastoral cover have the poorest water quality, and the best water quality is found in catchments with natural land cover (e.g. indigenous forest) (Gluckman, 2017). Regional long-term trend data is also variable; both by catchment and by indicator (some indicators are improving while other are deteriorating)[4]. Gluckman (2017, p.28) summarised:

> The science is clear - New Zealand's fresh waters are under stress because of what we do in and around them. In particular, intensified agriculture, altered land use, industrialisation and urbanisation have created this stress.

A number of studies linked the expansion and intensification of the dairy industry, with a change (decline) in the state of New Zealand's freshwater quality (e.g. Davies-Colley & Nagels, 2002; Parkyn, Matheson, Cooke, & Quinn, 2002; Parliamentary Commissioner for the Environment, 2013, 2015; C. M. Smith, Wilcock, Vant, Smith, & Cooper, 1993). New Zealand's first comprehensive review of the state of freshwater quality in relation to agricultural land use, directly linked the poor condition of lowland waterways in agricultural catchments with non-point and point source discharges from agricultural sources (C. M. Smith et al., 1993). Further research by NIWA scientists on the effects of agriculture on water quality and the ecology of waterways nearly a decade later (Parkyn et al., 2002), made similar conclusions to those made in the earlier work by C. M. Smith et al. (1993). More recent research by the New Zealand Parliamentary Commissioner for the Environment (PCE)[5] suggests the state of fresh water quality in New Zealand is continuing to deteriorate in some catchments (Parliamentary Commissioner for the Environment, 2012, 2013, 2015). These PCE reports identified nutrients, pathogens, and sediment as the three freshwater contaminants of greatest concern in New Zealand. Figure One defines and describes these contaminants. The latest PCE update study (Parliamentary Commissioner for the Environment, 2015) raised concerns about the impact of increasing nutrient concentrations

[3] Trend data are evaluated to determine whether water quality is improving, deteriorating, or remaining about the same over the time period.
[4] Water quality state and trend data for the Manawatu-Wanganui Region are summarised in Chapter Six.
[5] The Parliamentary Commissioner for the Environment (PCE) is an independent officer of the New Zealand Parliament, and investigates environmental concerns.

on freshwater quality: increased nuisance (excess) periphyton growth[6] and an associated decline in aquatic insects and fish.

Freshwater contaminants in New Zealand
Nutrients: **nitrogen (N) and phosphorous (P) from animal urine, manure and fertiliser.**
Pathogens: Illness causing micro-organisms, such as viruses, protozoa and bacteria. ***Escherichia coli (E. coli)* live in the gut of mammals and birds. *E. coli* is commonly used as a bacterial indicator of the presence of pathogens in freshwater**, because high levels of *E. coli* in water indicate that human or animal faecal matter is present (Parliamentary Commissioner for the Environment, 2012).
Sediment: loose soil, rocks, mud and silt that are washed into rivers and streams (Horizons, 2013b). Sediment can transport phosphorous and pathogens to waterways.

Figure 1: Freshwater contaminants of concern in New Zealand.
Adapted from: (Horizons Regional Council, 2013b; Parliamentary Commissioner for the Environment, 2012)

The terms contaminant, pollution, non-point source and point source have specific meanings in New Zealand's environmental planning framework (Resource Management Act 1991) and in this thesis. A contaminant (also termed pollutant) is 'any substance (including gases, odorous compounds, liquids, solids, and micro-organisms) or energy (excluding noise), or heat, that results in an undesirable change to the physical, chemical, or biological environment' (Ministry for the Environment, 2007, p.407). Pollution is the discharge of a contaminant (or pollutant) that adversely affects the receiving environment. Non-point source (also termed diffuse) is pollution that does not have a single point of origin, for example, pollutants that are carried from agricultural or urban land into rivers by rainfall run-off, or that leach through soil into groundwater (Ministry for the Environment, 2007, p.418). In contrast, point source is the discharge of pollutants from a single fixed point such as a pipe, for example, discharges from wastewater treatment plants and factories (Ministry for the Environment, 2007, p.419). The terms non-point source and diffuse are used interchangeably in this thesis. In summary, the non-point source discharge of contaminants (nutrients, sediments and pathogens) from dairy farm systems is contributing to a change in the state of freshwater quality in New Zealand.

[6] Periphyton is 'the mix of algae, fungi and diatoms that grows on the beds of lakes, streams and rivers' (Horizons Regional Council, 2013b, p.23). Periphyton is a food source for aquatic insects, which in turn are a food source for fish. An excess of periphyton affects the chemical properties of water (e.g. reduced dissolved oxygen availability), reduces habitat, creates weedy waterways that are less aesthetically attractive for recreation (e.g. swimming), can clog irrigation intakes, and reduce the palatability of stock water (Horizons Regional Council, 2013b; Roygard, McArthur, & Clark, 2012).

An introduction to water quality interventions: Government and dairy industry responses to declining water quality

Dairy farming has contributed to a decline in New Zealand's freshwater quality, and the public expects dairy farmers will change their farm management practices that impact on water quality. In response to scientific evidence and increasing concerns, the New Zealand government (central and regional) and dairy industry progressively introduced a suite of water quality interventions. Water quality interventions are commonly categorised into four types: regulatory (e.g. rules in a regional plan), economic (e.g. fencing materials subsidy), voluntary (e.g. industry accords) and educational (e.g. provision of advice and information). These interventions were designed and introduced to mitigate non-point source discharges from agricultural sources to freshwater by encouraging and enforcing farm management practice change. Central government enacted legislation to control the effects of development on the environment (the Resource Management Act 1991 - RMA), and set the direction for water management in New Zealand by developing national policy to guide local government decision making. The National Policy Statement for Freshwater Management (NPSFM) came into effect in 2011, and was revised in 2014 (Ministry for the Environment, 2011, 2014). The eleven regional councils (regional government) in New Zealand are responsible for the management of freshwater resources in their region (among other natural resources). National policy (NPSFM) guides regional council decision making around water management, and commonly used regional council interventions must implement the objectives of the NPSFM. Regional councils interpret the RMA in different ways and use different approaches (e.g. rules in a regional plan, economic incentives, education) to manage freshwater quality in their regions.

The dairy industry responded by developing two successive voluntary industry accords to reduce the impact of dairy farming on water quality. The initial Dairying and Clean Streams Accord (DCSA), introduced in 2003 and expired in 2012 (Fonterra, Local Government New Zealand, Ministry for the Environment, & Ministry of Agriculture and Forestry, 2003), was replaced by the more comprehensive Sustainable Dairying Water Accord (SDWA) in 2013 (DairyNZ & DCANZ, 2013). The SDWA aims to enhance the performance of dairy farming as it affects freshwater, and sets out the good management practices that are expected of all dairy farmers in New Zealand. In support of the dairy industry accord and regional council policy, New Zealand's biggest dairy company (Fonterra Dairy Co-operative) implemented a programme of on-farm initiatives to support and encourage farmer behaviour change (Supply Fonterra) in 2012. This thesis explores dairy farmers' responses to the regulatory, voluntary, economic and educational water quality interventions that operate in one regional council region of New Zealand: the Manawatu-Wanganui Region.

Why explore dairy farmers' responses to water quality interventions?

There is a scarcity of literature exploring dairy farmers' responses to environmental policy interventions designed to mitigate non-point source discharges to freshwater, and, the socio-cultural dynamics that influence farmers' responses to these interventions. This thesis contributes to the gap in understanding identified in Blackstock et al.'s (2010) literature review, which concluded: 'there has been little research that specifically examines the socio-cultural aspects of how stakeholders interpret, translate and respond to measures designed to mitigate diffuse pollution' (p. 5632). As previously argued by Blackstock et al. (2010), farmers do not farm in a social vacuum, but their decisions and actions are shaped by the individuals and social groups they interact with. The influence of social interactions on farmers' responses was also emphasised by Boxelaar and Paine (2005). They suggested Australian dairy farmer behaviour is '…the product of the broader social system of which a farmer is part' (Boxelaar & Paine, 2005, p.11), and recommended that 'interventions designed to improve water quality and biodiversity need to address a social system, rather than individuals or a collection of individuals' (p. 18).

From this socio-cultural context, the farm management research presented in this thesis uses a social capital framework to explore dairy farmers' responses to the interventions designed to mitigate diffuse pollution to waterways. Social capital in this thesis follows Robert Putnam (Putnam, 1995), who defines social capital as 'the features of social life—networks, norms, and trust – that enable participants to act together more effectively to pursue their shared objectives' (p. 664-665). In this research a social capital lens sheds light on the influence of social interactions through networks, the dynamics of trust, and social norms on dairy farmer behaviour. As will be demonstrated, these socio-cultural elements are key to shaping dairy farmers' decision making around farming and water quality.

Research aim and research questions

The aim of this doctoral research is to explore dairy farmers' responses to water quality interventions, and the socio-cultural dynamics that shaped these responses. Understanding these dynamics will assist individuals and organisations work with, rather than seemingly against farmers, in order to better inform and support farmers in a transition to farm management systems with less impact on water quality.

The research questions that guided this research are as follows:

- *How and why have New Zealand dairy farmers responded to water quality interventions?*
- *What role did social capital play in shaping dairy farmers' responses?*

Influence of the researcher

It is argued in social research, that the researcher is an influential component of what is being studied (Fries, 2009). In order to maintain what Bourdieu (2003, p.282) terms 'participant objectivation', he insists on reflexive sociology, or, a researcher recognising how their interpretation and understanding influences the research process and findings produced (Fries, 2009).

My perspective as a researcher is shaped by my consultancy experience with farmers, their communities, their industry, and the individuals and organisations who work with farmers. The socio-cultural dynamics that shape farmer decision making have always fascinated me. I'm intrigued by the unspoken understanding of how things happen in farm communities (you know what is accepted), and the way farmers share their knowledge and learn from other farmers. It's thought-provoking to see farmers watching and at times emulating what they describe as the 'good farmers', hear farmers talking about the 'bad farmers', and to observe how farmers' ideas about 'good' and 'bad' farming have changed over time. Farmers choose to work with some individuals and organisations above others, and watching how the dynamics of trust shape these relationships is fascinating. However, I am concerned about the lack of understanding and growing social distance between farmers and the public, particularly when farmers are increasingly in the spotlight for farm management practices that impact on water quality. From my perspective as a researcher, a social capital framework provides an effective way to explore the socio-cultural dynamics that shape dairy farmers' responses to water quality interventions.

Thesis structure

This thesis comprises ten chapters. Chapters One, Two, Three and Four establish the research rationale and structure. Chapter Two reviews social capital theory, and Chapter Three reviews the empirical literature around farmers' responses to interventions. The qualitative research and thematic analysis strategies used in this thesis are described in Chapter Four.

Chapters Five and Six provide context for this thesis. Chapter Five takes an international and national perspective, and examines the socio-cultural, political and economic factors that shaped the introduction of water quality interventions in New Zealand. This chapter also presents the national water quality interventions. Chapter Six takes a regional perspective, and presents the Manawatu-Wanganui Region, the research site, regional interventions, and the regional actors involved in farming and water quality. This chapter also summarises the farm management systems used by the farmers in this research.

Chapters Seven and Eight present the results. Chapter Seven explores the farmers' and the community's response to water quality interventions, and tells stories of response through the voices of the farmers, the staff who work with farmers, and a member of the collective action group. The second results chapter, Chapter Eight, also uses narratives to explore how the relationships between farmers, and between farmers and others, shaped dairy farmers' responses to water quality interventions. Additionally, Chapters Seven and Eight strategically uses 'asides' as a method to link the farmers' stories of response, and the relationships that shaped their responses, with the theory discussed in Chapters Two (social capital) and Three (farmers' responses).

Chapters Nine and Ten analyse and discuss the findings. Chapter Nine compares and contrasts the findings in this research with the literature. The final chapter presents the insights gained from investigating Manawatu-Wanganui dairy farmers' responses to water quality interventions, and discusses the implications of the findings from this research.

Chapter Two
Social Capital

Introduction

The theoretical framework used in this thesis is outlined and reviewed in this chapter. The social capital theory presented in this chapter framed the research, and for that reason, the social capital literature precedes the empirical farmer response literature in Chapter Three. During this research it was identified that additional theory was required to help explore an evidenced transition, or a gradual shift from one system to a more sustainable system in response to a slow societal change (Rotmans & Loorbach, 2010). Social capital and transition theory are not commonly linked in the literature, but both theories share some commonality (networks, trust and norms). Chapter Nine uses transition theory to discuss the nature of the transition evidenced in this research.

In this chapter the various definitions of social capital are initially compared and contrasted, then the widely accepted three-way linking, bonding and bridging structure of social capital is presented. Following this, the role of networks, trust and social norms in creating social capital, and the relationship between these forms, are explored and examined. Finally, transition theory is presented and reviewed.

Defining social capital

French sociologist Pierre Bourdieu (1977, 1986), American sociologist James Coleman (1988) and American political scientist Robert Putnam (1995, 2000) are the leading theorists in the development of social capital theory. Bourdieu (1986) proposed that non-monetary forms of capital, namely cultural capital and social capital, can provide benefits for individuals. He defined social capital as 'the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition' (Bourdieu, 1986, p.248). Bourdieu's (1986) definition deduces that social capital has two parts: the amount and quality of resources individuals have, and the social relationships that allow individuals access to these resources. Furthermore, an individual's social capital is dependent on the size of their social networks, and the amount of economic (material property) or cultural capital each connection has. Bourdieu's cultural capital exists in three forms: in the embodied state ('long-lasting dispositions of the mind and body'), in the objectified state (in the form of cultural goods), and in the institutionalised state (such as educational qualifications) (Bourdieu, 1986, p.243). According to Bourdieu (1986), as a result of social capital, individuals can access economic resources and can increase their cultural capital through their contacts with others or with organisations.

Coleman's (1998) concept of social capital contends that social capital is a resource for action, and similar to other forms of capital, for example, physical, human and economic capital. Coleman's (1988) discussion about how social capital contributes to an individual's human capital is similar to Bourdieu's analysis of cultural capital. Coleman (1988, p.S98) emphasises the functional and structural nature of social capital, and suggests:

> Social capital is defined by its function. It is not a single entity but a variety of different entities with two elements in common: they all consist of some aspect of social structure, and they facilitate certain actions of individuals within the structure.

Social capital, Coleman (1988) argues, exists in the relations or social ties between actors, and occurs as a result of changes in the relations between these actors. Individuals can use social relations as a resource in order to achieve their desired outcomes. Coleman's (1998) social capital theory contends there are three aspects that can create a useful resource for individuals. The first aspect constitutes obligations ('people doing things for each other', p. S102) and expectations, where an individual expects another individual to reciprocate actions in the future. Expectations rely on the trustworthiness of the other individual. Coleman (1988) likened obligations to 'credit slips' that an individual can draw on to achieve their desired outcomes, and argues that individuals with high levels of obligations have more social capital as a resource to draw on. The second theorised aspect is the potential for individuals to access information through social relations, and the third, the social norms and accompanying sanctions that influence individual and collective behaviour. In Coleman's (1998) opinion, social norms specify actions that are considered correct or incorrect.

Putnam's (1995) social capital theory incorporates both an individual and a community perspective. He defines social capital as 'the features of social life—networks, norms, and trust - that enable participants to act together more effectively to pursue their shared objectives'

(Putnam, 1995, p.664-665). Putnam's (1995) social capital theory is underpinned by a belief that an individual's life is made more productive by their social connections with others. His social capital theory presumes that increased connections between individuals leads to increased trust (and vice versa), and that social connections sustain social norms, or 'the rules of conduct' (Putnam, 2000, p.20). Putnam (2000) extended his theory in later work to incorporate norms of generalised reciprocity: doing a favour for someone knowing that a favour will be returned at some point. He argues that reciprocity in society leads to efficiency, because 'honesty and trust lubricate the inevitable frictions of social life' (Putnam, 2000, p.135). Putnam's (2000) definition of social capital is one of the more widely used in theoretical and empirical research.

Coleman's (1998) conceptualisation of social capital focuses at the individual, family and group scale. He argues that individuals and families gain benefit by their ties with others, and groups (social and community) provide benefits to individuals. Putnam's social capital focuses on 'civic engagement' (Putnam, 1995, p.665), or people's engagement with their communities. From his seminal empirical research in Italy and the United States, Putnam (2000) strongly concluded that a trend of declining civic engagement contributed to reduced social connectedness, which resulted in a declining resource of social capital within communities. Even though their focus may differ, Coleman's (1998) and Putnam's (1995) social capital theories incorporate an individual and collective perspective. Individuals gain personal benefits from their social connections, and these social connections also benefit the group or community. Both scholars also emphasise the importance of trust, social norms and sanctions in sustaining social capital.

Bourdieu, Coleman, and Putnam in particular, emphasise the intangible nature of social capital. Unlike economic capital (e.g. money) or human capital, which Portes (1998, p.7) described as the capital 'inside an individual's head', social capital exists in the structure of relationships between individuals. In order to access social capital an individual must be connected with others, and Portes (1998) argues that others are the source of an individual's benefit.

Sociologist Lin (1999) defines social capital from a social resources perspective as 'resources embedded in a social structure which are accessed and/or mobilised in purposive actions' (p. 35). The basic premise underpinning Lin's (1999) social capital definition, that investing in social relations provides a return, is consistent with other social capital scholars (Bourdieu, 1986; Coleman, 1988; Portes, 1998; Putnam, 2000). From Lin's (1999) perspective, resources within social networks facilitate the flow of information, provide access to resources, exert influence for the benefit of an individual, certify an individual's social credentials to others, and reinforce an individual's identity. Lin's (1999) social capital perspective suggests that an individual's social capital is determined by how far their networks extend, and specifically, how an individual can access another individual's wealth, power and status.

A range of social capital definitions have been compared and contrasted. Scholars theorise that social capital has three forms, termed bonding, bridging and linking social capital (e.g. Putnam, 1995; Szreter & Woolcock, 2004). These forms of social capital are developed through the social relationships or ties between individuals, and these forms are discussed in the next section.

The forms of social capital

Coleman (1988) theorises that social capital develops as a result of the social relations and social structure between individuals. He further maintains that social structure is dependent on the strength of the ties between individuals. The nature of the social ties – or relationships – between individuals has been developed and discussed by a range of scholars (Coleman, 1988; Granovetter, 1973; Putnam, 1995).

Economic sociologist Mark Granovetter (1973) distinguished between strong and weak interpersonal ties. He argues that strong ties are based on relationships of longevity, reciprocity, intensity and intimacy between similar individuals (e.g. family and friends), and weak ties on more short-lived relationships between different individuals. Furthermore, he theorises that tie strength influences network structure. Weaker ties link individuals from different groups and less dense networks are formed, while stronger ties form more dense networks of similar individuals within groups. Granovetter's (1973) influential research was used by other scholars (e.g. Putnam, 1995) to develop theory on the different forms of social capital.

Coleman (1988) and Putnam (2000) discussed how the strength of the tie between individuals can create bonding and bridging social capital. Putnam (2000) argues that bonding social capital is created through strong ties or relationships between similar individuals (e.g. between family and friends), and involves closed dense networks where everyone is connected. In contrast, bridging social capital is created from weaker ties between individuals from different groups or networks. Granovetter's (1973) hypothesis that weak ties between individuals can act as a bridge, was one of his key contributions to understanding network structure. He proposes that a bridge between different networks can provide a path between individuals, break down barriers, and allow for the flow of information and influence.

Several scholars compared and contrasted bonding and bridging social capital (Putnam, 2000; Szreter, 2002; Szreter & Woolcock, 2004). Strong ties between individuals can create inward looking and exclusive networks (bonding), whereas weaker ties between diverse individuals are inclusive and can bring networks together (bridging). Where bonding networks provide social support, but can slow the transfer of new information, bridging networks can provide access to a wider range of new information and resources. While bonding social capital can reinforce shared social identities, bridging social capital can generate broader identities because individuals are from a wide range of backgrounds. Putnam's (2000) analogy is useful here. He described bonding social capital as a 'kind of sociological superglue' and bridging social capital as a 'sociological WD-40 (Putnam, 2000, p.23).

While the literature emphasises the positive outcomes of social capital, Putnam (2000) labels negative outcomes as the 'dark side' of social capital. Strong ties may reinforce social inequalities, particularly he believes, if social norms discriminate against others or networks are segregated socially. Putnam's (2000, p.358) exclusion themed question is thought provoking: 'Who is inside and thus benefits from social capital, and who is outside and does not?' Portes (1998) similarly cautions that strong bonding ties can lead to negative social capital. He identifies four negative consequences that can eventuate from strong bonding ties: exclusion of outsiders; extra claims being made on group members (e.g. for jobs and loans); group participation creating demands for conformity (e.g. constraints on individual freedom); and norms which can obstruct an individual's mobility in and out of a group. Portes (1998) argues that the strong bonding ties that can bring individuals together, can also exclude others. At a societal level, High, Pelling, and Nemes (2005) contend that strong bonds can slow the transfer of new information into a group, because they look inwards and distrust others.

Other scholars introduced and developed linking social capital as a third form of social capital (Adler & Kwon, 2002; Lin, 1999; Szreter, 2002; Szreter & Woolcock, 2004; Woolcock, 1998). Szreter and Woolcock (2004, p.655) define linking social capital as 'networks of relationships between people who are interacting across explicit, formal or institutionalized power or authority gradients in society'. While bridging and bonding social capital can be thought of as horizontal connections between individuals, Szreter and Woolcock (2004) described linking social capital as a vertical connection to reflect the power gradient evident in this form of relationship. Some scholars use the terms hierarchical or top-down to describe the vertical relationship between individuals and formal institutions (Adler & Kwon, 2002). Linking social capital is argued to exist between individuals and representatives of institutions or organisations, for example, governments, aid agencies, law enforcement and non-governmental organisations (Szreter, 2002; Szreter & Woolcock, 2004), and between social classes and the poor and rich in society (High et al., 2005; Szreter, 2002). Linking social capital can empower the community, and can give members of the community access to state resources and services, for example, development and aid programmes (High et al., 2005; Szreter & Woolcock, 2004).

Linking social capital is absent from Putnam's (2000) social capital theory. Some scholars criticise Putnam's focus on bonding and bridging social capital, his subsequent neglect of linking social capital, and believe he has paid little attention to the importance of the relationships between state and the community (Szreter, 2002; Woolcock, 1998). After presenting and discussing the three theorised forms of social capital (bonding, bridging and linking), the next sections explore the three elements of social capital: networks, trust and norms.

Networks, trust and norms – the elements of social capital

Networks

Social networks are the core component of the social capital theory proposed by leading social capital theorists Bourdieu (1986), Coleman (1988) and Putnam (1995, 2000). Although Coleman (1988) uses the term 'social structure' and Putnam (1995) and Bourdieu (1986) use the term 'connection', these theories contain similar network themes of social structure, connectivity and relationships. By definition, 'a network is composed of a set of relations, or ties, among actors (either individuals or organisations)' (Powell & Smith-Doerr, 1994, p.377). More simply put, a social network refers to the social connections among individuals (Putnam, 2000).

Connections through networks provide individual and collective benefits (Putnam, 1995, 2000). Networks provide emotional support and friendship, plus access to resources, information, and new contacts with other individuals (Burt, 2000; Coleman, 1988; Putnam, 1995, 2000). Coleman (1988) in particular emphasised the importance of information flows through information channels. He contends that social relations through networks provide access to information, and that information facilitates action. Networks facilitate the transfer of knowledge and learning, argue Reagans and McEvily (2003), and Burt (2000) believes that networks allow individuals to share beliefs. Networking is a commonly used term, and refers to gaining benefit from connections through networks (e.g. finding a job) (Putnam, 2000). As Putnam (2000, p.20) commented: ‘it’s who we know - not what we know’.

Furthermore, social capital theory posits that trust is built and social norms of behaviour are developed and fostered through social networks. Putnam’s (1995, 2000) social capital theory is underpinned by his ideas about connections. He argues that social connections involve mutual obligations, and these obligations sustain and encourage social norms of reciprocity. He also argues that increased connections through networks result in increased trust. The next section will review the theoretical literature around trust.

Trust

A range of disciplines, including sociology, psychology, organisational management, political science and natural resource management, debate and explore the complex concept of trust. While there are no agreed descriptions or definitions of trust, scholars agree on the importance of trust. Coleman (1988) introduced trustworthiness, or, being worthy of trust. He believes trustworthiness is the expectation that an individual or group will act in a particular way and will fulfil or repay an obligation. Putnam (1995) theorised that trust is developed through connections: the more that an individual connects with another, the more that individual will trust them (and vice versa). Trust is a property of the relationships that develop between individuals in Coleman’s (1998) and Putnam’s (1995) descriptions, and both scholars acknowledge that the level of trust is dependent on the strength of the relationship. Coleman’s (1988, p.S102) description in particular also emphasises behaviour that is based on expectations and obligations, and as he points out, ‘people are always doing things for each other’.

Political scientist Francis Fukuyama investigated social trust in his influential book *Trust*, and explored how social trust can maintain social order. A nation’s well-being and its economic prosperity, Fukuyama (1995) firmly maintains, depends on the degree of social trust inherent in society. If people don’t trust each other, he argues, rules, regulations and enforcement mechanisms are required to establish cooperation and expectations of behaviour. Fukuyama (1995, p.26) defined trust as ‘the expectation that arises within a community of regular, honest and cooperative behaviour, based on commonly shared norms on the part of other members of that community'. Similarly to Coleman (1988), Fukuyama's (1995) trust is underpinned by expectations of behaviour, and a recognition that trust develops when social norms are commonly adopted. Based on a review of cross-disciplinary literature, organisational management scholars Rousseau, Sitkin, Burt, and Camerer (1998, p.395), defined trust as a 'psychological state comprising the intention to accept vulnerability based upon positive expectations of the intentions or behaviour of another.' To accept vulnerability in this definition refers to an individual's willingness to rely on others. Risk and uncertainty create the opportunity for trust in their opinion, and they argue trust would not be needed if actions could be taken without risk and under complete certainty about whether others will act appropriately.

These descriptions and definitions share some general themes and suggest some important attributes of trust. Firstly, trust is underpinned by an expectation that other individuals will behave in a particular way currently and into the future. These expectations imply the notion of calculated risk taking: deciding to accept risk implies trust. Secondly, trust is based on moral obligations (social norms), and the adoption of commonly held social norms give individuals reasons to trust. Thirdly, trust promotes cooperation between individuals.

Trust is theorised to exist in a number of forms: individual, institutional (Rousseau et al., 1998; Sutherland et al., 2013) and social (Putnam, 2000). Individual (variously termed relational or personal) trust is the trust between individuals, while institutional (also termed organisational) trust, is the trust individuals have in formal institutions in society (e.g. government) or in organisations (Rousseau et al., 1998; Sutherland et al., 2013; Welter & Smallbone, 2006). Social trust is the generalised trust that individuals have in their fellow citizens (Putnam, 2000).

Confusingly, social trust is conceptualised differently by different scholars. Some scholars such as Putnam (2000) and Leahy and Anderson (2008) emphasise the general nature and broad scale of social trust. Social trust, to Leahy and Anderson (2008, p.103), is 'trust in people in general' (p. 103). Others such as Cvetkovich and Winter (2003), conceptualise social trust more similarly to other scholars' definitions of institutional trust (Rousseau et al., 1998). Social trust, to Cvetkovich and Winter (2003, p.287), is 'a willingness to rely on those who have the formal responsibility to develop policies and take actions'.

Putnam (2000) discusses social trust and clearly differentiates between social trust and institutional trust. He wonders whether institutional trust, or trust in government, is a cause or a consequence of social trust. Putnam (2000) made an interesting distinction between 'thick' and 'thin' trust (p.136). Thick trust, he argues, exists between individuals who know each other personally and are at a closer social distance. In contrast, thin trust or social trust, exists between 'generalised others' (p.466), or between individuals with minimal personal experience and are at a greater social distance. Putnam's thick trust appears similar to the individual trust described by other scholars (e.g. Rousseau et al., 1998; Sutherland et al., 2013). Putnam (2000) argues that a decline in social trust is linked to a decline in the social norm of reciprocity, or, the norm of helping others for mutual benefit. Furthermore, he linked declining social trust with an increasing reliance on mechanisms for social control (e.g. rules and regulations) rather than individuals relying on informal networks reinforced by reciprocity.

Various scholars suggest factors that can influence trust. Trust can be influenced by previous encounters and experiences (Prazan & Theesfeld, 2014; Rousseau et al., 1998 ; Welter & Smallbone, 2006), historical trustworthiness, attributes of the other party (Rousseau et al., 1998), the longevity of relationship (Emtage & Herbohn, 2012; Sutherland et al., 2013), and institutional performance (Kasperson, Golding, & Tuler, 1992; Sutherland et al., 2013). Furthermore, Rousseau et al. (1998) contend that institutional controls over behaviour can undermine institutional trust, particularly when formal mechanisms of control (increased rules and regulations) are used. Trust is underpinned by expectations of behaviour, and reliability and dependability from past interactions will lead to positive expectations about future interactions (Rousseau et al., 1998).

Kasperson et al. (1992) defined and explored the dynamics of trust in the process of developing a trust framework. They defined social trust as 'a person's expectation that other persons and institutions in a social relationship can be relied upon to act in ways that are competent, predictable, and caring' (Kasperson et al., 1992, p.170). In contrast to Putnam's (2000) definition of social trust, Kasperson et al.'s (1992) social trust appears to be a combination of individual and institutional trust. Kasperson et al. (1992) formulated a four-dimension (commitment, competence, care and predictability) three-level (cognitive, emotional and behavioural) framework to conceptualise the dynamics of trust. This trust framework conceptualises an individual's interactions with individuals and organisations, and an individual's interactions with society in general. According to Kasperson et al.'s (1992) framework, trust requires a perception of commitment to a goal, a fairness in decision processes, and the provision of accurate information (commitment). Additionally, trust is built when an individual or institution (organisation) is judged as technically competent over time (competence). Furthermore, trust is built when an individual perceives that another individual or organisation demonstrates concern or cares for others (care). Finally, trust relies on the fulfilment of expectations (predictability). Kasperson et al.'s (1992) social trust definition and trust framework is underpinned by expectations of behaviour, and moral obligations (social norms).

Trust is argued to be dynamic rather than static, because it is constantly developing, growing and declining over time (Fukuyama, 1995; Kasperson et al., 1992; Lewicki, McAllister, & Bies, 1998; Rousseau et al., 1998). Organisational management scholars Lewicki et al. (1998, p.339) argue trust ('positive expectations') and distrust ('negative expectations') are not opposites, but are linked as part of a continuum of trust behaviour. Actions, words and decisions contribute to the growth and decline of trust along this continuum. Trust is underpinned by expectations of behaviour, and trust declines from a violation of these expectations (Kasperson et al., 1992). If expectations are violated, either once or consistently, then an individual expects further violations. In general, Kasperson et al. (1992, p.169) summarised, 'trust is hard to gain and easy to lose'.

The role of trust in relationships has been reviewed. The literature argues that trust exists between individuals (individual), between individuals and institutions/organisations (institutional or organisational), and at a broader level between people in general (social trust). Previous interactions and encounters determine the level of trust and distrust in a relationship. Expectations of behaviour, or social norms, are developed and fostered through socialisation or interactions with others through social networks. The adoption of commonly held social norms provide individuals with the reasons to trust. Social norms are discussed in the next section.

Norms

Norms are the third core element of the social capital theories proposed by Coleman (1988) and Putnam (1995, 2000). Putnam (2000) described the social norm of generalised reciprocity, or helping others for mutual benefit, as the 'touchstone of social capital' (p. 134). He further argues that norms of reciprocity are 'fundamental to civilised life' (Putnam, 2000, p.135).

Norms are variously described and reported in the literature. Horne (2001) reviewed some of these descriptions and concluded that while some scholars consider a norm to be an all-encompassing term that includes formal and informal rules, others consider a norm to be an unwritten rule that is informally enforced. The latter are commonly termed social norms, and a component of the social capital theories in this research.

Many definitions of social norms abound in the literature. Elsenbroich and Gilbert (2014, p.4) defined a norm as 'a rule of conduct derived from a social behavioural expectation'; Opp (2001, p.235) as a 'statement about what is allowed, what ought or not ought to be done; and Horne (2001, p.4) as a 'statement that regulates behaviour'. Two main themes are apparent in these definitions: a moral imperative and expectations. Firstly, social norms have an imperative, a moral principle, or a sense of oughtness that compels people to act: what they ought to do or ought not to do. 'Oughtness', according to Hechter and Opp (2001, p.403), is 'an expectation that is shared by the members of a group'. Secondly, norms are other people's expectations of how an individual will behave in a given situation.

There is consensus, however, about what constitutes a social norm and how social norms operate. Social norms are unwritten rules that reflect society's shared beliefs and ideas about how people should behave (Eggertsson, 2001). Social norms 'maintain a stable social order', argues Fine (2001, p.139), through the shared expectations people have of behaviour they consider to be 'right and appropriate', or as Hechter and Opp (2001) termed it, behaviour that is considered to be acceptable. Norms exist through shared understandings and expectations. Fine (2001) discussed oughtnesss, and he believes that normative behaviour emerges and is negotiated through socialisation or interactions with others. He also contends that people learn what is accepted and unaccepted by observing others' behaviour, and by previous experience.

There is clear agreement that social norms are only effective with some form of enforcement system or sanction (Horne, 2001). The literature presents two main enforcement methods for norm violation: internalisation and external social sanctions. A norm is internalised, explains Horne (2001), when individuals either apply sanctions to their own behaviour, or follow a norm because they want to: they value the behaviour specified by the norm. For example, feeling guilty for violating a norm and feeling 'a warm glow' after compliance (Ellickson, 2001). Psychologists argue that the majority of social norms are internalised during childhood, as a result of socialisation, and cognitive and social development (Elsenbroich & Gilbert, 2014).

Norms can also be enforced externally through informal social sanctions. Informal sanctioning of norm violations by group members, Horne (2001) argues, is the main method of enforcing social norms. Informal social sanctions are based on the shared social agreement of what is considered accepted and unaccepted behaviour, or, a sense of what ought to or not ought to occur (Hechter & Opp, 2001). A sanction may include punishments (for actions that are considered unacceptable) or rewards (for accepted actions). For example, a punishment may be negative gossip or being ostracised from a group, while a reward may be a higher level of self-esteem or access to more opportunities (Ellickson, 2001). Social enforcement is a pivotal component of social norms (Horne, 2001). The 'social' aspect of social norms implies that externally applied social pressure motivates people to comply with a social norm (Horne, 2001).

It is commonly agreed that social networks develop and foster social norms (Hechter & Opp, 2001). Furthermore, some scholars argue that norms are more likely to emerge in close knit groups and societies compared with loosely-structured networks (Adler & Kwon, 2002; Coleman, 1988; Fine, 2001; Hechter & Opp, 2001). Closed networks, or networks where everyone is connected, maintains Coleman (1988), facilitates the emergence of effective norms, reduces risk, and thereby increases the trustworthiness of others. Norm violations are more likely to be detected and informally sanctioned in a closed network, and individuals who sanction others are more likely to be recognised and rewarded (Coleman, 1988). In a more open network, norm violations are more likely to go undetected and unpunished, thus people will be less trusting of one another (Adler & Kwon, 2002).

As an example of how social networks foster norms, Putnam (2000, p.118) described volunteering as a 'readiness to help others', or more simply, 'giving time'. He posits that social networks provide the channels through which norms of reciprocity are fostered and these social norms encourage volunteering. Putnam (2000) further argues that volunteering is an important indicator of social capital within communities: individuals who belong to social networks are more likely to give time and money to help others compared with those who are more socially isolated.

Hechter and Opp (2001) contend that social norms do not exist in isolation, but are linked to and influence other social norms. As such, a system of norms is theorised to influence behaviour (Hechter & Opp, 2001). Norms can operate simultaneously, and Cialdini, Reno, and Kallgren (1990) propose that in a given situation, an individual focuses more on one norm than another.

Furthermore, the norm that is more salient or more prominent in a given situation, will influence an individual's immediate behaviour (Cialdini et al., 1990). These scholars concluded that norm saliency is dependent on the individual's personal norms, cultural norms or the cultural rules within a society, and the particular situation or context.

Norms are not static, Ellickson (2001) argues, but evolve in response to a range of external factors. Norms can change in response to new scientific or technical information, changing environmental conditions (e.g. a drought), or changes within a group (e.g. members leave or join) (Ellickson, 2001). The rate of norm change is related to the time taken for group members to obtain knowledge about the new norm, which helps them understand that the new norm is more useful than the old one (Ellickson, 2001). Bicchieri and Mercier (2014) propose that norms change from people observing others' behaviour, for example, observing the 'trendsetters' or those who question existing norms and start behaving differently. Additionally, government interventions (e.g. rules and new sanctions) can facilitate behavioural change, by making it acceptable for individuals to behave differently to expectations and disobey accepted social norms (Bicchieri & Mercier, 2014). However, Bicchieri and Mercier (2014) caution that social change resulting from a law changes relies on an individual's perceptions of: 1. legitimacy of the law which can result in respect; 2. procedural fairness (decision seen as fair); 3. consistent enforcement; and 4. honesty of the law maker. Individuals also seek an opportunity to take part in the decision making process in relation to law changes, want to be listened to, and want their opinions considered. These factors result in a sense of moral obligation to obey the new law. The most important factor, Bicchieri and Mercier (2014) argue, is a shared sense that a new law is close to existing social norms, which they believe, ensures social sanctions of norm violation. The final section of this chapter presents a brief synopsis of transition theory.

Transition theory

Transition theory was introduced to help explore and understand the long-term gradual shift or transition identified in this research. Although a theoretical framework that links social capital and transition theory does not exist, networks, trust and norms similarly feature in both theories. Networks, trust and norms are the theorised components of social capital theory (Putnam, 2000). Transition theory indicates a normative orientation: complex social problems arise from changes in social expectations over time and from societal actors with different values and norms (Loorbach, 2010). A transition management governance approach for managing transitions emphasises the role of networks: societal actors gain benefit from working with others, share resources, learn, and influence social change through their social networks (Loorbach, 2010). Additionally, Grin (2010) argues that trust is both a requirement and a product for successful governance in the transition to more sustainable societies.

A transition is a gradual shift, or a transformative change from a current system (or regime) to another more sustainable system (Rotmans & Loorbach, 2010; Van der Brugge, Rotmans, & Loorbach, 2005). Transitions occur in response to a slow societal change, and are gradual long term processes that often span one or two generations, for example, 20-25 years (Rotmans & Loorbach, 2010). Furthermore, Rotmans and Loorbach (2010) claim that transitions involve a transformative change in structure (e.g. rules and regulations), culture (e.g. shared values and norms) and practices (behaviour).

The framework that underpins transition theory consists of three interlinked concepts: multi-phase, multi-level and multi-pattern (Rotmans & Loorbach, 2010; Van der Brugge et al., 2005). The multi-phase concept describes the temporal dynamics of transitions and includes a sequence of fast and slow phases in the change from a current to new regime. The multi-level concept views transitions as operating across macro (landscape), meso (regime) and micro (niche) scales. At the macro level, or the overall societal setting, developments are usually slow and autonomous in nature, for example, a global agreement such as the Kyoto protocol. At the meso level, regimes or systems of rules, structures, social norms, and practices, are more resistant to change as the actors involved want to retain the status quo. Short–term development occurs at the micro level, learning occurs, and new initiatives and management practices are created. The multi-pattern concept refers to the combination and sequence of mechanisms (e.g. adaptation, empowerment, and transformation) that occur during the dynamics of changing from one system to another.

Transition management is a governance approach that focuses on the management processes required to govern transitions (Van der Brugge et al., 2005). According to Markard, Raven, and Truffer (2012), transition management focuses on how societal actors can influence the direction and pace of transformation processes rather than analysing a transition and focusing on transition dynamics. Transition management encourages learning, collaboration, and creating open and dynamic networks between actors (Kemp & Loorbach, 2003). Van der Brugge et al. (2005) used transition theory to investigate the structural change or transition in Dutch water management over time. Their research highlighted a change in management style, from a technocratic scientific style towards a societal integrative style based on participatory processes rather than planning. A change in management style resulted in a change in relationships between actors.

Conclusion

A social capital framework is used in this thesis to explore the 'features of social life' that inform and influence farmers' responses to water quality interventions. As this chapter illustrated, social capital provides a lens through which the nature of the relationships farmers form with others can be explored. A social capital lens sheds light on the 'features of social life', or the influence of social networks, the dynamics of trust, and social norms on dairy farmers' individual and collective responses to interventions. As Robert Putnam (2000) argues, these features of social life, the three elements of social capital, enable individuals to work together more effectively.

Social capital is variously defined and interpreted by scholars, and the leading theorists' conceptualisations of social capital were presented and reviewed. Robert Putnam's (1995, 2000) definition of social capital is commonly used in empirical research, and his conceptualisation incorporates both an individual and a community perspective to social capital. Putnam differentiates between the bonding and bridging forms of social capital, but his neglect of linking social capital is criticised by other scholars. The three-way structural classification of bonding, bridging, and linking social capital, is widely accepted and used by social capital researchers.

The theoretical focus of this research is how social networks, trust and social norms influenced farmers' responses to interventions. Through social networks, information and knowledge are shared, trust is gained, behavioural expectations established, existing social norms shared, and new social norms developed. Relationships built on trust provide emotional support, enable access to resources and information, and result in the sharing of knowledge between individuals. Shared social norms, in combination with increased access to resources, information and the creation of knowledge, can influence an individual's behaviour.

Transition theory provided the theoretical framework to explore the long-term gradual change or transition identified in this research. A transition involves a transformative change in structure (e.g. rules and regulations), culture (e.g. shared values and norms) and practices (behaviour), and transition management is the approach that focuses on the governance of transitions. The next chapter reviews the empirical literature around farmers' responses to interventions. This review explores how farmers use their social networks, the pivotal role of trust, and how social norms influenced farmers' responses to interventions.

Chapter Three
Farmers’ Responses to Interventions

Introduction

The empirical literature exploring individual and collective farmer responses to interventions is presented in this chapter. Chapter One highlighted a gap in understanding the socio-cultural aspects of farmers’ responses to water quality interventions. The social capital (previous chapter) and farmer response literature (this chapter) provide the framework from which to discuss the socio-cultural aspects of farmers’ responses to water quality interventions in Chapter Nine.

The interventions commonly used in natural resource management are initially described in this chapter, followed by sections that explore the diverse ways that farmer response is reported in the empirical literature. Some studies explore individual farmer’s responses, others explore a collective farmer response, and these responses are presented in turn. The response section then examines farmers’ responses to intervention programmes (agri-environment schemes and Landcare), policy instruments, and industry interventions. The chapter concludes by presenting the empirical literature on how social capital, or the elements of (networks, trust, and norms) inform and influence farmers’ responses to interventions.

A description of environmental policy interventions and industry initiatives

Introduction

The interventions used in natural resource management (also termed policy instruments or mechanisms) are commonly categorised into four broad types: regulatory, economic, voluntary and educational (Jones, Sophoulis, Iosifides, Botetzagias, & Evangelinos, 2009; Moon & Cocklin, 2011; Murray, 2011). These interventions operate in different ways. Regulatory interventions enforce behaviour change through rules and regulations, whereas economic interventions encourage change through a financial advantage (or disadvantage) and voluntary instruments encourage change through motivation and social acceptance of a practice (Moon & Cocklin, 2011; Pannell, 2008). All interventions rely on education and the provision of information, claim Cocklin, Mautner, and Dibden (2007), and educational interventions are designed to empower individuals to make informed decisions (Moon & Cocklin, 2011). An intervention programme or strategy may use a combination of policy instruments to enforce and/or encourage behaviour change in the management of private land.

Blackstock et al. (2010) contend that interventions influence human behaviour. In the context of water quality management, a question can be posed: *How can farmer behaviour and farm management practices be influenced to improve water quality outcomes for individuals and society?* The theory in this section assists in providing answers to this question.

Regulatory interventions

Interventions that regulate or legislate against certain behaviour, are termed regulatory interventions. This type is variously termed command and control, or compulsory instruments, and are characterised by having a higher level of control over an individual's behaviour (Jones et al., 2009). Eckerberg (1997) described command and control interventions as 'hard', because they can be compulsory, rigid and exact. Under a command and control approach, a problem is identified, a solution developed, and the solution is implemented (Holling & Meffe, 1996). Holling and Meffe (1996, p.329) argue that control 'is a deeply entrenched aspect of contemporary human societies', and control is reflected in the wide variety of legislation used to govern human behaviour and land use activities. A command and control approach is expected to solve the problem (e.g. increasing nutrients in freshwater) either through control of the processes that created the problem (e.g. resource consents that control application of dairy effluent) or by improving the problem after it occurs (issuing a fine).

Economic interventions

Economic instruments (also termed market-based instruments) operate on the basis of economic incentives. Incentives can be categorised as either positive (e.g. subsidies), negative (e.g. taxes) or mixed (Jones et al., 2009; Pannell, 2008). Positive incentives encourage change by offering payments (subsidies), while disincentives (negative incentives) discourage practices that are believed to be more environmentally damaging (e.g. pollution taxes). Using Eckerberg's (1997) comparison of intervention types, economic instruments can be described as 'powerful' because the incentive changes the individual's economy, and through a consideration of self-interest, the individual can voluntarily choose to accept or reject the reward.

Economic theory suggests that market failure is one of the underlying causes of resource use decline and depletion (OECD, 1994). Market failure occurs when 'markets fail to properly value and allocate scarce resources because the right market signals are not being sent to resource users and decision-makers' (OECD, 1994, p.7). When markets do not capture the value of a resource, there is little economic incentive for individuals and producers to protect and preserve the resource. Moon and Cocklin (2011) contend that economic instruments are commonly used in an attempt to redress market failure. Economic subsidies offer positive incentives for change, and use what Pannell (2008) termed a beneficiary-pays mechanism, to encourage land owners to change their practices for environmental benefit. Under this mechanism, taxpayer funds are used to pay for subsidies and society benefits from the change in land use practice. For example, economic incentives encourage a change in land management practice by assisting landowners with the costs associated with best management practices (Moon & Cocklin, 2011). However, critics argue that economic incentives fail to address the underlying causes of environmental issues (Cocklin et al., 2007).

Voluntary interventions

Moon and Cocklin (2011) contend that voluntary interventions create a moral incentive for individuals to participate in a programme or to adopt a best management practice. Moral incentives exist when a behaviour is considered socially acceptable and equitable. Voluntary interventions are designed to encourage and motivate individuals to change their behaviour. By willingly choosing to change behaviour, the balance of power or control stays with the individual rather than the regulator (Murray, 2011). For this reason, Eckerberg (1997) described voluntary interventions as 'soft' compared with 'hard' compulsory regulatory interventions. Some common voluntary based intervention programmes, where farmers choose to become involved, include the Australian Landcare Programme (e.g. Cary & Webb, 2000; Compton & Beeton, 2012; Sobels, Curtis, & Lockie, 2001), and the agri-environment schemes (AES) of the European Union (e.g. Burton & Paragahawewa, 2011; Juntti & Potter, 2002; Lobley, Saratsi, Winter, & Bullock, 2013; J. Morris, Mills, & Crawford, 2000).

Voluntary interventions are usually supported by educational interventions (information and advice). Several scholars (e.g. Blackstock et al., 2010; Juntti & Potter, 2002; Moon & Cocklin, 2011; J. Morris et al., 2000) acknowledged the key role of information and advice in raising farmer awareness of environmental issues, changing farmer environmental attitudes, providing best management practice solutions, and encouraging a change in farm management practices.

An intervention introduced and self-regulated by industry (commonly termed industry initiative) is an example of a voluntary intervention. Industry initiatives are usually developed by industry in response to specific issues, and are often motivated by a combination of self-interest, a recognition of society's values, and industrial morality (the principles that define conduct and the public commitment to achieving these values) (Gunningham & Rees, 1997). Although there is no legal enforcement, government can be involved in the design and implementation of industry initiatives (Cocklin et al., 2007). Industry initiatives generally operate through a framework that establishes a set of guiding principles and general standards. As Gunningham and Rees (1997) explained, these general standards define the behaviours that industry believe will fulfil their public commitment, and individuals usually conform to these standards because of obligations and expectations of behaviour. Examples of industry self-regulation include codes of practice, environmental certification and eco-labelling (Cocklin et al., 2007). In New Zealand, the Dairying and Clean Streams Accord (Fonterra et al., 2003) and the Sustainable Dairying Water Accord (DairyNZ & DCANZ, 2013) are other examples of dairy industry initiatives. These industry accords were introduced by the New Zealand dairy industry in response to concerns about the dairy industry's impact on freshwater quality.

Educational interventions

Educational interventions (also termed communicative instruments) and the provision of information, commonly support the other policy interventions (Cocklin et al., 2007; Jones et al., 2009). Eckerberg (1997) described educational interventions as 'soft', which implies flexibility and voluntary compliance. Specifically relating to farming, Moon and Cocklin (2011) claim the purpose of these interventions, is to provide information and knowledge, raise awareness, improve decision making, and to encourage rather than enforce behaviour change. Examples of educational interventions include information (e.g. brochures, on-line resources), training events (e.g. field days, workshops, seminars), one-on-one advice, and award schemes (Cocklin et al., 2007; Moon & Cocklin, 2011).

A variety of communication channels disperse environmental advice and information. Common channels include policy organisations (e.g. government departments and regional councils), industry groups (e.g. DairyNZ), individuals (e.g. dairy company and regional council staff) and mass media (e.g. print, online and social media). The advice and information that flows through these channels is a policy instrument in its own right, or, can operate in support of other policy instruments (Eckerberg, 1997). After presenting intervention theory, the next sections explore farmer response: how response is used in the literature, the diversity of farmers' responses, and farmers' responses to intervention programmes, individual policy interventions, and industry initiatives.

Farmer response

The term 'response' is used extensively in the literature, commonly described, yet rarely defined. The Oxford English Dictionary defines response as 'an action or feeling caused by a stimulus or influence: a reaction' (Stevenson, 2010). Tompkins and Adger (2005) loosely defined response in the context of environmental change, as 'any action taken by any region, nation, community or individual to tackle or manage environmental change, in anticipation of that change or after change has occurred' (p. 564). Although Tompkins and Adger (2005) were exploring national climate change policy, aspects of their definition are useful in this research. Their definition acknowledges response can be at both an individual and community level, and that response occurs before, or after change. The next section uses these aspects of response and explores the diversity of individual farmer's responses to interventions.

The diversity of individual farmers' responses to interventions

This section presents the diversity of individual farmer's responses to interventions that are identified in the literature. As will be presented in this section, the majority of studies report response to an intervention as a change in farmer behaviour. Additionally, some studies explore changes in an individual farmer's characteristics in response to an intervention, for example, a change in understanding, attitude towards, or perception of a problem or an intervention (e.g. Botha, Roth, & Brown, 2013; Macgregor & Warren, 2016). In these studies, changes in individual farmer characteristics (e.g. a change in understanding) are responses to an intervention, and drivers of other responses (e.g. a change in behaviour).

The majority of studies interpret individual farmer response as a change in behaviour, and commonly as a change in farm management practice. A change in farm management practice is variously described by researchers, for example, adopting a best management practice (e.g. Bewsell, Monaghan, & Kaine, 2007; Greiner & Gregg, 2011; Lankester, Valentine, & Cottrell, 2009), and a change in farm management practice to mitigate environmental impacts (Macgregor & Warren, 2006, 2016). A large body of empirical literature explores European farmers' responses to agri-environment schemes (AES)[7], and these studies often describe behavioural response as a willingness to participate in, or the uptake of, an AES. Lobley et al. (2013) provide a useful summary of some AES farmer response studies. Some scholars found other farmer behavioural responses to interventions, the majority of which involve farmers interacting with others, including: joining a Landcare group (Compton & Beeton, 2012; Sobels et al., 2001); involvement in preparing the farm's nutrient budget (Bewsell & Brown, 2011); and seeking information, for example, attending a field day (Lankester et al., 2009; Mendham, Millar, & Curtis, 2007), trialling a new practice (Cotching, Sherriff, & Kilpatrick, 2009; Moon & Cocklin, 2011), and monitoring changes after a practice was introduced (Lankester et al., 2009).

Some researchers used behavioural approaches (C. Morris & Potter, 1995) to investigate farmers' responses to policy interventions. Using C. Morris and Potter's (1995) definition, a behavioural approach focuses on the attributes of the intervention and the individual characteristics of farmers, or, 'the motives, values and attitudes that determine the decision-making processes of individual farmers' (p. 55). Burton (2004a) termed these individual farmer characteristics as 'psychological constructs'.

Some researchers investigated farmers' attitudes, and, how farmers' attitudes influenced their behavioural responses to interventions. Some studies explored farmers' attitudes towards a single factor, for example, farmers' attitudes towards environmental management (Macgregor & Warren, 2016), natural resource management issues (Emtage & Herbohn, 2012), and environmental regulation (Barnes, Toma, Willock, & Hall, 2013). Other studies investigated farmers' attitudes towards multiple factors, for example, farmers' attitudes towards government, environmental problems, environmental laws and regulations (Bartel & Barclay, 2011), and conservation, pollution and Nitrate Vulnerable Zone (NVZ)[8] regulations (Barnes, Willock, Hall, &

[7] Agri-environment schemes are described in Chapter Five.
[8] Nitrate Vulnerable Zone regulations are described in Chapter Five.

Toma, 2009). These researchers identified that positive attitudes towards the environment or intervention are more likely to result in practice adoption (a behavioural response). Burton (2004a) criticises the studies he argues have an 'overwhelming emphasis on attitude as the main motivational determinant of behaviour' (p. 361), and believes the weakness of such work is to ignore the socio-cultural component of farmer response. He argues the relationship between attitude and behaviour is unreliable, and that attitudes to the environment are not necessarily reflected in on-farm actions. Furthermore, studies focussing on attitude, in his opinion, do not consider how culture (self-identity) and the influence of others (social norms) shape farmer decision making (Burton, 2004a).

Other psychological constructs, such as perception and emotion, received attention by some researchers. Other than Botha et al. (2013) who described farmers' perceptions as their 'views and understanding' (p.7) about a topic or intervention, the majority of researchers do not define or describe perception. Botha et al. (2013) and Barnes, Willock, Toma, and Hall (2011) both investigated farmers' perceptions of the compulsory water quality regulations that were enforced on farmers. Botha et al. (2013) investigated farmers' perceptions to new environmental policy, and Barnes et al. (2011) explored farmers' perceptions towards water management and NVZ regulations. Both studies found a farmer's perception of compulsory regulations influenced their behavioural response to the regulation: positive perceptions were linked with acceptance of change (e.g. adoption of a practice) and negative perceptions with resistance to the change expected by compulsory regulation.

Farmers' emotional responses to interventions are not widely reported in the empirical literature. Botha et al.'s (2013) research is one of a few studies specifically investigating farmers' emotional responses to compulsory policy interventions and change, and how these emotions influenced farmer behaviour. Botha et al. (2013, p.3) defined emotion as: 'A constant, vigilant process which periodically reaches a level of detection (i.e. a feeling) for the person or an observer (e.g. a friend or someone else)'. Similarly, they found positive emotions were linked with acceptance of change and negative emotions (e.g. shock and fear) with resistance to enforced change.

Some researchers identified a change in farmers' awareness and/or a change in understanding of an issue or an intervention as a response. Awareness was commonly described as recall of information, for example, having 'heard of' an intervention or components of a scheme (J. Morris et al., 2000). Other researchers identified a change in understanding as a response, for example, a change in farmer understanding about AES (J. Morris et al., 2000), sustainable land management (Mills, Gibbon, Ingram, & Reed, 2011), natural resource management issues (Sobels et al., 2001), and soil management (Cotching et al., 2009). Mills et al. (2011) in particular, clearly differentiated between a surface level change in individual farmer recall of information (change in awareness), and a deep level change in farmer understanding about an issue or intervention. They also linked a change in farmer understanding about sustainable land management, to a widespread change in farm practice (e.g. destocking).

This synopsis of empirical research highlights the diversity of ways researchers study individual farmers' responses to interventions. This synopsis also highlights the diversity of interventions or programmes that are focussed on agriculture and the environment. Some studies investigated farmers' responses to a specific intervention, for example, NVZ regulations (e.g. Barnes et al., 2009; Barnes et al., 2011; Macgregor & Warren, 2006, 2016). Other studies investigated farmers' response to an intervention type, for example, economic incentives (e.g. Mendham et al., 2007), and regulatory interventions (e.g. Bartel & Barclay, 2011; Botha et al., 2013). Others explored farmers' responses to more than one intervention type, for example, voluntary and economic interventions to encourage biodiversity conservation practices (e.g. Moon & Cocklin, 2011). A number of researchers investigated farmers' responses to intervention programmes, for example, farmers' responses to the European AES (e.g. J. Morris et al., 2000), and the Australian Landcare programme (e.g. Sobels et al., 2001). A few studies investigated farmers' responses to an industry initiative, for example, an industry accord (Bewsell et al., 2007). Furthermore, these studies are snapshots of farmers' responses and do not look back in time to investigate how history influenced current farmer response. Relatively few studies explore farmers' responses to a suite of interventions (voluntary, economic, educational, regulatory and industry initiatives), and even less explore response to a suite of interventions in light of the broader and temporal context within which they were introduced.

Worldwide, there is limited research of farmers' responses to the water quality interventions designed to mitigate diffuse water pollution. Most studies investigate farmers' responses to interventions designed to reduce the impact of nutrients on water quality. For example, compulsory NVZ regulations, Scotland (e.g. Barnes et al., 2009; Macgregor & Warren, 2016), regulatory controls over nutrient use, New Zealand (Botha et al., 2013), voluntary best management practices, Great Barrier Reef, Australia (e.g. Emtage & Herbohn, 2012), regulations that set nutrient limits, New Zealand (Duncan, 2013, 2016), and voluntary nutrient management technology, Denmark (Gachango, Andersen, & Pedersen, 2015). Some studies are more general, for example, Blackstock et al's (2010) literature review on farmers' responses to interventions designed to mitigate diffuse water pollution. Furthermore, these studies investigate farmers' responses to one water quality intervention. Very few studies investigate farmers' responses to a suite of interventions designed to improve water quality. Although Blackstock et al.'s (2010) literature review summarised how advice and persuasion influence farmer behaviour, they acknowledge that most diffuse water quality pollution solutions use a combination of voluntary, economic and regulatory instruments.

As highlighted earlier in this chapter, this research builds on and expands the work of Blackstock et al. (2010) and explores the socio-cultural aspects of farmer response to interventions designed to mitigate diffuse pollution. This research builds on and expands the empirical literature in six main ways. Firstly, this research interprets individual response as a change in farm management practice, a change in other behaviour (e.g. information seeking), and a change in individual farmer characteristics (e.g. understanding, attitude, perception, emotion). Secondly, this research explores the socio-cultural aspects of farmer response, and recognises individual farmer response is influenced by social norms and cultural factors. Thirdly, this research investigates response to a suite of interventions, rather than a single intervention type or programme. Fourthly, response is explored within an understanding of the broader context within which these interventions were introduced and explores how farmers' past experiences shaped their current responses. Fifthly, this research illustrates farmers' responses from both an individual and a collective perspective. Finally, this research explores how farmers respond to interventions that do not use subsidies to encourage participation. The next section explores a collective farmer response to policy interventions.

The diversity of farmers' collective responses to interventions

The term 'collective' is variously used by researchers in the empirical literature. Collective is commonly interpreted as collective action, or 'the action taken by a group (either directly or on its behalf through an organisation) in pursuit of members' perceived shared interests' (Mills et al., 2011, p.70). Examples of farmer collective action include collective AES, or AES schemes involving a group of farmers within a geographical boundary (Emery & Franks, 2012; Mills et al., 2011) and Landcare groups (Cary & Webb, 2000; Sobels et al., 2001). Emery and Franks (2012) used the term 'collaborative AES', and their concept of collaborative is similar to the collective action of Landcare groups described by other researchers. In their words, a collaborative approach 'provides space for interaction and normative shift among peers' (Emery & Franks, 2012, p.220). In these examples of collective action, farmers interact, learn and work together for the benefit of themselves, others and for the environment. Learning through social interaction, Blackstock et al. (2010) argue, is an effective way for farmers to share ideas and create knowledge. As such, scholars interpret social learning as a collective farmer response to interventions, and an informer and influencer of farmer responses. Several researchers found social learning contributes to farmer understanding, and a change in individual farmer behaviour (e.g. Cotching et al., 2009; Lankester et al., 2009).

Other scholars interpreted collective more broadly, and investigated the socio-cultural aspects that influence individual and collective farmer responses to interventions (e.g. Blackstock et al., 2010; Burton, Kuczera, & Schwarz, 2008; Burton & Paragahawewa, 2011). These researchers acknowledge that individual farmer behaviour is shaped by the dynamics, ideas and behaviour of the groups they belong to (Blackstock et al., 2010). Furthermore, Blackstock et al. (2010) argue that supporting and enabling a collective farmer response is crucial to managing 'common pool resources' (p. 5633) such as water. This interpretation of collective response encompasses the socio-cultural aspects of farmer response introduced at the start of this chapter.

A socio-cultural approach

The weakness and simplicity of behavioural approaches, Burton (2004a) argues, encouraged a shift towards cultural based approaches to investigating farmer decision making. The 'cultural turn' in agricultural studies, as Burton (2004a, p.360) describes it, focuses on 'the importance of understanding language, meaning, representation, identity, and difference'. Scholars, such as Burton and colleagues (e.g. Blackstock et al., 2010; Burton, 2004a, 2004b; Burton et al., 2008; Burton & Paragahawewa, 2011), suggest agri-cultures and farmer identity are major factors influencing individual and collective farmer behaviour, and responses to interventions. While acknowledging that other individuals influence farmer behaviour (normative pressure), Burton (2004a) argues that cultural and social influences are wider than normative pressures. Furthermore, empirical evidence suggests that in response to government schemes, farmers may resist change due to an anticipated loss of identity (Burton, 2004a, 2004b).

Burton (2004b) introduced the 'good farmer' metaphor. The concept of a 'good farmer' is based on identity theory developed by Sheldon Stryker and colleagues, and according to Stryker and Burke (2000), identity is socially constructed through the groups an individual associates with. Through interactions with groups in society, it is stated that individuals accept each group's understanding of the world as their own, and adopt the label of that group: 'I am a farmer' (Burton, 2004a). Stryker's identity theory also posits that individuals do not adopt a single identity, but hold multiple identities based on the social groups they identify with (Stryker & Burke, 2000). As Burton (2004b) summarised from one empirical study: 'Farmers want to farm. It gives them their identity and their sense of achievement' (p. 196). He argues that a 'good farmer' identity is tied to farmers' productive ability. The agricultural skills evident to other farmers are symbols of a farmer's farming ability (e.g. physical appearance of crops or livestock, tidiness of the farm), and these symbols signal a 'good' or 'bad' farmer to other farmers. He believes that farmers resist change based on an anticipated loss of their 'good farmer' identity, which he argues is tied to their loss of productive identity as farmers. Further research contends that environmental farming practices are not becoming accepted as symbols of 'good farming' practice, and as such, not being established in farming culture (Burton & Paragahawewa, 2011).

Social learning

Social interaction between farmers, argue Blackstock et al. (2010), is an effective way for farmers to share ideas and create knowledge. Social interaction is the heart of social learning, and as Reed et al. (2010, p.4) simply summarised, social learning occurs when 'the message is spread from person to person through social networks'. Social learning through collective groups (e.g. landcare groups), organised farmer activities (e.g. a field day) and informally through farmer networks (e.g. talking to other farmers) is both a response to an intervention, and an informer and influencer of farmers' responses to interventions. The empirical literature presents many studies of farmer social learning, and in particular, social learning about agri-environmental and natural resource management issues (e.g. Cotching et al., 2009; Lankester et al., 2009; Mills et al., 2011; Sobels et al., 2001). In these studies, social learning contributed to a change in understanding about the issue, and a change in farmer behaviour.

The social learning literature is diverse, and social learning is defined, understood and used in a number of ways (e.g. Harvey et al., 2013; Reed et al., 2010; Rodela, 2011). Some scholars argue social learning is the formal and informal individual learning (knowledge creation) that takes place through social interaction (Oreszczyn, Lane, & Carr, 2010; Reed et al., 2010; Rodela, 2011). The social learning process of sharing and exchanging experiences and knowledge, may be at an individual level or at a network level (Oreszczyn et al., 2010; Rodela, 2011). Other scholars believe social learning is a process of social change (Reed et al., 2010; Rodela, 2011). These scholars argue that individuals learn from each other, make decisions that shape wider society (wider than the individual), and enhance socio-ecological systems (coupled systems of human and nature). Reed et al. (2010, p.6) combined these two perspectives and defined social learning as 'a change in understanding that goes beyond the individual to become situated within wider social units or communities of practice through social interactions between actors within social networks'. Harvey et al. (2013) suggest the key components of social learning for natural resource management purposes, are an interaction and a sharing of knowledge between individuals, which results in a change in understanding and behaviour. The next section explores farmers' individual and collective responses to policy interventions.

Farmers' responses to policy instruments and industry initiatives

Introduction

The final section in this chapter reviews the empirical literature exploring how farmers individually and collectively responded to interventions in relation to water quality and other agri-environmental issues. The majority of studies explore farmers' responses to an intervention programme (e.g. AES or Landcare) or one policy instrument (e.g. voluntary, economic, regulatory, or educational). There is a scarcity of literature exploring farmers' responses to a suite of interventions.

In this section, farmers' responses to intervention programmes (AES and Landcare), policy interventions (voluntary, educational, economic and regulatory) and industry initiatives are initially reviewed. Intervention programmes are recognised entities (e.g. agri-environment schemes) and farmers responded to the programme rather than the specific policy mechanism used in the programme. The section concludes by examining how social capital, or the elements of (networks, trust and norms) inform and influence farmers' responses to policy interventions.

Farmers' responses to intervention programmes

European agri-environment schemes

European agri-environment schemes (AES) were introduced into European Union agricultural policy in the late 1980s, and offer financial incentives for individual farmers to adopt management practices that will enhance their environment (Lobley et al., 2013). Individual AES operate as single farm agreements. Even though the European AES model prescribes individual farm practices (Emery & Franks, 2012), AES are considered voluntary interventions because participation in an AES and choice of management options are optional. As Burton et al. (2008, p.16) summarised, voluntary AES have become 'a key policy instrument for conserving and enhancing the environment'.

A large body of empirical literature explores farmers' responses to AES. As highlighted earlier, farmers responded to the AES scheme as a whole, rather than responding to the interventions used (e.g. educational, economic incentives) to achieve the goals of an AES. While the majority of literature investigates individual farmers' responses to AES (e.g. attitudes, awareness and understanding), some researchers also investigate a collective response, for example, group based collective AES, social learning, and how socio-cultural aspects influenced individual farmers' responses.

Studies variously investigate individual farmers' responses to AES. For example, awareness and understanding of AES, participation in AES, resistance to AES, adoption of AES contracts, engagement with AES principles, and changes in management practice. Several studies report varied participation: while many farmers were adopting contracts, putting areas under management agreement and changing practice, other farmers were not (Lobley et al., 2013; C. Morris & Potter, 1995; J. Morris et al., 2000). Some researchers found varied farmer awareness and understanding of AES schemes. For example, the farmers in J. Morris et al.'s (2000) study were aware that farming negatively impacts on wildlife and the landscape, but had less knowledge and understanding of how an AES operates.

A range of studies found farmer resistance to AES. The factors contributing to farmer resistance varied. In earlier studies of farmers' responses to AES, researchers found some farmers considered AES intrusive, thought AES would restrict their autonomy and/or their freedom to make their own decisions, constrain productive farming, increase bureaucracy, and increase long-term uncertainty (Curry & Winter, 2000; C. Morris & Potter, 1995; J. Morris et al., 2000). Some farmers were concerned about increased public access to their land (C. Morris & Potter, 1995; J. Morris et al., 2000). C. Morris and Potter (1995) developed a participation spectrum based on farmer attitude towards AES, and this spectrum indicated the level of farmer resistance to AES measures. They classified farmers as either active (farmers committed to the scheme) or passive adopters (farmers were motivated by financial gain), conditional non-adopters (can be persuaded to join if farmer, farm or family circumstances change), or resistant non-adopters (would not participate under any circumstances). Although farmers were adopting AES contracts, C. Morris and Potter (1995) found high rates of passive adoption. These findings suggest behavioural change was motivated by financial reward, with limited farmer engagement with the schemes' environmental objectives and limited long-term change in attitude towards the environment. Lobley et al.'s (2013) more recent research summarised studies with similar findings to C. Morris and Potter (1995). Lobley et al. (2013) described farmer uptake of AES as considerable, yet summarised studies where farmers participated in AES for financial gain. Based on these studies, they concluded there is limited farmer engagement with the environmental principles of these schemes, and minimal long-term farmer attitudinal change towards the environment. Compared with other research that emphasises the diversity within agriculture, and the complexity of socio-cultural aspects that influence farmers' responses to interventions (Blackstock et al., 2010; Burton, 2004a), these findings of the factors influencing farmer resistance appear simplistic.

The majority of AES target individual farmers, establish single farm agreements, and the majority of empirical research investigates individual farmers' responses to agri-environment schemes. A few researchers investigated farmers' responses to collective AES, or AES involving a group of farmers in a geographic location (e.g. Emery & Franks, 2012; Mills et al., 2011). These scholars found that social learning and socio-cultural aspects, namely social norms and being a 'good farmer', can both encourage and discourage individual farmer behaviour change. Mills et al. (2011) found social interaction and knowledge sharing during farmer group activities, led to changes in individual farmers' understanding about sustainable management of their land. Shared norms (e.g. valuing traditional hill management practices) and trust were identified as key factors in influencing individual farmer behaviour. Emery and Franks (2012) investigated farmers' interest in collective AES (termed collaborative AES), and identified several 'cultural barriers' to a collective scheme. The farmers identified: a loss of autonomy and timeliness (ability to quickly respond to changing circumstances), where timeliness and flexibility are recognised attributes of a 'good farmer'; a lack of communication and mutual understanding of other farmers' motives; and a fear of scrutiny: that other farmers may judge their ability to be a 'good farmer'. The cultural factors identified by Emery and Franks (2012), builds on Burton's (2004a, 2004b) earlier work on how farmer identity influences farmer decision making.

Other researchers also investigated the socio-cultural aspects of farmers' responses to AES (Burton et al., 2008; Burton & Paragahawewa, 2011). Burton et al. (2008) reviewed a range of European studies, and summarised that although individual farmers were participating in AES schemes, there has been little enduring change in individual farmer motivation, environmental attitude, and long-term behaviour change. These studies suggested farmers were motivated to participate for commercial interests (financial rewards), and because little change in existing farm systems was required. Burton et al. (2008) contend that if farmers' attitudes towards the environment and behaviour are to change, AES must become integrated into the existing farming culture and become a 'symbol' of good farming. Once an AES scheme is established (e.g. fences erected), Burton et al. (2008) found farmers have limited opportunity to demonstrate their productive skills, or their 'good farming skills' (p.26), through conservation practices to other farmers. They concluded that AES have failed to change the farming culture from a production-led to a pro-conservation, or in Burton et al's (2008) words, to an 'environmentally friendly farming culture' (p. 30). Further work by Burton and Paragahawewa (2011) built on these findings. They contend that voluntary AES support a conventional farming culture, rather than encouraging a culture based on farming and the environment where environmental farming practices are accepted as part of 'good farming' practice. Additionally, they argue that 'little' long-term change in farmers' attitudes towards the environment are not resulting in changes in social norms, or in their words, not 'altering the culture of conventional farming' (Burton & Paragahawewa, 2011, p.96). As a result, they concluded that removal of financial rewards could result in farmers reverting to pre-AES social norms and behaviours.

The Australian Landcare programme

Landcare, the Australian Land Management Programme, was established by the Australian Federal Government in 1989 (Sobels et al., 2001). The voluntary National Landcare Programme is a federal government programme designed to encourage individual farmers to work collectively to improve natural resource outcomes (Compton & Beeton, 2012). Community landcare refers to the network of voluntary community groups established across Australia that are working towards sustainable land management (Cary & Webb, 2000). While Landcare and AES are both voluntary interventions, their approach differs. Landcare is a group-based scheme (individuals join groups, obtain group funding, undertake group projects), whereas AES offers payments to individual farmers and operates as single farm agreements. Collective AES are more similar in approach to Landcare groups. Farmers' responses to the Landcare programme and landcare groups are included in this review, because this voluntary intervention utilises a group- based approach (collective response) to encourage an individual farmer response.

Individual and collective farmer response to the Landcare programme is variously reported. Farmer involvement in community landcare is wide and varied. Many farmers are or have been a member of a landcare group (Cary & Webb, 2000), and many farmers have undertaken an individual or cooperative group project (e.g. revegetation, rabbit extermination) (Sobels et al., 2001). Farmers have participated in social learning. Through community landcare, farmers attended field days, group meetings and training courses where they discussed issues and best practice with farmers and others, shared ideas, and observed other farmers' practices (Sobels et al., 2001). Sobels et al. (2001) contends that knowledge creation through landcare has resulted in landholders with an improved understanding of natural resource management issues.

Through community landcare, group members were found to feel empowered and more in control of their decisions (Compton & Beeton, 2012; Sobels et al., 2001). Group members work with and lobby government, deal with bureaucracy, and write funding proposals. Group members were found to feel more confident to choose and trial methods to address the natural resource management issues facing their group (Compton & Beeton, 2012; Sobels et al., 2001). Sobels et al. (2001) also found that as a result of landcare, group members have an increased ability to adapt to change. The next section explores farmers' responses to the four intervention types: voluntary, educational, economic and regulatory.

Farmers' responses to voluntary, educational, economic and regulatory interventions

The first part of this section investigates farmers' responses to interventions that encourage behaviour change (voluntary, educational and economic) and the second to interventions that attempt to enforce behaviour change (regulatory). Educational interventions commonly support other intervention types. Industry initiatives are voluntary interventions, but considered separately in this review because control is retained by industry rather than government as occurs with government instigated or funded voluntary interventions.

Farmers' responses to interventions that encourage change: voluntary, educational and economic

In these studies, farmers responded to a mix of interventions that encourage behaviour change. Although voluntary or economic interventions are the key policy instrument used, educational interventions (e.g. field days, printed information, advice) are commonly used to support these interventions.

Voluntary interventions encourage social interaction (Cocklin et al., 2007) and attempt to establish a moral incentive, or social acceptance of a practice, to ensure the practice is implemented (Moon & Cocklin, 2011). Studies investigating farmer response to voluntary interventions commonly interpret individual response as a change in behaviour, for example, adoption of recommended best management practices (e.g. Emtage & Herbohn, 2012; Lankester et al., 2009). A few studies found other responses, including: experimenting and trialling different management practices ('to see if there was any difference') (Cotching et al., 2009; Moon & Cocklin, 2011); and monitoring changes after practices were adopted (Cotching et al., 2009; Lankester et al., 2009). Additionally, Lankester et al. (2009) found farmers were sceptical of the government's scientific information about factors that can impact on water quality. The government's scientific information about water quality differed from the landholders' beliefs and observations about the factors that can contribute to water quality decline.

Some scholars identified a collective farmer response, and a collective influence over individual farmer adoption of best management practices. Both Cotching et al. (2009) and Lankester et al. (2009) found farmer group activities facilitated social interaction between farmers, and social interaction enabled farmers to share knowledge, learn and develop understanding through a social learning process. In Cotching et al.'s (2009) study, social learning contributed to a change in individual farmers' understanding (about soil management), and a change in farm management practices. Social learning among the farmers in Lankester et al.'s (2009) study contributed to a change in social norms (e.g. farmers questioning current farm practice, concerns about how other farmers view their riparian management practices), and this change in norms contributed to farmers adopting riparian best management practices.

Economic interventions encourage change by offering economic incentives. Most researchers interpret farmer response as participation in a subsidy programme, uptake of incentives, and adoption of best management practices. Mendham et al. (2007) found a spectrum of landholder participation: some landholders accepted incentives and changed behaviour (e.g. fencing and revegetation), some sought information about the incentive scheme, some attended field days and workshops (social learning), and some landholders did not participate. Mendham et al. (2007) identified a number of individual farmer factors that influenced farmers' non-participation in this subsidy scheme. These factors include: farmers' concerns about a loss of autonomy; decreased trust in government's intentions; a belief that accepting money would restrict their future farm management practices; a belief they were being unfairly criticised by the public; and a belief their contributions to native vegetation management were not being recognised or valued. Farmers' concerns about a loss of autonomy were similarly identified by scholars investigating farmers' responses to European agri-environment schemes (e.g. Curry & Winter, 2000; C. Morris & Potter, 1995; J. Morris et al., 2000).

Farmers' responses to interventions that enforce change: regulation

Regulatory interventions aim to control human behaviour by regulating or legislating against certain behaviour. Researchers commonly view response to a regulatory intervention as a change in individual farmer behaviour (e.g. change in farm practice). Many researchers also investigated how individual farmers' characteristics, such as attitude (Barnes et al., 2011; Bartel & Barclay, 2011; Macgregor & Warren, 2006, 2016), perception and emotion (Botha et al., 2013), influence a farmers' behavioural response to rules and regulations. In most cases, these researchers interpret a change in farmer characteristics (e.g. a change in attitude) as both a response to rules and regulations, and a driver of other farmer responses. Similarly to other researchers, Duncan (2013, 2016) reported farmers' responses as a change in understanding and behaviour, however, she also explored farmers' 'ways of knowing' water quality.

Duncan (2013, 2016) also responded to Blackstock et al.'s (2010) identified research gaps in understanding the socio-cultural aspects of farmers' responses to water quality interventions. She investigated New Zealand farmers' responses to the process used to set nutrient limits[9] to achieve agreed water quality goals, and to the regulatory intervention (a regional plan) that set the limits. Her research investigated how farmers and policy makers framed and conceived water quality, or their 'ways of knowing'. Duncan (2013) found general understanding of and acceptance of the water quality issue, general agreement that nutrient limits were necessary, and farm practice change (e.g. waterway fencing). Importantly, she also found a divergence between farmers and

[9] Nutrient limits and regional plans are described in Chapter Five.

policy maker's framing of the water quality problem: what farmers observe and know about their land differed from what science modelling was indicating. These findings support Blackstock et al. (2010), who emphasise that gaining agreement on the problem is crucial to influencing farmer behaviour change.

Duncan (2016) built on her earlier research (Duncan, 2013), and further investigated the divergence in farmers and policy makers problem framing, or, what she termed as 'ways of knowing'. She also investigated farmers' responses to Overseer[10]; a computer model commonly used as a regulatory tool by regional councils in New Zealand, to predict nutrient losses. Some farmers were sceptical of the results from Overseer, and others criticised policy makers for relying on a predictive modelling tool that is 'prone to assumptions and error'. She concluded that while policy makers rely on Overseer to develop their ways of knowing, farmers' ways of knowing are based on gut feeling, observations, and common sense.

In another New Zealand water quality study, Botha et al. (2013) investigated New Zealand farmers' responses to new regional council regulation in terms of their perceptions (of policy change), emotions (in response to change), and behaviour (farm practice change). These authors grouped farmers' perceptions of policy change as either negative (e.g. rules unfairly target farmers), ambivalent (e.g. science results about farming and pollution are inconclusive), or positive (e.g. farmers are guardians of Lake Taupo). Emotional responses ranged from shock, denial and fear because they believed these rules would threaten their farming operations, to feelings of inevitability and acceptance of environmental regulations. Behavioural responses ranged from no change to their current farm practices because of uncertainty about current and future regional council compliance standards, to making a management practice change. Botha et al. (2013) concluded that an individual's behavioural response to environmental policy is shaped by their perception and their emotions: negative perceptions and emotions were associated with resistance to change, and positive perceptions and emotions with acceptance of change.

A few studies investigated individual farmers' responses to the Nitrate Vulnerable Zone (NVZ) regulations introduced in Scotland to address declining water quality. Earlier studies by Macgregor and Warren (2006) and Barnes et al. (2009) found a range of individual farmer responses. The farmers in Macgregor and Warren's (2006) study were interviewed in 2002 before NVZ regulations were introduced, and were reluctant to change practice. They often used denial

[10] Overseer is described in Chapter Five.

of personal responsibility for river pollution to justify their reluctance, and these farmers rarely considered environmental impacts past the farm's boundary. Building on Macgregor and Warren's (2006) research, Barnes et al. (2009) found most farmers who operate within NVZ had not changed farm practices to improve water quality since the NVZ were designated in 2003. Additionally, most farmers in both studies felt negatively towards the NVZ regulations. The farmers in Barnes et al.'s (2009) study either did not believe the scientific evidence used to designate the NVZ or wanted proof that input reductions have a positive impact on water quality. Additionally, the farmers in the NVZ felt unfairly penalised by the restrictions placed on their farm practices, and wanted the restrictions to be more flexible. Some farmers felt the Scottish government was not listening to their concerns. Farmers in both studies were negative about bureaucratic process, for example, time spent on record keeping and complicated paperwork.

In later studies, Barnes et al. (2011) found most farmers had made some farm practice changes since NVZ regulations (e.g. fencing watercourses). Similarly to Macgregor and Warren's (2006) study, Barnes et al. (2011) also found a range of negative attitudes towards water quality regulations. They classified farmers based on their attitudes towards regulations. Farmers who were negative towards NVZ regulations, based on their perception it would increase workload and reduce income, were labelled as 'resistors'. Farmers who were disengaged and indifferent towards regulations were labelled as 'apathists'. However, in contrast to Macgregor and Warren's (2006) results, they did find some farmers (the 'multifunctionalists') who were aware of environmental and water quality issues and agreed with stated practices to reduce nitrogen use. More recent work by Macgregor and Warren (2016) builds on earlier work by Macgregor and Warren (2006) and by Barnes and colleagues (Barnes et al., 2009; Barnes et al., 2011). They found an increasing number of farmers were adopting farm practices designed to improve water quality (e.g. reduction in fertiliser use). They also found a shift in farmer attitude towards NVZ regulation since earlier studies. Most farmers did not express negative views towards NVZ, and some acknowledged the NVZ regulations had changed their attitudes towards the environment.

Other researchers also investigated farmer response as behaviour change (adoption of best management practices) and attitudes towards environmental regulation. Bartel and Barclay (2011) found the majority of Australian farmers in their study had negative attitudes towards government, environmental law and agricultural regulations, and as a result, more likely to defy regulations. A smaller group held positive attitudes, supported the government, and would be more likely to comply with regulations. Furthermore, farmers with more positive attitudes towards regulation and government were more likely to comply with regulation, and adopt best management practices to reduce environmental impacts.

Most studies of farmer response towards regulatory interventions focus on individual farmer responses with less attention to a collective farmer response. Although taking an individual farmer perspective, Botha et al. (2013) did note how peer support encouraged farmer practice change. The next section investigates farmers' responses to voluntary industry initiatives.

Farmers' responses to industry initiatives

In some situations, industry initiatives can be described as voluntary in nature (individual chooses to participate), and are developed by industry in response to specific issues facing the industry (Gunningham & Rees, 1997). There is limited international research on farmers' responses to industry initiated interventions, and in particular, little international research on industry initiatives around farming and water quality.

A few studies measured New Zealand dairy farmers' responses to the 2003 Dairying and Clean Streams Accord (DCSA)[11]. The DCSA established principles and farm practices around dairy farming and water quality and relied on social pressure to encourage farmer behaviour change. The DCSA was not a legally binding agreement and did not use economic incentives or regulatory interventions. The researchers investigating the DCSA, viewed individual farmer response as a change in behaviour (Bewsell et al., 2007) and a farmer's level of involvement (from high to low) in developing a nutrient budget for their farm (Bewsell & Brown, 2011). Bewsell et al. (2007) investigated whether the DCSA influenced farmers' stream fencing decisions, and found the majority of farmers fenced their streams for practical stock management reasons. Some fenced due to off-farm pressure and expectations (to conform with the DCSA). The farmers yet to fence did not perceive any stock benefits from fencing and did not feel pressured by community concerns to fence. In a later study, Bewsell and Brown (2011) found the majority of farmers in their study had a low involvement in the preparation of their farm's nutrient budget (e.g. spent little time and effort in gathering information), and had their budget prepared by another individual (e.g. fertiliser representative). Many farmers had a budget prepared to comply with the industry's requirements, and had little interest in using the results from their budget to assess

[11] The Dairying and Clean Streams Accord is described in Chapter Five.

their environmental impacts and change their farm management practices. There was no evidence in these studies of farmers being motivated by financial gain to change behaviour.

This synopsis of empirical farmer response studies highlights the diversity of ways scholars investigated farmers' responses to interventions. Firstly, some studies viewed response as behaviour change, and others as the individual farmer characteristics and socio-cultural aspects that influence farmer behaviour. Secondly, interventions operate in different ways: regulations remove choice and enforce change, whilst voluntary and economic interventions offer choice and encourage change. Educational interventions commonly support the other policy instruments. Farmers are different individuals, and as such, different individuals respond differently to different interventions. Thirdly, farmer resistance to a perceived loss of autonomy was commonly reported over many studies, to the majority of intervention types (regulatory, voluntary and economic), and intervention programmes (AES). Finally, scholars identified individual and collective farmer responses. Individual farmer behaviour was influenced by farmers' socio-cultural identity, or influence over what others consider to be accepted practice (the 'good farmers'). The final part in this chapter reviews how social capital, or the elements of social capital (networks, trust and norms), have been found to shape farmers' responses to interventions.

The concept of social capital and farmers' responses to interventions

Social capital is variously used in empirical research exploring farmers' responses to interventions. While some scholars use a social capital framework, scholars more commonly investigate how one or more elements of social capital (networks, trust and norms) influence farmers' responses. While some scholars specify the social capital framework they used in their research, for example Fisher (2013) and Compton and Beeton (2012) used Putnam's (1995, 2000) theory, others do not stipulate a particular social capital theory (Hall & Pretty, 2008). Putnam's (2000) social capital framework incorporates networks, trust and norms; however, some scholars (Compton & Beeton, 2012; Fisher, 2013) paid more attention to how networks and trust influence farmers' responses and paid little attention to social norms. In addition, the work by Hall and Pretty (2008), is one of the a few studies that explores how historical events and relationships ('the past') shape farmers' current responses towards government policy interventions and staff.

Coleman (1988) theorises that social capital develops as a result of the social relationships between individuals. Furthermore, social capital is argued to develop through the strength of the relationships between individuals. Bonding (between similar individuals), bridging (between different individuals) (Putnam, 2000), and linking (between individuals across a power gradient) (Szreter & Woolcock, 2004) forms of social capital are commonly described. The next sections review how the theorised elements of social capital, networks, trust and norms, shaped farmers' responses to policy interventions.

How social networks shape farmers' responses to interventions

A social network refers to the social connections among individuals (Putnam, 2000). Some scholars explored how the bonding, bridging and linking forms of social capital influenced farmers' responses to interventions. Low levels of linking social capital between farmers and government staff in the United Kingdom were reported by some researchers (Fisher, 2013; Hall & Pretty, 2008). Low levels of linking social capital led to reduced trust between the majority of farmers and government, and between farmers and government staff in these studies. As a result of low levels of linking social capital, farmers described disrespect for government policies and a reduced likelihood of adopting sustainable land management practices (Hall & Pretty, 2008); and reduced confidence in the government's abilities, doubt in the information provided, and a reluctance to seek advice from government staff (Fisher, 2013). A range of factors contributed to a low level of linking social capital: a lack of consistent and regular contact between farmers and government (Fisher, 2013), and/or reduced contact with government staff, high staff turnover rates, and policy solutions that lacked credibility to farmers (Hall & Pretty, 2008).

Other scholars investigated how bridging and bonding social capital influenced farmers' behaviour. While Fisher (2013) investigated farmers' responses to government bovine TB policy, some scholars studied voluntary landcare groups in Australia (Compton & Beeton, 2012; Sobels et al., 2001). The farmers in Fisher's (2013) study described high levels of bridging social capital with their veterinarian. These strong relationships, built on mutual trust and respect, provided emotional support during times of stress, and were a key source of new information and advice for farmers about policy and control methods. The farmers in this study were more likely to believe and act on information provided by their trusted veterinarian. The farmers also described high levels of bonding social capital with neighbours and other farmers, emotional support from family and friends, and the importance of knowledge exchange between farmers (social learning).

The networks operating within Landcare groups are purported to foster social learning, enable farmers' access to information, resources (e.g. funding) and support, and influence individual farmer behaviour change. Compton and Beeton (2012) found bridging and bonding social capital either encouraged or discouraged farmers to change their land management practices. The balance between bonding and bridging social capital in some groups (high bonding/low bridging) prevented farmers learning about new ideas ('more focussed on the old days'), and this resistance to change prevented the group from undertaking new land management activities (changing practice). In contrast, other groups had high levels of both bridging and bonding social capital, which resulted in increased access to information and resources (funding) and increased group activity. Sobels et al. (2001) found that shared learning through the bonding and bridging networks operating within landcare groups, increased farmer knowledge and understanding about land management. Additionally, farmers participated in group activities, changed on-farm practice (changed behaviour), were able to attract funding, and accessed emotional support from other farmers. Observing the land degradation on other farmers' farms, and talking with other farmers, provided emotional support and an ability for farmers to share common problems and experiences.

Other studies (Lankester et al., 2009; Lobley et al., 2013; Mills et al., 2011) have also found the importance of social learning, or learning from others through social networks, in bringing about practice change. In these studies, social learning occurred through established groups (e.g. landcare groups, collective AES), organised farmer activities (e.g. field days, training sessions) and informally through farmer networks (e.g. talking to other farmers, family, extension officers). All studies found social learning resulted in a change in farmer behaviour, for example, an increased uptake and adoption of AES practices (Lobley et al., 2013; Mills et al., 2011), and the adoption of voluntary best management practices designed to improve water quality (Lankester et al., 2009). In addition, Mills et al. (2011) found being part of the group increased social interactions and increased trust and respect.

This synopsis of studies highlights how social networks informed and influenced farmers' responses to policy interventions. The farmers in these studies learnt through their bonding (e.g. other farmers, family), bridging (e.g. extension officers) and linking networks (e.g. government staff) about the farm practice changes encouraged by policy interventions. Additionally, farmers gained access to resources through their bridging and linking networks (e.g. funding, subsidies), and felt supported by relationships with trusted individuals in their bonding and bridging networks. Individual and organisational trust was a key component of the relationships identified in many of these studies. The next section will review the role of trust in shaping farmers' responses to policy interventions.

How trust shapes farmers' responses to interventions

The literature emphasises 'the importance of contact from a trusted source' in influencing farmer behaviour change (Blackstock et al., 2010, p.5632). A range of research investigated how individual trust (between individuals) and/or organisational trust (between an individual and an organisation or institution) influenced farmers' responses to interventions. In terms of individual trust, studies found trust between a farmer and another individual influenced the farmer's use of and belief in information, and behaviour change. The landholders in Emtage and Herbohn's (2012) research preferred to obtain their information about best management practices from other farmers rather than agency staff, because farmers were perceived as a more trusted information source. Similarly, Fisher (2013) found farmers doubted and disregarded information from less trusted sources (e.g. government), and used, believed and acted on information from trusted sources (e.g. their veterinarian).

Researchers identified some of the factors that can influence individual trust and farmer access to information. Individual trust can depend on previous experiences with specific individuals (Prazan & Theesfeld, 2014) and on longevity of the relationship (Emtage & Herbohn, 2012; Fisher, 2013; Sligo & Massey, 2007; Sutherland et al., 2013). Sutherland et al. (2013) found that long-standing service providers were a more trusted source of agri-environment information and advice for farmers, rather than other providers. The landholders in Emtage and Herbohn's (2012) study, historically used information from their trusted locally based extension officers, but after funding cuts and staff changes, those valued connections were lost, and landholders sought advice from other landholders.

In terms of organisational trust, a range of studies found low levels of organisational trust (distrust) between farmers and government adversely influenced farmers' responses to interventions (e.g. Emtage & Herbohn, 2012; Fisher, 2013; Mendham et al., 2007; Prazan & Theesfeld, 2014). Distrust between farmers and government adversely affected farmers': adoption of vegetation management practices (Mendham et al., 2007), use of government information about water quality management practices (Emtage & Herbohn, 2012), belief in information and use of government advice (Fisher, 2013), and participation in AES in the Czech Republic (Prazan & Theesfeld, 2014) and in England (Sutherland et al., 2013). Although the causes of organisational distrust were study specific, there were some common themes. The landholders in Emtage and Herbohn's (2012) study did not accept they were to blame for the marine pollution problem in the Great Barrier Reef, lacked confidence in the government's appraisal of the problem, and felt their autonomy, local knowledge and identity ('honour as responsible citizens') were being challenged. The landholders in Mendham et al.'s (2007) study were suspicious of current and future government intentions, and concerned about a loss of autonomy: that accepting government money for vegetation management practices may lead to future land management restrictions. The farmers in Fisher's (2013) study were frustrated by a perceived lack of government action to tackle bovine TB, a perception that government did not care about farmers, a lack of farming knowledge among government officials, and unpredictability from policy makers (changing direction).

Researchers identified some of the factors that can influence organisational trust and farmers' responses to interventions. In these studies, institutional trust was influenced by personal relationships with the staff of an organisation (e.g. Prazan & Theesfeld, 2014) and/or organisational performance (e.g. Sutherland et al., 2013). The level of organisational trust between some Czech farmers and government in Prazan and Theesfeld's (2014) research, was based on the farmers' previous experiences with government administration staff when applying for an AES. In particular, some staff member's arrogant and authoritarian approach, and lack of farming knowledge, reduced individual and organisational trust. Some of the English farmers in Sutherland et al.'s (2013) study distrusted the government agency (Defra) because of their previous experiences with Defra. In this study, the farmers' distrust of the government agency was influenced by their handling of the Foot and Mouth epidemic, and their perceived lack of practical farming knowledge.

This synopsis of farmer studies highlights the key role of trust in informing and influencing farmers' responses to interventions. These studies found the level of trust between a farmer and the information provider (government or non-government) will determine whether the farmer will believe and use, or challenge and ignore the information provided. The level of trust (or distrust) between a farmer and government staff may also affect whether a farmer may change behaviour.

The next section investigates how social norms influence farmers' responses to policy instruments.

How social norms shape farmers' responses to interventions

While social norms are recognised as influencers of behaviour, they are inherently complex and not widely studied. As such, the work by Minato, Curtis, and Allan (2010), is one of the rare studies that investigates how the social norms that operate within a rural community, and the sanctioning of norm violation, influence farmer behaviour. The majority of empirical research focuses on how social norms within formal (e.g. Landcare group) and informal groups (e.g. a workshop) influence farmer behaviour, with little attention given to how the social norms operating in a rural community influence individual and collective responses to policy interventions.

Voluntary and group interventions (e.g. Landcare) rely on the influence of social norms (individual behaviour is influenced by others) to encourage individual and collective farmer behaviour change. While investigating the role of a landcare group, Minato et al. (2010) identified some of the norms operating within their study community, how they developed and operated, and their impact on landholders' native vegetation management practices. Six norm types were identified: existing injunctive or 'oughtness' norms (e.g. ensures weed control 'ought' to be done); changing injunctive norms (e.g. social disapproval of a practice discourages the practice); descriptive norms (e.g. provides visible social proof that the practice is correct); personal or internalised norms (e.g. behaviour is preferred and guilt acts as a sanction); abstract norms (overarching norms, e.g. being a 'good neighbour'); and no tolerance norms (e.g. majority agreement about what is accepted behaviour). In un-published literature, Minato (2011) also identified agricultural practice norms, or the land management practices commonly accepted in this community.

Minato et al. (2010) found the Landcare group fostered existing norms around weed control and around welcoming newcomers to the district. Landholders held strong local norms around weed control, which gave community members the right to informally sanction others who did not control their weeds. Sanctioning norm violation in this community included direct (e.g. one farmer spraying another farmer's weeds, direct communication) and/or indirect action (e.g. judgemental gossip). The farmers preferred informal sanctions (community action) above formal sanctions (fines) to enforce norm violation. Strong local norms around welcoming newcomers to the district also existed in this community. Social networks informed newcomers to the district about the expected behaviours around weed control, and in turn, the newcomers shared their new ideas and information through social networks. The Landcare group contributed to new ideas and information being disseminated through social networks, and new information was the catalyst for new norms about vegetation management being formed (e.g. planting trees). The visual evidence of trees being planted provided 'social proof' that tree planting was 'what everyone did', and increased the likelihood that others would change behaviour and plant trees.

Other studies of Australian landcare groups similarly found a group approach both encouraged existing norms and the development of new norms (Cary & Webb, 2000; Sobels et al., 2001). Existing social norms of reciprocity (working together for mutual benefit) resulted in landholders changing their behaviour and working on cooperative land management projects for the benefit of others (Cary & Webb, 2000; Sobels et al., 2001). Sobels et al. (2001) found landcare group members were willing to invest time and energy in group land management projects, because group members expect others to do the same. Landcare also plays a role in changing practice norms, argue Cary and Webb (2000). They believe practices that were 'once treated with suspicion, are now widely accepted in rural and regional Australia' (Cary & Webb, 2000, p.20). The development of a landcare ethic within rural communities has resulted in a farming culture where more sustainable farming practices are accepted as normal rather than different to the norm, and the adoption of such practices is encouraged (Cary & Webb, 2000).

Other scholars (Emery & Franks, 2012; Lankester et al., 2009) identified how peer expectations influenced individual farmer behaviour. Lankester et al. (2009) found the Australian graziers in their study adopted best management practices in response to concerns about how other producers (their peers) would view their current riparian management. As highlighted earlier, the farmers in Emery and Frank's (2012) study felt other farmers may judge their farm practices, and were reluctant to participate in a collective AES.

This synopsis of studies highlights how social norms influence both individual and collective farmer behaviour. Group interventions foster existing norms and contribute to new norms being formed. The social networks that operate within groups inform individuals about expected behaviour, allow for informal sanctioning of norm violation, and share new information that acts as a catalyst for new norms being formed.

Conclusion

This chapter compiled and reviewed a range of international empirical literature exploring farmers' individual and collective responses to interventions. This review emphasised the diversity of the farmer response literature. The diversity originates from the variety of country and problem-specific interventions and programmes, and the variety of mechanisms used by governments and organisations to encourage and/or enforce farmer behaviour change. In addition, scholars investigated response differently: some used an individual farmer approach and others a broader socio-cultural approach.

Interventions are designed to influence behaviour, and the empirical literature commonly describes farmers' responses to an intervention as a change in individual farmer behaviour (change in practice). Additionally, several scholars presented a change in individual farmer characteristics (e.g. attitude, perception, emotion) as both a response to an intervention, and a driver of other farmer responses. A perceived loss of autonomy and associated resistance to the intervention was a commonly reported farmer response by many scholars, and resistance was reported to a range of intervention types and programmes. The researchers investigating individual farmer's responses generally found that positivity (e.g. a positive attitude or perception) results in a positive response (e.g. behaviour change), and negativity results in resistance to change.

Other scholars used a collective approach to interpret farmers' responses. Some scholars criticised the approach used in individual farmer response studies, an approach some regard as simplistic, because an individual approach ignores the influence of social pressure (the influence of others) and culture ('good farmer' identity) on individual farmer decision making. These scholars found that socio-cultural aspects can both encourage and discourage farmer behaviour change. In these studies, social pressure, or concerns about how others may judge their farming practices, can encourage farmers to change practice, and farmers may resist change based on an anticipated loss of their 'good farmer' identity.

Social capital theory posits that social capital is a resource existing in the relationships between individuals, and a resource that enables individual and collective action. Empirical research identified the importance of social networks in informing and influencing farmers' responses to interventions. In empirical studies, networks facilitated access to information, knowledge, support and resources, reinforced expected behaviour (existing social norms), and enabled informal sanctioning of norm violations. In addition, social learning through social networks was found to contribute to a change in farmer understanding, which contributed to change in farmer behaviour. New information flowing through social networks contributed to the development of new social norms, which contributed to a change in farmer behaviour. Empirical research also emphasised the pivotal role of trust in social interactions. In some studies, interactions based on trust were productive: farmers believed and used information and knowledge from those they trust, which resulted in a change in farmer understanding and behaviour. In other studies, interactions characterised by distrust resulted in farmers disbelieving and challenging the validity of information, and a reduced likelihood of behaviour change.

This research addresses an identified gap in the literature and explores the socio-cultural aspects of farmer response to interventions designed to mitigate diffuse pollution. Building on the literature reviewed in this chapter, this research investigates the multi-dimensional nature of farmers' responses: individual farmer response (e.g. a change in farm management practice, a change in other behaviour, a change in individual farmer characteristics), collective farmer response (e.g. resistance, social learning), and the socio-cultural dynamics that influenced individual and collective farmer responses. Using a social capital framework (networks, trust and norms), this research expands existing knowledge about how social interactions through social networks influence farmers' responses to interventions.

This thesis now moves to outline the research design used in this research. A single-case study research strategy was used to explore dairy farmers' responses to water quality interventions in the Manawatu-Wanganui Region. The empirical literature reviewed in this chapter will be used to discuss the findings from this case in Chapter Nine.

Chapter Four
Research Design

Introduction

Qualitative research of New Zealand dairy farmers' responses to environmental policy interventions is limited. This research seeks to answer two questions: *How and why have New Zealand dairy farmers responded to water quality interventions?,* and, *What role did social capital play in shaping dairy farmers' responses?*

This chapter describes the qualitative research strategy underpinning this research. I discuss the research design dilemmas I faced, and describe how learning about research design philosophy was a significant and stimulating research and personal journey. I also outline how I overcame these dilemmas, by designing a strategy that would ensure my research would assist in solving a 'real world' problem and provide a valid research framework for the academic requirements of a PhD. In this chapter, the research paradigm that defines this research is initially outlined, followed by the rationale for choosing a single-case study methodology. The process of case and within-case selection is presented, along with the data collection methods and an exploration of how networks, trust and norms would be conceptualised in the semi-structured interviews. Finally, the thematic data analysis method used in this research is described.

Philosophical approach

Understanding the philosophy and theory behind research design was a stimulating significant personal and research journey. I explored the literature, and learnt through Crotty (1998), O'Leary (2009, 2014) and Robson (2011). Using a metaphor of building a wall, Crotty (1998) provided the foundations or the theoretical framework, Robson (2011) provided the context, and from O'Leary (2009, 2014) I learnt which bricks to use (methodology and methods). Robson's (2011) 'real world' approach to social research was particularly insightful. I recognised that Robson's (2011) 'real world' focus neatly summarised the key components of my research: small-scale (rather than global); practical; grounded in local contexts; exploring the social dimension (people and their issues); carried out in the 'real world'; and exploring change.

Crotty's (1998) research process provided a useful start-point and framework to explore a research design to use in this social research. He argues that a researcher's justification for the choice of research approach and methods is shaped by their assumptions about how knowledge is generated. Crotty's (1998) definition of constructionism was a revelation for me, because it fitted with my beliefs about the world and how it could be understood and studied:

> …all knowledge, and therefore all meaningful reality as such, is contingent upon human practices, being constructed in and out of interaction between human beings and their world, and developed and transmitted within an essentially social context (Crotty, 1998, p.42).

From my constructionist epistemological perspective (Crotty, 1998), I believe 'meaning' is not discovered or created, but is constructed through people's interactions with each other and with their surroundings through practices and language. In this research, I assumed individuals and groups construct meaning in different ways in relation to the same event or thing. I also assumed different individuals and groups have different perspectives, contexts and ways of understanding the world, all of which they experience as real. I found Crotty's (1998) tree metaphor helped me understand meaning at this stage of my research journey, and in particular, how meaning can differ depending on the individual and their context:

> What the 'common sense' view commends to us is that the tree standing before us is a tree. It has all the meaning we ascribe to a tree. It would be a tree, with that same meaning, whether anyone knew of its existence or not…'Tree' is likely to bear quite different connotations in a logging town, an artists' settlement and a treeless slum (Crotty, 1998, p. 43).

In the context of this research, I assumed an individual's meaning is socially constructed. Water quality is declining, and the interventions put in place to change farm management practices are real and do exist. However, a farmer's interactions with individuals and organisations give meaning to, help farmers make sense of, and shape farmers' responses to the changes the water quality interventions will bring. In this research, I assumed farmers made sense, created meaning, and learnt from one another through their social networks, via relationships built on trust, and through the socially constructed agreements of behaviour. I also assumed that social learning, sense-making and meaning construction will inform and influence farmers' behaviour, emotions and perceptions. This constructivist train of thought had at least two implications for the decision-making process around the research strategy used in this research. Firstly, it acknowledges that farmers' responses are subjective and there is not one 'objective truth', and secondly, it implies that farmers' responses have different meanings and need to be explored in relation to their local context. Building from my constructionist view, the next section outlines the case-study research strategy and methods used in this research.

Research strategy

Following Robson (2011), this research is 'real-world' research in a real-life setting, and as such, explores the complex interactions between individuals and organisations within a rural community. I required a flexible research strategy in order to explore the nature of these complex interactions between individuals, how these interactions informed and influenced farmers' responses to interventions, and the changes these individuals made. I returned to Crotty's (1998) theoretical framework to further explore the research process, and to decide upon an appropriate methodology. I explored different methodologies, such as mixed methods (Johnson, Onwuegbuzie, & Turner, 2007), action research (Kemmis & Wilkinson, 1995; Parminter et al., 1999), and case study research (Stake, 1995, 2008). I also examined a range of different methods, including document analysis and semi-structured interviews (O'Leary, 2014), photo elicitation (Baldwin & Chandler, 2010; Maclean & Woodward, 2013) and focus groups (Robson, 2011). It was common to find conflicting opinions about the advantages and disadvantages of each of these methodologies and methods. While aspects of each of these methodologies appealed, I realised that a flexible qualitative research design was required to explore this complex phenomenon in its context.

Smart (2009) believes that everyday life is rich, complex and 'messy'. She advocates for a research approach that will capture this richness and messiness, and also advocates for a way to present the complexity of participants' stories. A qualitative case-study strategy was chosen as the most appropriate methodology for this research. Following Crotty (1998), case study research, or the investigation of one or more cases, is a logical extension of a constructionist epistemology. In this research, case-study research enabled an in-depth and holistic examination of a complex phenomenon in its multi-dimensional contexts (Stake, 2008). Stake (2008) further expanded on context, and in his opinion, context includes historical, physical, cultural, social, economic, aesthetic, ethical and political elements. In addition, case-study research has explanatory power, and enabled an exploration of 'how', 'what' and 'why'. Following Smart (2009), a case study research strategy enabled the richness, complexity, connections and 'messiness' of everyday farmer and community life to be captured. Additionally, a case-study research strategy provided a flexible and holistic approach to exploring temporal change, and the socio-cultural dynamics within a rural community. Case-study research has been subjected to a number of criticisms, including generalisability, the difficulty of summarising data from case studies, and bias being introduced by the researcher and others involved in the case (Flyvbjerg, 2006). Although case-study research does have some limitations, I believed the richness and in-depth understanding obtained from case study research outweighed these limitations. The implications of case-study research for the findings and insights from this research are explored in more depth in the conclusions chapter (Chapter Ten).

An important aspect of case study research is to define the unit of analysis, or more simply, what the case is. The phenomenon of interest in this research, is dairy farmers' responses to water quality interventions. Stake (1995, 2008) would describe this case study research as both instrumental and intrinsic. This research is instrumental because the case was chosen to provide insight into an issue (dairy farmers' responses to water quality interventions), and intrinsic because it has value in its own right.

Case study research involves the detailed analysis of a single case or the study of several cases (Stake, 1995, 2008). A single case was investigated in this research, because of the complexity of the case and the detailed data required to answer the research questions. The site for this single case-study research is one regional council region in New Zealand, because regional council policy determines which interventions are used to govern water management in that region. The results of this single-case study can be used to provide a basis for further research into farmers' responses to water quality interventions in other New Zealand regions.

Social capital is the theoretical framework used in this research to explore farmers' responses to water quality interventions. Researchers have used a range of methods to explore how social capital, or the elements of social capital, shaped farmers' responses to interventions. Some used mixed methods (e.g. Fisher, 2012; Hall & Pretty, 2008), and others used case study research (e.g. Graham, 2013; Minato et al., 2010; Sutherland et al., 2013). Using a case study methodology, Minato et al. (2010) investigated social norms, Sutherland et al. (2013) explored trust in agri-environment advisory services, and Graham (2013) examined trust and social relationships. It is therefore recognised that case study research is an effective way to explore how networks, trust and norms inform and influence farmers' responses to water quality interventions.

Research integrity

O'Leary (2009, 2014) emphasised the importance of research integrity and ethical responsibility in social research. In her opinion, integrity involves reaching conclusions that are not affected by bias or error, acting within the law, recognising and balancing any subjectivities or personal influences that an interviewer may have, and ensuring the rights and well-being of participants are protected at all times. As will be discussed in later sections, I used both methods (semi-structured interviews) and personal approach (built rapport and trust) to undertake credible and ethical research.

Ethics is about protecting the research participants, or in O'Leary's (2009) opinion, maintaining the mental and physical dignity and welfare of those being researched. Ethics involves researchers showing respect for cultural beliefs, treating participants in an equitable manner, obtaining informed consent from all participants, doing no harm during the research, and ensuring participant's confidentiality of private information (O'Leary, 2014). This research follows the Code of Ethical Conduct for Research Involving Human Participants (Massey University, 2015) and the procedures required by Massey University's Human Ethics Committee were completed. The ethical issues considered in this study include: respect for individuals; minimisation of harm; informed and voluntary consent; respect for privacy and confidentiality; avoidance of deception; avoidance of conflict of interest; social and cultural sensitivity; and justice. The purpose of the research and the information sheet (Appendix Four) were discussed at the start of each interview, participant's questions answered, and confidentiality issues discussed before the participants gave their informed and voluntary consent (Appendix Five). The confidentiality of participants was ensured by the use of pseudonyms. The transcriber signed a Transcribers Confidentiality Agreement to ensure all recordings remain confidential, and that no copies or records were kept by the transcriber. The next section presents the process used to select the case study site for this research.

Case selection

Selecting a case study site was the first research step. In consultation with my PhD supervisors, and using three pre-determined selection criteria, one region was selected from the 16 local government regions in New Zealand. The three selection criteria were:

1. A recognised dairying region that has a recognised freshwater quality issue;

2. Regional council and industry organisations introduced a range of regulatory, voluntary, educational and economic interventions in response to the freshwater quality issues in this region; and
3. Freshwater quality interventions in this region will have been in place for more than five years to allow dairy farmers time to respond.

The Manawatu-Wanganui[12] Region was chosen as the case study site for this research. This region meets the first criteria of being a recognised dairying region (LIC, 2014). From development of the first dairy factories in the region in the 1880s (Knight, 2014), industry statistics depict that based on the total number of dairy cows, the Manawatu dairy region[13] is currently the seventh largest (321,547 total cows or 6.4% of the total) out of the seventeen recognised dairy regions in New Zealand (LIC, 2016).

The Manawatu-Wanganui Region, managed by Horizons Regional Council, has a recognised decline in freshwater quality. Baseline water quality monitoring by the Manawatu Catchment Board in 1978 indicated poor freshwater quality in the Manawatu River catchment (Manawatu-Wanganui Regional Council, 1998b). Monitoring data has shown that freshwater quality in the region has continued to decline over time in some catchments, as reported in regional plans and strategies (Horizons Regional Council, 1997, 1999a; Manawatu-Wanganui Regional Council, 1998a, 1998b), scientific reports (Ballentine & Davies-Colley, 2009), and Horizons Regional Council's State of the Environment Reports (Horizons Regional Council, 1999b, 2005, 2013b). Horizons' 2005 State of the Environment report (Horizons Regional Council, 2005) identified that intensive agricultural land use, and in particular increased dairy farming, was contributing to declining regional freshwater quality.

Declining freshwater quality has necessitated the introduction of water quality interventions. A range of voluntary, economic, educational and regulatory policy mechanisms have been operative in the region for more than five years. At a national level, voluntary dairy industry water quality interventions were introduced in 2003. At a regional level, regulatory interventions have been operative since October 1998 (Manawatu Catchment Water Quality Regional Plan), and more

[12] The spelling of Wanganui in this research follows the legal gazetted name of the Manawatu-Wanganui Regional Council (without an 'h'), rather than the officially recognised spelling of the river (1991) and city (2012) as Whanganui (with an 'h').
[13] For the purposes of this research, the Manawatu dairy region includes the Tararua district because the Manawatu-Wanganui Region boundaries include this district. Industry statistics classify Tararua in the Wairarapa dairy region.

latterly, the targeted nutrient management focus of the One Plan (notified 2007 and operative 2014). The range of water quality interventions that are, or have recently been operative in the Manawatu-Wanganui region, are described in Chapter Six. The next section describes how the research site and participants were selected.

Within-case selection

After the regional council region was selected, within-case selection involved three stages: selecting a research site, selecting dairy farmers, and selecting key informants to interview.

Selecting a case study site within the Manawatu-Wanganui Region

The Manawatu-Wanganui region is a geographically large and diverse region and defined by the many and varied waterways and agricultural land uses[14]. A specific research site was required within this large and diverse region. The One Plan's geographic framework of water management zones (WMZ) and water management sub-zones (WMSZ) for water quality and quantity management purposes, provided a useful framework from which to also select a research site[15]. Based on the framework initially developed by McArthur, Roygard, Aussiel, and Clark (2007), the eleven parent catchments in the Manawatu-Wanganui region are divided into 43 water management zones (WMZ), which are further divided into 124 water management sub-zones (WMSZ). The WMZ and WMSZ are further classified as either targeted or non-targeted. Targeted WMZ and WMSZ are the zones where Horizons Regional Council believe the management of existing intensive farming land use activities must be specifically controlled to improve water quality. Horizons and DairyNZ[16] use different regulatory, voluntary, economic and educational interventions to achieve improved water quality outcomes in the targeted versus non-targeted WMZ. For example, the regulatory methods specified in the One Plan to control land management in the targeted WMZ (Rule 14-1), do not apply to the non-targeted WMZ.

Following the One Plan's water quality framework, choosing one of the eleven parent catchments was the first step in selecting a research site. The site must: 1. be a dairying parent catchment; 2. contain both targeted and non-targeted WMZ; and 3. all regional water quality interventions are

[14] Chapter Six contains a description of the Manawatu-Wanganui Region.
[15] Chapter Six describes the One Plan's geographic framework of WMZ and WMSZ.
[16] The role and function of Horizons and DairyNZ are described in Chapter Six.

in force. All dairy farms in the Manawatu-Wanganui region must hold a Dairy Effluent Discharge Consent, and Horizons Regional Council's Dairy Effluent Discharge database indicates 922 Dairy Effluent Discharge Consents were issued in the Manawatu-Wanganui region in 2015. Table One illustrates the number of dairy effluent discharge consents issued in the targeted and non-targeted WMZ in each of the eleven parent catchments. This data illustrates where dairy farms are located in the Manawatu-Wanganui region; the relative size of dairying in each of the eleven parent catchments; and the relative location of targeted and non-targeted WMZ.

Table 1: The number of Dairy Effluent Discharge Consents issued by Horizons Regional Council in 2015.

Parent catchment	Tot no. dairy effluent discharge consents (2013)	No. of dairy effluent discharge consents in targeted WMZ	No. of dairy effluent discharge consents in non-targeted WMZ
Manawatu	650	283	367
Rangitikei	111	92	19
West Coast	61	47	14
Whanganui	39	0	39
Wangaehu	21	0	21
Ohau	21	0	21
Lake Horowhenua	10	10	0
Turakina	9	0	9
East Coast	0	0	0
Akitio	0	0	0
Owahanga	0	0	0
Total	922	432	490

Source: Horizons Regional Council's Dairy Effluent Discharge Consents Database 2015.

The Manawatu River catchment is the parent catchment chosen for this research. This catchment is a dairying catchment, contains targeted and non-targeted WMZ, and all regional water quality interventions were used, including some that were focused in (e.g. the Dairylink project) or only applied to (e.g. the Tararua Stream Fencing campaign) this parent catchment. Following the One Plan water quality framework, the Manawatu River catchment is divided into 13 WMZ. Of the 13 WMZ in the Manawatu River catchment, seven are classified as targeted, five as non-targeted and one WMZ (Upper Gorge) contains both targeted and non-targeted WMSZ.

The Upper Gorge WMZ (Mana_9) is the selected research site. The Upper Gorge WMZ contains targeted and non-targeted WMSZ, and has subzones with different dates when the rules for management of intensive land use activities under the One Plan take legal effect (July 2014 and July 2016). This occurred because Horizons established a pilot programme to develop and trial the Land Use Consent application process in one of the Upper Gorge subzones (Mangapapa Mana_9b). Table Two indicates the five WMSZ in the Upper Gorge WMZ, and the relative number of dairy farms based on the number of dairy effluent discharge consents in each sub-zone.

Table 2: Targeted and non-targeted sub-zones in the Upper Gorge Water Management Zone.

Water management sub-zone	Targeted or non-targeted	Date rules take legal effect	No. of dairy effluent discharge consents
Mana 9a Upper Gorge	Targeted	1 July 2016	12
Mana 9b Mangapapa	Targeted	1 July 2014	7
Mana 9c Mangaatua	Targeted	1 July 2016	23
Mana 9d Upper Mangahoa	Non targeted		12
Mana 9e Lower Mangahoa	Non targeted		18

Source: Horizons Regional Council's Dairy Effluent Discharge Consents Database 2015.

The Upper Gorge WMZ was selected as the research site for four key reasons. Firstly, investigating farmers' responses within the same WMZ would ensure consistency across McArthur et al.'s (2007) water management zone framework criteria[17]. Secondly, the research site contains targeted and non-targeted WMSZ, which provided an opportunity to explore whether farmers in targeted WMSZ responded differently to those in non-targeted WMSZ. Thirdly, the Upper Gorge WMZ contains WMSZ with different dates by when the One Plan rules have legal effect (July 2014 and July 2016), which provided an opportunity to investigate whether the date from which farmers are required to have a Land Use Consent influenced farmers' responses to and understanding of the One Plan. Fourthly, all identified regional water quality interventions apply

[17] The WMZ framework criteria include local water management conservation notices and orders, physical variables (e.g. underlying hydrology or catchment boundaries) and resource variables (e.g. catchment land use type and intensity).

to dairy farmers in this zone. The next section describes how the dairy farmer participants were selected.

Selecting dairy farmer participants

The total population of dairy farms was defined by Horizons Regional Council's 2015 Dairy Effluent Discharge Consent Database for the Upper Gorge WMZ. I contacted Horizons and requested use of the Dairy Effluent Discharge Consent Database, which was released on the understanding that the information was to be used for research purposes only and not for commercial use.

According to this database, 72 dairy farms are located in the Upper Gorge WMZ. Of these 72 dairy farms, 42 are in targeted WMSZ and 30 are in non-targeted WMSZ. A stratified random sampling strategy (O'Leary, 2014) ensured a representative range of farm business ownership structures were selected from the total population of dairy farms in the Upper Gorge WMZ. The total population of farms in the Upper Gorge WMZ was sorted into the five sub-zones, and based on the number of consent holders in each sub-zone, a computer based random number generator (www.random.org) randomly selected the consent holders to interview. Extra random numbers were generated for each sub-zone to allow for farmer refusals and to ensure farmer confidentiality.

Ten consent holders, two from each of the five WMSZ, were randomly selected from the database. Table Three lists the dairy farmer participants, their farm classification, farm business structure and role. Three of the ten farms had farmer/sharemilker business structures. A decision was made to interview both the owner and sharemilker, because both are involved in the farm decision making, and in interactions with the regulatory and educational organisations around farming and water quality. The sharemilker was more likely to make operational decisions (e.g. daily effluent management) while the owner was more involved in strategic decision making (e.g. applying for resource consents). It was anticipated that owners' and sharemilkers' information needs may differ, depending on their role in the business and the stage of their family farm business life cycle. These factors could impact on the farmers' understanding of and responses to water quality interventions. Both the farmer and sharemilker were interviewed for two of the farms with sharemilkers, and in the third, only the sharemilker was interviewed because the owner was unavailable.

Table 3: Dairy farmer research participants.

Interview date	Pseudonym	Farm classification	Farm business structure and role
17 April - pilot	Jack	Targeted	Owner/operator
18 May	Fred	Targeted	Owner/operator
19 May	Paul	Targeted	Owner/operator
19 May	Owen	Targeted	Off-farm owner Has a 50:50 sharemilker (Steve)
20 May	Tom	Non-targeted	Owner/operator
20 May	Ian	Non-targeted	50:50 sharemilker (owner unavailable)
9 June	Jim	Non-targeted	Owner/operator
10 June	Ken	Non-targeted	On-farm owner/operator Has a lower order sharemilker (Stu)
11 June	Steve	Targeted	50:50 sharemilker for Owen
11 June	Max	Targeted	Owner/operator (equity partnership)
7 July and 15 July*	Stu	Non-targeted	Lower order (31%) sharemilker for Ken
8 July	Roy	Targeted	Owner/operator

* Interview completed via a short telephone call.

The concept of saturation (O'Leary, 2014) determined the dairy farmer sample size. At the end of the 12 dairy farmer interviews, it was decided that further interviewing of farmers would not add additional understanding or richness to the case. The next section outlines the process of selecting key informants.

Selecting key informants

O'Leary (2014) described key informants as participants who are able to provide relevant information, knowledge, and a deep insight into the events of the world around them. The key informants in this study were interviewed to provide background and insight into farmers' responses, or the 'what' and 'why' from their perspective; to confirm the accuracy and authenticity of other data sources; and to build an understanding of the case. The key informants' information also provided sensemaking opportunities (O'Leary, 2014) and helped me to understand the context from different perspectives and make sense of particular key events, for example, the large public meeting that occurred in May 2013.

A purposive snowball sampling method (Robson, 2011) was used to identify and select the key informants specific to this case. The key informants were interviewed after the dairy farmers and selected in three main ways. Firstly, the interviewed farmers commonly named the same key individuals who provided information, farm-specific knowledge and emotional support, and/or influenced their decision making around farming and water quality. Secondly, the interviewed key informants identified other key informants to interview about dairy farming and water quality. Each participant was encouraged to identify individuals who could provide insight from within their organisation and from other organisations and groups, both at a regional and national level. Thirdly, I identified individuals I believed could provide information and insights into the regional and national perspective of dairy farming and water quality. Both regional and national perspectives were sought because dairy farmers were responding to both national and regional water quality interventions.

The snowball sampling method set the key informant sample size. Interestingly, the three key informant selection methods identified the same core group of key informants to interview. This core group was interviewed and following O'Leary's (2014) concept of saturation, it was decided that further interviewing of key informants would not add additional understanding or richness to the case.

A total of nine regional and national key informants from a range of organisations and groups were interviewed. As indicated in Table Four, the interviews included three Horizons' staff, three DairyNZ staff, and one each with a Federated Farmers and Fonterra staff member. These key informants operated at a range of levels within their respective organisations, from working with farmers on a daily basis, to developing policy, to executive level. One interview was conducted with a member of the Tararua Community Economic Impact Society (TCEIS); the collective action group that formed in response to Horizons Proposed One Plan (POP). In order to retain confidentiality, each key informant's role within their organisation or group will not be identified.

Table 4: Key informant research participants.

Interview date	Pseudonym	Organisation or group
21 October	John	DairyNZ
21 October	Mark	Horizons Regional Council
27 October	Pete	Fonterra
27 October	Sam	Horizons Regional Council
28 October	Chris	Federated Farmers
28 October	Doug	Tararua Community Economic Impact Society (TCEIS)
3 November	Simon	Horizons Regional Council
19 November	Ross	DairyNZ
19 November	Henry	DairyNZ

The next section outlines the data collection methods (documents and semi-structured interviews) and presents how trust and norms were conceptualised.

Data collection methods

Using multiple sources of evidence is a distinguishing feature and strength of a case study research strategy (Robson, 2011). Documents and semi-structured interviews were the main data sources used in this research. Field observations are often cited as a component of case-study research (Robson, 2011), but were not a data source used in this research due to the logistics of timing and travel to the study site (the researcher lives in another region). The different sources of data were not used to check or validate information given by participants, or to confirm a single meaning. Instead, the interpretation of participants' stories, and the information contained in documents, enabled a deeper and richer exploration of the case.

Document collection

A wide range of web-based and hard copy documents were collected and used in this research. Following O'Leary (2014), the documents used can be classified as: official data and records (e.g. legislation, national and regional plans, statistics, maps, submissions and evidence presented to Horizons during the Proposed One Plan process); organisational communication, documents and records (e.g. websites, press releases); the media (e.g. websites, newspaper, radio, farming magazines); and personal communication (e.g. emails, social networking sites). Appendix Two lists the documents used.

Semi-structured interviews

Semi-structured interviews with dairy farmers and key informants were the primary data source used in this research. Stake (2008) simply summarised that every case tells a story, and semi-structured interviews were the tools I used to draw out the rich contextual stories about the participants' lives and their responses to water quality interventions. From the perspective of organizational scholars Brown, Gabriel, and Gherardi (2009), storytelling provides 'vivid insights' (p.326) on the processes of change. Storytelling in Brown et al.'s (2009) opinion, provides temporality, and a way to understand, make sense of and create meaning from situations and events 'in which multiple characters, agents, contexts and occurrences overlap and interweave' (p.325). I used semi-structured interviews as a tool to explore how history shaped the context, 'messiness' (Smart, 2009) and complex relationships that inform and influence everyday farmer life, with particular reference to farmers' responses to water quality interventions.

An interview schedule rather than a questionnaire was used in this research in order to encourage 'narrativization', or participants telling stories about important moments in their lives (Riessman, 1993). The interview schedule provided consistency across interviews, yet was flexible to allow deviation from the plan to follow the natural flow of the conversation and to explore other ideas (O'Leary, 2005). The interview schedule was not a list of questions to ask, but a series of headings and prompts that formed a checklist of information to collect. I used open-ended questions, for example, '*Tell me what happened …..*' and '*Can you think back to when you …..*', which enabled an extended account of the participant's recollections of the past (Riessman, 1993). Prompts and probes were used to encourage the natural flow of the story (e.g. '*Then what happened …..?,* and more simply, '*Why*?'). Following Riessman's (1993) suggestion, I listened 'with a minimum of interruptions'. Different interview schedules were used with dairy farmers and key informants to capture the diversity of participants and their role in this case. Examples of the interview schedules are contained in Appendix Three.

Dairy farmer interviews

Developing the interview schedule

The literature guided the development of interview topics for the semi-structured dairy farmer interviews. The interview schedule was designed around three key areas: 1. the farmer's background; 2. current farm system and changes made in the past five years; and 3. responses to water quality interventions and the role of social capital (networks, trust and norms) in shaping those responses. Starting the interview with the background and farm systems data set the scene, and helped the farmer feel more relaxed. During the interview, I often referred back to the farm systems data as a way of helping the farmer explore their reasons for change, or when introducing a new topic for discussion (e.g. '*You mentioned that you had …..*'). The farm systems data focused on the environmental aspects of their production system (e.g. nutrient management, waterway management), and the specific topics for discussion were sourced from recommended dairy farmer best management practices (DairyNZ, 2012a, 2012b, 2014c), industry projects (DairyNZ, 2013a) and from a report about regionally recognised mitigation practices to improve water quality (Horizons Regional Council, 2014b).

Piloting the farmer interview schedule

The interview schedule was piloted on two occasions to assess the effectiveness of this data collection protocol. The first pilot with a young couple farming in a targeted WMZ, provided a way to test question wording, clarity and sequencing, and to learn about the historical, political, economic and social contexts of this case. Before the first pilot, the potential interview time was of some concern. I slightly reduced the amount of farm systems data collected in the first pilot, but found I did not have sufficient understanding of the farm system and changes made to enable me to explore farmers' responses to water quality interventions in detail. Data from the first pilot interview is not included in the results, because the farm was not located in the study site. Following a revision of the interview schedule the revised interview was tested with a farmer in the study site (Upper Gorge WMZ). Still concerned about length of interview, I debated having two interviews per farmer: one for farm systems data and one for responses and social capital. After considering the advantages and disadvantages of holding two interviews, the revised interview was conducted as one interview. This structure proved successful and was used for all following dairy farmer interviews. The revised interview guide was effective and the results became part of the data collected for this study. Minor wording changes were made after the second pilot before the remainder of the dairy farmer interviews were undertaken. The extended length of interview did not concern the farmer participants.

Conceptualising trust

Data from the first pilot interview emphasised the pivotal role of trust in shaping farmers' responses to water quality interventions. However, data from the first pilot also indicated that using the word trust during the interview did not provide useful and meaningful data about farmers' trust with individuals and with organisations. Although not using the word trust, the participants were able to describe several key features of trust that are also reported in the literature. Firstly, trust is described as dynamic, and builds, maintains and declines over time (Lyon, Möllering, & Saunders, 2015). Secondly, there are different forms of trust (individual and organisational) (Rousseau et al., 1998), and thirdly, individuals describe and conceptualise trust in different ways. These identified points raised certain methodological challenges to conceptualising trust. The method used must capture the dynamics of relationships, the dynamics of how trust changes within relationships over time, and also, how the level of trust can change relationships. This challenge necessitated an in-depth exploration of the conceptualisation of trust and whether the word trust would be used directly or indirectly in the interview schedule.

Many researchers debate whether the word trust should be used directly or indirectly in interviews. Those advocating for direct use (e.g. Davenport, Leahy, Anderson, & Jakes, 2007) argue that trust is a complex and subjective topic, therefore if trust is not mentioned, the researcher cannot assume its significance or understand the participant's perceptions of trust. On the other hand, from her research in qualitative community studies, Goodall (2015) believes that direct use of the word trust can create some defensiveness, because people do not like admitting their lack of trust in others. Individual and organisational trust are variously described in the literature (e.g. Emtage & Herbohn, 2012; Fisher, 2013; Kasperson et al., 1992; Palmer, Fozdar, & Sully, 2009; Sutherland et al., 2013). After investigating how other researchers conceptualised trust, I chose indirect methods as a way to investigate the trust that farmers have with individuals (individual trust) and with organisations and institutions (organisational trust). The in-direct method used in this research did not use the word trust, but worded the questions to reflect the various conceptualisations of trust. Appendix One lists the different ways trust is conceptualised in the literature and examples of the questions used to indirectly explore individual and organisational trust with the farmer participants.

The social trust framework developed by Kasperson et al. (1992) was used to conceptualise trust in this research. Kasperson et al.'s (1992) framework of four trust dimensions (commitment, competence, care, and predictability) was used to guide question wording in the interview schedules, and used extensively during data analysis. Conceptualisations of trust from farmer empirical research, expanded and added agricultural relevance to the four categories in Kasperson et al.'s (1992) framework. The new categories include longevity of relationship between farmers and advisors, and farmers and organisations (Emtage & Herbohn, 2012; Sutherland et al., 2013), and the perceived level of external control over a farmers' on-farm practices (Emtage & Herbohn, 2012). In contrast, direct use of the word 'trust' was used to ask farmers about the social trust that they perceive the general public has in their farming practices around water quality. Direct use ensured the participants provided data about a specific concept: the public's social trust in dairy farmers.

Conceptualising norms

The pilot interview also indicated that direct use of the word 'norm' would not provide the data I sought. The word 'norm' is a theoretical term, and I was concerned that participants would not understand the term, and this would lead to different interpretations of the question. I used the phrase 'farm practices' to explore what farmers believe are the expected or accepted and unaccepted farm practices around water quality. Minato et al. (2010) termed these accepted farm practices as practice norms. This led to a discussion about how farmers learnt about what are accepted/unaccepted practices, how practices change over time, and sanctions for violations of social norms (e.g. '*What happens if farmers aren't doing what others expect*?'). By using an indirect method, I believed the findings would emerge from the data, rather than the participant's interpretation of a theoretical term.

Conceptualising social networks

Putnam (2000) simply described social networks as the social connections between individuals. Results from the pilot interviews highlighted the diversity of farmers' social networks, and diversity in the way farmers used their social connections to access resources, support, information, new contacts and to exchange knowledge. After investigating how other researchers explored social networks (e.g. Fisher, 2012), I chose a qualitative rather than a quantitative method, or use of scales. By using a qualitative method, I could explore the connections between networks, trust and norms, and, how these connections shaped farmers' responses to water quality interventions.

I investigated how other researchers qualitatively explored farmers' social networks. I based the farmer interview schedule on the method Fisher (2012) used in her PhD research of English farmers' response capacity to bovine tuberculosis, and asked farmers to describe their interactions with individuals, groups and organisations. The farmers described their interactions with: other farmers and family; farming groups (e.g. Federated Farmers); agricultural professionals (e.g. farm consultant, fertiliser representative); non-farming groups (e.g. sports, church); the local community and school; key organisations involved in farming and water quality (e.g. Horizons, DairyNZ, Fonterra); and the general public. Farmers were also asked to describe their main sources of information about farming and water quality. The key informants also described their interactions with individuals, groups and organisations around farming and water quality. The aim was to describe the social networks each farmer used to obtain information, knowledge, support and resources around farming and water quality.

Farmer interview process

As described earlier, a stratified random sampling strategy (O'Leary, 2014) was used to select farmer participants from Horizons' Dairy Effluent Discharge Consent Database. The database listed the consent holder, location address and a site contact. No personal contact details were listed. The randomly selected farmers were Fonterra suppliers, so in order to obtain the personal contact information for research purposes, I contacted the two Fonterra Area Managers who work with dairy farmers in the Upper Gorge WMZ. These Fonterra staff provided a main and an alternative contact (usually the owner or sharemilker), which in some cases differed from the site contact in the database. They also provided phone numbers, personal information about the farm situation (if relevant) and sharemilker details (if applicable) for each randomly selected consent holder. Confidentiality was a key consideration at this stage of the research process, so I requested personal details about a larger group of farmers to ensure the Fonterra staff would not know who was actually contacted. I also stressed it was important for the Fonterra staff not to discuss a farmers' potential inclusion in the research before or after the interviews had taken place.

I phoned the first contact name on the list for each WMSZ and discussed the survey with the main contact person (usually the owner). Open and honest communication was established by outlining the study's purpose, the process of random selection, and how their personal contact details were obtained from their Fonterra Area Manager. In all cases, the farmer agreed to take part in the survey at this first contact point (no refusals). I then emailed each participant a copy of the information sheet, confirmed the date and location of the interview, and supplied my personal contact details for the farmer to contact me with questions, or to change interview timing. One participant did not use email, so I discussed the information sheet in detail with him at the start of the interview.

The interview schedule was piloted in late February and mid-April 2015, and the main farmer interviews were conducted from mid-May to mid-July 2015 when farmers were less busy. All interviews were face to face at the participant's choice of location: 11 were held at the participant's home and one at a local café. All main interviewees were male, although in nine interviews, the female spouse also contributed. One interview was completed via a 15-minute taped telephone conversation one week later, as the farmer had an unexpected appointment to attend partway through the initial interview. For the farmer/sharemilker farm businesses, the owner was interviewed first in his home and the sharemilker interviewed at another time in his home. At the end of the owner interview, I discussed why I wanted to interview the sharemilker and obtained this individual's contact details from the farm owner.

Two interviews were conducted with one interviewee and ten interviews with two interviewees. In the interviews where there was more than one participant, the extra participant chose to become involved. In nine of the ten two-person interviews the extra participant was the farmer's spouse. The extra participant in the tenth interview was a digger driver friend, also a farmer, who had come to install culverts on the farm that afternoon. The digger driver friend came to the house to talk with the owner partway through the interview and ended up staying for the rest of the interview. The contribution from the extra participants varied. In one interview the spouse was present for all of the interview; in another the spouse was present in about half of the interview; and in the others the extra participant either provided comments when in the same room (e.g. while preparing a meal in the kitchen) or when they chose to. As well as offering his own perspective on the topic as a farmer, the digger driver friend added in detail about the farmer's community involvement that the farmer had not previously mentioned. While not pre-planned, these extra participants added a richness to the storytelling process, with the spouse at times correcting their partner as well as presenting another perspective.

The interviews ranged from 1.5 to 2.45 hours. After 1.5 hours, I would check with the farmer (and spouse if present) to confirm if they had other tasks to perform or if they wished to keep on talking. I was initially concerned about the length of interview, however, all participants remained fully engaged (body language cues: e.g. relaxed posture, leaning forward at times, not fidgety, not checking the clock), and were willing to continue sharing their experiences. At the end of the interview I received permission from all participants to re-contact them to verify or obtain further information.

With the interviewees' permission, all interviews (farmers and key informants) were audio recorded. Audio recording helped me capture 'how people really talk' (Riessman, 1993), or, capture their verbal (words, inflection and laughter) and non-verbal communication (pauses, unfinished sentences, physical emphasis and gestures). When participants used hand gestures to emphasise a point, I asked the individual to describe the action they were making and why.

To supplement the audio, four types of notes were taken during and after the interviews.

1. Farm systems data was recorded on the interview schedule, which enabled me to check and confirm details during the interview. This was a very open system, and the farmer and I would often point to or refer to the written data.
2. Written notes after the interview about the different ways participant's emotions were displayed through voice: timbre, pitch, inflection, speaking speed, using different or funny voices to emphasise different participants in a story; use of swear words; and through physical emphasis, for example, banging the table.
3. Personal reactions and observations written after the interview – a synopsis of my thoughts and notes about how the interview had gone and observations of interviewee comfort level.
4. Follow-up activities – information on further individuals to interview (e.g. sharemilker contact details, other individuals identified by the farmer) and farm details to investigate and clarify.

Key informant interviews

Developing the interview schedule

The literature, farmer interview schedule, and farmers' responses were used to guide the development of interview topics for the semi-structured key informant interviews. The interview schedule was designed around four key areas: the key informant's background; their involvement with water quality interventions; their contact and communication with farmers; and their relationships and trust with farmers, other individuals, and other organisations. The key informant schedule was adapted depending on the location and the role of the participant. Some key informants operate at a national level and have a broad overview of dairy farming and water quality, while others operate at a regional level and have daily contact with dairy farmers. While some key informants are involved in policy and regulation, others have an educative and supportive role. The key informant interview schedule was adapted as required to capture this range of data.

In contrast to the farmer interviews, the key informants were more likely to spontaneously use the word trust when describing their relationships. Their use of the word trust provided an understanding and platform from which to continue with direct use of the word trust. Trust was explored by asking the key informants about trust at a number of levels. Firstly, they were asked about their perceptions of trust between farmers and staff from their organisation (individual trust), between farmers and their organisation (organisational trust), and between farmers and other organisations. Secondly, they were asked about the trust that the key informant has developed with specific staff from other organisations (individual), and with other organisations (organisational). Thirdly, they were asked about the level of trust between organisations.

Key informant interview process

As described earlier, after the dairy farmer interviews were completed a purposive snowball sampling method (Robson, 2011) was used to select the key informants to interview. The key informant interviews were carried out over a seven-week period between mid-October and mid-November 2015. All interviews were conducted face to face at the participant's choice of location: seven were at the participant's workplace, one was at the participant's home, and the other was started at a café and finished at the workplace. Seven of the key informants were male and two were female. The interviews ranged from 1.5 hours to 2.0 hours. As with the farmer interviews, the interviews were audio recorded with the participant's permission, notes taken during and after the interview to supplement the audio, transcripts of the audio recordings made, and permission given from all participants to re-contact them to verify or obtain further information. The next section describes the process of transcribing and analysing the participants' experiences.

Data analysis

All audio recorded interviews were transcribed by a professional transcriber, and I chose this method because of the quantity of data to transcribe. Regular communication between myself and the transcriber built a strong relationship, which ensured the transcripts were of high quality and in the format I wanted. A quick turnaround of interviews meant I was able to check the transcript while the interview was fresh in my mind. The transcriber captured both verbal and non-verbal communication. For example, the transcriber reported laughter (e.g. laughs) and the type of laughter (e.g. evil laugh), which helped me remember how the interviewee felt during the interview. The transcriber also captured pauses, unfinished sentences and overlapping speech when there was more than one participant, by using a series of full stops. Each transcript was carefully read and edited (if required), tapes re-listened to clarify words, and this cross-checking was a form of triangulation (O'Leary, 2014) which verified the data's accuracy. Non-linguistic responses were also captured via the interview transcripts. Pauses, laughter and silences were used as indicators of how people responded to the questions, my approach, and reactions to the topic.

In order to maintain Bourdieu's (2003) 'participant objectivation', I recognised that my interpretation and analysis of the data would influence the findings reported in the results chapters. I needed to consider how I would select the story to tell, or how I would re-narrate the narratives from farmers, key informants and documents to accurately capture farmers' responses to water quality interventions. I also needed to consider how my personal bias and past consultancy experiences with farmers and industry would influence how I represented the farmers' stories of response.

An inductive thematic analysis strategy (Guest, MacQueen, & Namey, 2012) was used to rigorously and systematically analyse the data from documents and semi-structured interviews. I chose this method, because I wanted to represent the stories and experiences expressed by the participants as accurately and comprehensively as possible. Additionally, as Guest et al. (2012) argue, thematic analysis enables a researcher to capture the complexities of meaning from within the data. Each interview transcript was initially read in its entirety, notes were made, the transcript was then re-read, summary notes were made and so forth, until I gained an overall understanding of the data within its context. Each interview was then analysed manually in more detail. I identified themes or the 'units of meaning' (Guest et al., 2012, p.50) that existed within the context of each interview. Sub-themes within each theme were identified. As is consistent with a thematic analysis strategy, the themes and sub-themes were derived from the data rather than being pre-determined categories (O'Leary, 2014).

The farmers used metaphors, idioms and colloquial phrases, and these word patterns were interpreted in a consistent manner within the context of their individual transcripts. These word patterns were also compared and contrasted between the farmers' transcripts. These linguistic devices bought richness and imagery to the farmers' words, and were used to lend meaning to the content and themes (O'Leary, 2014). I also used the participants' non-linguistic cues (e.g. laughter and hand gestures) that accompanied their words to aid in my understanding of a participants' meaning of an event or interaction. For example, Jim demonstrated the tipping of a hat off his head, and he explained that this meant subservience to Horizons. As O'Leary (2014, p.309) suggests, these non-verbal cues are central to thematic exploration and to the ‘meaningful understanding’ of data.

The themes and sub-themes were compared and contrasted across participants’ transcripts. I looked for patterns and connections between and among themes (O'Leary, 2014), and I also looked at the context around each farmer and their farm system to help explain why they may be different or similar to other farmers. I then developed large rich ‘mind maps’ to enable an understanding of the similarities and differences between contexts, themes and connections. I returned to the social capital and response literature at this stage, and I believe that an engagement with both the data and the literature enabled me to develop a greater depth of understanding of farmers’ responses to water quality interventions.

An analysis of each farmer’s social networks was also undertaken. Each farmer’s interactions with others were initially identified (e.g. farmer to farmer, farmer to family, farmer to farm consultant), then a summary made of the extent of each farmer’s social networks. These summary factors included: the size (e.g. number of interactions); frequency of contact; location (e.g. regional, national or international); the reasons for the interaction; and the relevance of each interaction to farming and water quality (e.g. a source of information). I looked for patterns in the interactions and reason for interaction across each farmer’s transcript, and then compared and contrasted these patterns across other farmers’ transcripts. After the themes and sub-themes were identified, I classified the farmers’ interactions based on the three-way theoretical conceptualisation of social capital (bonding, bonding, bridging) and the methods used by other empirical researchers (Fisher, 2012) to classify farmers’ interactions through social networks.

Questions emerged while I was reading the transcripts. These questions stimulated an exploration of documents, for example, to understand the chronology of events, the various perspectives of events, and how the media reported on some events. I systematically ‘found, appraised and selected’ (Bowen, 2009, p.28) the data from documents, and then organised this data into themes. This process identified further questions and themes, which stimulated a rereading of the interview transcripts. Bowen (2009) and O'Leary (2014) alerted me to the potential limitations of documents and the danger of bias. I critically analysed the credibility, accuracy, original purpose, balance and completeness of each document, and established whether the document contained fact, opinion or both.

Documents were also used to ensure a degree of accuracy in reporting dates and events, for example, where, who and what. An analysis of national and regional dairy industry statistics provided trend data on the expansion and intensification in the dairy industry, which is identified as one factor contributing to declining water quality. In addition, the development and operation of a number of water quality interventions were also analysed from documents. This analysis included: the two successive dairy industry accords; the Proposed One Plan and operative version of the plan; Tararua fencing subsidy programme; the Dairylink project; Supply Fonterra; and Fonterra's Dairy Diary.

The themes identified during the data analysis were developed into a structure, and this structure shaped the writing of the two results chapters. While writing up the results I continually returned to the transcripts and documents, to ensure that my interpretation was firmly anchored in the words of the participants. As a result, pseudonyms and direct quotes are used extensively in the results chapters to emphasise and reinforce points made in the text. Importantly, the results chapters are loyal to the voices of individual participants, and the perspective of farmers' responses is clearly identified as being from a farmer or from a key informant. The results chapters (Chapters Seven and Eight) make strategic use of 'asides'. Seen as 'alternative writing spaces' (Pierre, 1995, p.6), asides are the structural method used to highlight the links between the data (narratives) and the social capital theory used to frame this research. These asides clearly signify my moments of interpretation and reflection and aim to help the reader link data and theory.

The last section in this chapter describes how creating and accessing social capital facilitated the research process.

Accessing social capital through the research process

The social capital I built and accessed during this research journey, facilitated and enhanced the process of this research. I built a diverse bridging network with staff from Horizons, DairyNZ, and Fonterra at a regional and national level, with staff from a range of other organisations (e.g. AgResearch, Lincoln University, the Cawthron Institute), and with international researchers. This bridging network did not exist before the start of the research process. The literature does not commonly present social capital as a resource that can enhance qualitative research.

These bridging relationships became an integral part of the research process. Through this bridging network I became aware of and gained access to a wide range of information and resources, for example, published and unpublished data and reports, and farmer contact details. These relationships provided technical advice (e.g. comments on technical and scientific aspects), academic and personal support (e.g. individuals to debate and discuss issues with), and more importantly, access to other contacts which continued to build the bridging network. In return, the bridging network raised awareness of research gaps and provided a way for a wide range of individuals to learn about, debate, and participate in the research. Some Horizons' staff spontaneously sent information they found and thought would benefit the research, informed me about upcoming events and meetings, and prepared maps and data specifically for this research. The two-way flow of information and resources through the bridging network continued to enhance the research process.

The bridging network was used extensively during the interviewing phase. I developed an informal system whereby I emailed regional staff from Horizons, DairyNZ and Fonterra, to let them know each time I would be in the region interviewing dairy farmers (no specific details were given). I believe this is a form of professional courtesy and respects the staff member's work with farmers. In return I received a positive response from these staff, and this informal contact strengthened relationships and built trust. This research approach is rarely discussed in the literature.

I used the mutual trusting relationship developed with Horizons to obtain access to the Dairy Effluent Discharge Consent Database used to randomly select the dairy farmers to interview. Horizons trusted I would use the database for research purposes and not for commercial gain. I used the mutual trusting relationship with the Fonterra Area Managers to obtain farmer contact details: they trusted I would use the information for research purposes and I trusted that they would not disclose any information about the research to other farmers or outside individuals. Interestingly, some of these individuals became key informants who were interviewed as part of the research process. The mutual trusting relationships that built over time between myself and these key informants, ensured that in-depth and rich data was obtained. I was aware that a previous relationship may introduce bias, and ensured that these relationships would not influence the results obtained.

Trust was also an integral part of the farmer and key informant interview process. I was aware that my ability to capture meaning was dependent on my ability to build trust and rapport with the research participants (O'Leary, 2014). I was also aware that the topic was contentious for many participants, and to answer the research questions, I needed to explore these sensitive issues in-depth. I wanted the farmers to trust me with their own and their family's narratives about their responses to interventions. I believe trust was built during the farmer interview process through my personal approach (open, honest and sharing communication), willingness to listen, and my genuine interest in the farmer's farms and farm systems. These factors were identified by O'Leary (2014) as contributing to trust and rapport between an interviewer and interviewee. I also emphasised research ethics at several points during the interviews (e.g. confidentiality of private information), and in many cases, light-heartedly discussed the pseudonym a participant may wish me to use. A key factor I had not considered, was the farmers perceiving me as independent (a student, don't live in the region), and I believe this enabled me to gain a valuable insight into the context and complexity of the case. Farm owner Jim made the following comment at the start of his interview:

> *'With the history in this area, of the One Plan, the improvement in water quality, the processes that we've been through, and the negative connotations that it has all generated, if somebody from within the area was to conduct this research, they wouldn't have been well received. Unless their background is, where they stood, was fully understood. So, somebody from outside the area, with no baggage, coming in, would be better received than probably somebody within the area*'.

I believe my personal approach, genuine interest and independence, contributed to the farmers being willing to make time to discuss and debate, and to share their narratives about an issue they sometimes described in a negative and emotional manner. Almost all participants thanked me at the end of the interview for the opportunity to share their ideas. Farmer Jack remarked: '*As farmers we don't often get the opportunity to download any of this stuff*' (comment recorded in personal note taking after the interview).

Conclusion

A constructivist research paradigm framed this qualitative research. Two research questions were posed, and a single-case study research strategy was used to answer these questions: '*How and why have New Zealand dairy farmers responded to water quality interventions*?, and, '*What role did social capital play in shaping dairy farmers' responses*?' The case in this qualitative research is dairy farmers' responses to water quality interventions.

The Manawatu-Wanganui Region was the case-study site in this research. One water management zone (WMZ), the Upper Gorge, was selected as the research site from the 43 WMZ in the region. This research site is located within the Manawatu River Catchment, contains dairy farms from both targeted and non-targeted WMSZ, and all regional water quality interventions apply to dairy farms in the Upper Gorge WMZ.

Documents and semi-structured interviews with dairy farmers and key informants, were used to collect the data for this research. A detailed description of the interview processes, how trust and norms were conceptualised, and the transcription and analysis of interview data was presented. A holistic thematic analysis strategy ensured each participant's past experiences, and the meaning they attributed to the experiences was captured.

The historical national and regional context of the development of water quality interventions is presented in the next two chapters. The first, Chapter Five, explores the socio-cultural, political and economic context that underpinned the development of water quality interventions in New Zealand. Data for this chapter is drawn from documents. The second context chapter, Chapter Six, presents the Manawatu-Wanganui Region, regional water quality, the Upper Gorge WMZ, regional actors, and the water quality interventions put in place to address declining regional water quality. This chapter draws on documents, and data from farmer and key informant interviews. These context chapters set the scene for the two following results chapters.

Chapter Five
Historical Context

Introduction

The introduction of water quality interventions, and farmers' responses to these interventions, were influenced by the broader events and factors that shaped farming in New Zealand. This chapter looks back in time, and presents the broader political, economic and socio-cultural aspects that shaped agriculture in New Zealand, agriculture's impact on freshwater quality, and the development of national water quality interventions. Describing and analysing the historical context in this chapter, provides a platform from which to explore the regional context (Manawatu-Wanganui Region) in the following chapter, and farmers' responses to interventions in the results chapters.

This chapter presents both an international and national perspective. The first section in this chapter takes an international perspective, and presents an introduction to concerns about the impact of agriculture on the environment in the European Union (EU), resulting changes in EU agri-environment policy, and the development of agri-environment indicators. European farmers' responses to voluntary agri-environment schemes (AES) and targeted regulation (NVZ) were explored in Chapter Three. After an international introduction, the following sections take a national perspective. Initially, the historical political and economic factors that influenced a change in land use are investigated, then the impact of expansion and intensification in the dairy industry on water quality is discussed. A change in the public's perceptions of New Zealand's environment over time is then examined, and in particular, the public's increasing concerns about the cause-effect relationship between farming and water quality. The government, stakeholder and dairy industry's responses to scientific evidence and increasing public concern, are explored in the final section.

Factors influencing the introduction of water quality interventions in New Zealand

Farming in New Zealand occurs within a broad socio-cultural, political, and economic context, and is influenced in part by international policies and events (Parliamentary Commissioner for the Environment, 2004). Figure Two identifies some of the international, national, regional and farm level factors influencing the introduction of water quality interventions in New Zealand. The factors at each level interact. For example, overseas consumers' perceptions about the impact of dairy farming on the environment, influenced the development of national dairy industry interventions. The factors within each level also interact, for example, regional council environmental policy is influenced by regional resources, climate and weather. As highlighted in Chapter One, an increasing global demand for agricultural protein (milk powder) contributed to the expansion and intensification of dairying in New Zealand, which contributed to the introduction of national and regional water quality interventions. This chapter investigates the international, national and some of the farm level factors identified in Figure Two. Other farm-level factors (farmers' values and relationships with others) are explored in the results chapters (Seven and Eight). The regional factors in Figure Two are explored in the following chapter (Chapter Six).

Figure 2: Factors influencing the development of water quality interventions in New Zealand.
Adapted from: Parliamentary Commissioner for the Environment (2004, p.57).

International factors

Farming in New Zealand can be influenced by a range of international factors, including international environmental policies, and international consumers' values and expectations (OECD, 2008; Parliamentary Commissioner for the Environment, 2004). The European Union (EU) provides an example of how international factors can influence farming in New Zealand. Based on the total value of goods and services exported, the EU is New Zealand's third largest export market (Statistics New Zealand, 2016). This export market was built in part from strong historical, cultural and political linkages (e.g. historical European migration, military and peacekeeping initiatives) between New Zealand and the EU (Ministry of Foreign Affairs and Trade, 2014). As such, Saunders (1998) argues that developments in European agri-environment policy, and European consumer's values and preferences, can have direct and indirect implications for New Zealand agriculture. While indirect implications relate to the EU's potential influence on international trade negotiations, Saunders (1998) claims that European consumers' increasing concerns about the impact of agriculture on the environment, and an increasing demand for goods produced in an environmentally friendly manner, will have direct implications for New Zealand's agriculture.

Curry and Winter (2000) linked European consumers' concerns about the impact of agriculture on the environment (e.g. air and water pollution from intensive agriculture, landscape and nature conservation) with an increasing environmental content in EU agricultural policy. The European Commission established the first European Environment Action Programme (EAP) in 1972, and as Hey (2005) summarised, EAPs reflect current thinking about environmental problems. Successive EAPs set out the priority objectives that guide European environmental policy, and these environmental objectives have been integrated into other EU policies and activities, including the Common Agricultural Policy (CAP) (Hey, 2005).

Agri-environment measures were integrated into EU Common Agricultural Policy (CAP) as a way to address society's increasing concerns about the impact of agriculture on the environment (European Commission, 2017). Agri-environment schemes (AES) were first introduced into EU agricultural policy in the late 1980s as an option for member states, and compulsory since 1992 (European Commission, 2017). These voluntary measures (farmers choose whether to become involved) 'are designed to encourage farmers to protect and enhance the environment on their farmland by paying them for the provision of environmental services' (European Commission, 2017). Under the terms of an AES, farmers commit to adopting environmentally friendly farming practices, and receive agri-environment payments in compensation for any additional costs and income forgone from adopting those practices. These agri-environment payments encourage farmers to adopt practices that will deliver positive environmental outcomes (European Commission, 2017). Agri-environment payments were described as a significant contributor to overall farm business income (FBI) for some UK farms in 2016 (Winter et al., 2016). Based on farm type, this report indicated that agri-environment payments contributed from less than 10% of FBI (dairy farms), to 30%-40% of FBI for mixed and less favoured area grazing livestock farms. The contribution was up to 60% of farm business income for smaller mixed grazing farms.

Other EU environmental legislation, such as the Nitrates Directive[18] (1991), was introduced to address rising nitrate levels in ground and surface water across Europe (European Commission, 2010). The Nitrates Directive (1991) aims to improve surface and groundwater quality by preventing pollution from agricultural nitrates, and is implemented through a number of mechanisms, including the promotion of best management practices, and Nitrate Vulnerable Zones (NVZ) (European Commission, 2010). In accordance with the Nitrates Directive, member states are required to designate areas of agricultural land as NVZ where water nitrate concentration exceeds the European Commission 1980 drinking water limits (mg/l of nitrates) (Osborn & Cook, 1997). The NVZ scheme covers both surface and ground water, is compulsory and farmers are not compensated. The United Kingdom adopted a targeted approach to NVZ (discrete areas designated as NVZ), while other EU countries (e.g. Netherlands, Germany) adopted a blanket approach (entire area is designated an NVZ) (Osborn & Cook, 1997). The agri-environment schemes of the CAP back up the Nitrates Directive (European Commission, 2010). As a result of changes to EU environmental policy, farmers in the EU have farmed under some form of government intervention for the past three decades.

At a similar time (1990s), the OECD initiated a global programme to monitor and evaluate agriculture's environmental performance and policies in developed countries. An OECD report claimed: 'The impacts – both harmful and beneficial - of agriculture and agricultural policies on the environment are a major issue in OECD countries' (OECD, 1999, p.3). A set of agri-environmental indicators were developed by the OECD to track trends in the state of the environment and environmental policy, and the environmental performance of agriculture in OECD countries (including New Zealand) has been measured by the OECD since 1990 (OECD, 2013b).

This summary of EU agri-environment policy development over three decades, and the global development and use of agri-environmental indicators, highlights increasing international discussion and debate about the impact of agriculture on the environment. Increasing international awareness, contributed to an increasing awareness about the impact of agriculture and the environment in New Zealand. For example, Saunders, Kaye-Blake, Campbell, and Benge (2009), used OECD agri-environmental indicators to measure the environmental performance of individual kiwifruit orchards in New Zealand. The Ministry for the Environment (2001) investigated New Zealand's clean green image, and in particular, how New Zealand's exports could

[18] A Directive is a legislative act that sets out a goal that all EU countries must achieve.

benefit from international consumer's positive perceptions about the environment. International consumers' perceptions of agriculture and the environment are explored later in this chapter. From an international introduction, the next sections in this chapter take a national focus and investigates the national factors illustrated in Figure Two.

National factors influencing farming and the introduction of water quality interventions

As illustrated in Figure Two, a range of national factors influenced the development of water quality interventions in New Zealand. The first section investigates how changes in New Zealand economic policy encouraged diversification, which resulted in the expansion and intensification of New Zealand's dairy industry. As will be presented later in the chapter, expansion and intensification of the dairy industry contributed to a decline in freshwater quality and encouraged the introduction of water quality interventions.

Expansion and intensification of dairy farming

A significant and dramatic change in New Zealand's economic policy during the 1980s, was identified by MacLeod and Moller (2006) as one of the main drivers for a change in pastoral land use. Following the National government's defeat in a snap election in 1984, the incoming Labour government aimed to reduce government intervention in the economy and adopted a policy of economic deregulation. All agricultural production subsidies were removed in the government budget, including subsidies for fertiliser, the eradication of noxious weeds and Supplementary Minimum Prices (SMPs)[19] (W. Smith & Montgomery, 2004). The policy changes and impacts on the agricultural industry are well documented (e.g. Fairweather, 1992; Rhodes et al., 2003; W. Smith & Montgomery, 2004). SMPs and subsidies had artificially increased the profitability of sheep and beef farming compared with dairying (W. Smith & Montgomery, 2004), and the removal of subsidies economically affected sheep and beef farmers more than dairy. The removal of subsidies encouraged diversification: sheep and beef to dairying, farmland to forestry, and increased areas in viticulture and horticulture (W. Smith & Montgomery, 2004).

[19] SMPs were an output price assistance scheme that was predominantly used to support sheep meat. Rhodes, Willis, and McCann (2003) estimated that prior to 1984, approximately 37% of the average sheep and beef farmers income came from government subsidies.

Expansion of the dairy industry has occurred through three key mechanisms since the 1970s: increased farm size, increased per cow production, and an increase in input use (intensification) (LIC, 2016). In terms of increasing farm size (farm area and cow number), industry statistics illustrate a gradual increase in the total number of cows over the 1970s and 1980s, and a more rapid increase from the late 1980s/early 1990s to the latest recorded data for the 2015/16 season (Figure Three) (LIC, 2016). These statistics indicate that the national dairy herd increased from 2.08 million cows in the 1974/75 season (LIC, 1999), to 2.44 million cows in the 1991/92 season, to 5.00 million cows in the 2015/2016 season (LIC, 2016). Combined with increase in total cow numbers, dairy farms increased in size (total effective area - ha), but the number of herds declined, and the average herd size increased - herd size has more than tripled from the 1974/75 to the 2015/16 season (LIC, 2016).

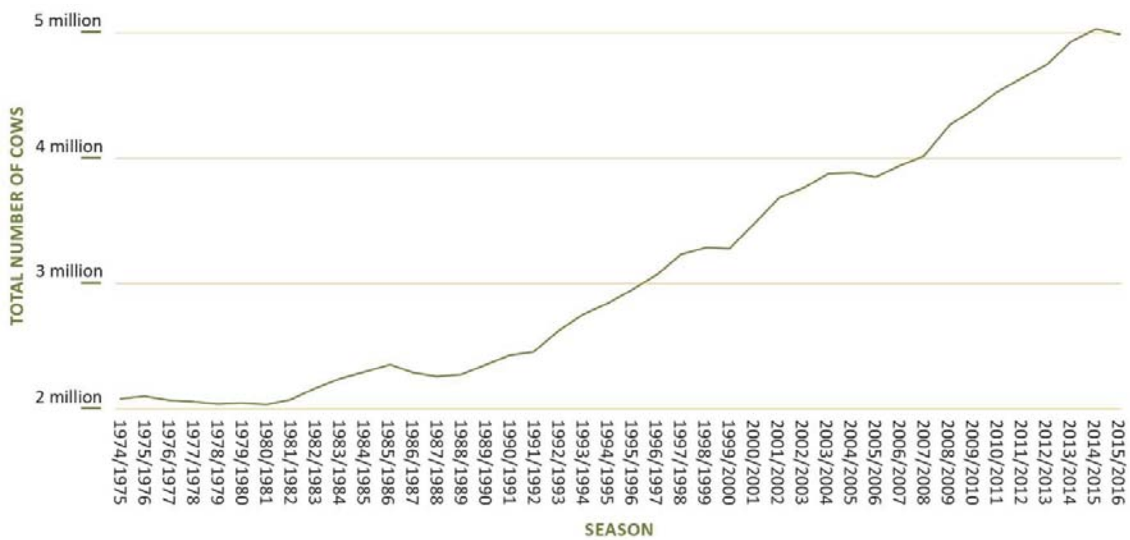

Figure 3: Trend in the total number of dairy cows in New Zealand from the 1974/75 to 2015/16 seasons.
Source: (LIC, 2016)

Although dairy farming has been historically based in the North Island for climatic reasons (rainfall), the regional dairying pattern has changed over time. Figure Four illustrates that at the end of the 1990s (1998/99 season), the majority of dairy farms were located in the North Island (86%; South Island 14%) (LIC, 1999). The most recent statistics for the 2015/16 season, however, illustrate that while the majority of dairy herds are still located in the North Island (59.7%), dairying has noticeably increased in the South Island (40.3%) (LIC, 2016) with a movement into 'non-traditional dairy farming areas' (e.g. Canterbury and the dry semi-alpine McKenzie country) (Fraser, Ridler, & Anderson, 2014). Irrigation removed climatic restrictions (rainfall) on dairy farming in the South Island, and Moot, Mills, and Pollock (2010) describe how the increased availability and the rapid expansion of irrigation in Canterbury contributed to the conversion of sheep and beef farms to large scale dairy production. Herds are on average larger in the South than the North Island, in terms of the number of cows and the average herd size (average herd size for the 2015/16 season: South Island 624, North Island 343) (LIC, 2016).

Figure 4: The regional distribution of dairy cows in New Zealand for the 1998/99 and 2015/16 seasons. Source: (LIC, 1999, 2016).

Over the last two decades, an increasing trend towards more intensive dairy farm systems has been noted (Foote, Joy, & Death, 2015). Following Moller et al. (2008), intensification of agricultural practices in a New Zealand context is defined as ‘any increase in farm inputs or farm production off-takes per unit area of land’ (p.254). Intensification has largely occurred through a gradual shift from traditional low input pastoral based systems, to higher off-farm input based systems (MacLeod & Moller, 2006; Parliamentary Commissioner for the Environment, 2004). Off-farm inputs include bought-in supplementary feed (e.g. maize and grass silage, palm kernel extract (PKE) and grain), non-nitrogenous and nitrogenous fertiliser and irrigation (in some areas) (Fraser et al., 2014; MacLeod & Moller, 2006; Parliamentary Commissioner for the Environment, 2004). Irrigation enabled farmers to intensify production in drought prone areas, or regions with seasonally low or unpredictable rainfall (MacLeod & Moller, 2006). Dairy farm systems intensified in order to increase output, lift revenue (farm and national scale), and to maintain international competitiveness. Intensification has resulted in an increased stocking rate (average cows/ha), increased per cow milk production (kg MS/cow), and increased production per hectare (kg MS/ha) since the 1970s (LIC, 2016). Intensification has also resulted in an increase of nutrients entering the farm system through increased cow numbers, nitrogen fertiliser and supplementary feeds, and as a result, an increased quantity of nutrients that can runoff or be leached from the farm system (Beukes et al., 2012). Additionally, increased cow numbers contribute to a potential for increased pathogens (e.g. *E.coli* from cattle faeces), and a potential for increased soil impacts (e.g. soil disturbance and erosion) which contribute to sedimentation of waterways.

More intensive dairy farm systems can impact on the environment. The consequences of more intensive dairy farm systems can include: reduced biodiversity, degraded recreational areas, increased soil compaction, increased water abstraction, increased greenhouse gas emissions and reduced freshwater quality (Foote et al., 2015; Fraser et al., 2014). Additionally, intensive dairying can harm New Zealand's 'clean and green' image, argues Foote et al. (2015). Others are concerned about increased dairying in 'non-traditional' dairying regions (Fraser et al., 2014), and the potential impact on the ecological and aesthetic values of these landscapes. The debate between environmentalists and landowners over the large-scale development of some of the South Island's iconic high country regions (e.g. the McKenzie Basin) for agricultural purposes[20] has been widely reported in the media (Benny, 2014). The next two sections discuss the question: how is dairy farming affecting freshwater quality in New Zealand?

Is dairy farming affecting freshwater quality in New Zealand? The scientific evidence

Expansion and intensification of the dairy industry has been linked to a change in the state (decline) of New Zealand's freshwater quality (e.g. Davies-Colley & Nagels, 2002; Parkyn et al., 2002; Parliamentary Commissioner for the Environment, 2013, 2015; C. M. Smith et al., 1993). New Zealand's first comprehensive review of freshwater quality in relation to agricultural land use was carried out by the National Institute of Water and Atmospheric Research (NIWA) in the early 1990s (C. M. Smith et al., 1993). These scientists investigated the effects of agriculture on water quality by comparing regional water quality data with published water quality standards. The report concluded that the quality of freshwater in lowland rivers, streams, creeks, lakes and some shallow groundwater resources was poor to very poor, whereas waterways in sparsely developed areas and river headwaters were in good condition. The poor condition of lowland waterways in agricultural catchments was attributed to 'agriculturally derived diffuse and point source waste inputs in isolation or in addition to urban and industrial waste inputs' (C. M. Smith et al., 1993, p.vii).

[20] Agricultural development would include replacing native tussock grasses with pasture species, subdivision fencing and irrigation.

Further research by NIWA scientists on the effects of agriculture on the state of water quality and the ecology of waterways nearly a decade later (Parkyn et al., 2002), made similar conclusions to those in the earlier work by C. M. Smith et al. (1993). Parkyn et al. (2002) concluded that the poor condition of lowland rivers in agricultural catchments was caused by high nutrient levels, turbidity and stock faecal contamination, and that agricultural practices have a detrimental effect on water quality. In particular, they found that streams in dairy farming areas were in poor condition, which they attributed to increasing levels of nutrients, sediments and faecal bacteria from the intensification of dairying. These conclusions were made by comparing data from regional council and unitary authority state of the environment reports with water quality and periphyton guidelines that were revised and updated since Smith et al.'s (1993) study. They also conducted an extensive literature review of New Zealand water quality and ecology studies published since Smith et al.'s (1993) report.

Other researchers quantified the effects of agricultural practices on water quality. Davies-Colley and Nagel's (2002) research in intensively grazed dairy catchments in the Waikato and Westland regions, compared water quality data recorded over a thirteen-month period from lowland streams in dairy catchments with reference streams in native forests. They found that streams in dairy catchments contained faecal contamination, elevated phosphorous and nitrogen concentrations, and increased fine suspended sedimentation. Davies-Colley and Nagels (2002) concluded that the water quality in dairy catchments was degraded compared with reference streams in lowland forests.

More recent research suggested that freshwater quality in New Zealand is continuing to deteriorate in some catchments. A 2012 report published by the New Zealand Parliamentary Commissioner for the Environment (PCE) explained the complex freshwater quality cause-effect relationships that operate in New Zealand catchments, and the relationship between land use and water quality (Parliamentary Commissioner for the Environment, 2012). A 2013 PCE report investigated the link between land use and the nutrients that reduce water quality in New Zealand catchments (Parliamentary Commissioner for the Environment, 2013). This 2013 report combined the results of two modelling exercises. The modelling exercise first predicted rates of rural land use change over time, and the second predicted the total amount of nutrients that can enter freshwater from land. The results of this modelling exercise predicted that the rapid land use change from sheep and beef to dairy farming will lead to increasing nutrient loads in waterways, and the deterioration of water quality in many catchments (particularly in Canterbury and

Southland). A more recent PCE report (2015) updated the modelled land use predictions from the 2013 report (Parliamentary Commissioner for the Environment, 2015). This report confirmed that land use change from sheep/beef to dairy has continued, but, suggested that the modelled data has underestimated the quantity of nutrients that would enter waterways from pastoral land use. The next section explores national and international consumers' perceptions about the impact of agriculture on the environment. In particular, perceptions of the cause-effect relationship between farming and freshwater quality is presented.

Is dairy farming affecting freshwater quality in New Zealand? Public perceptions of agriculture and the environment

A range of quantitative and qualitative studies explored the public's perception of New Zealand's environment, and the impact of agriculture on the environment. Some studies were long term trend surveys of New Zealanders' perceptions (e.g.Environment Waikato, 2007; Hughey, Cullen, & Kerr, 2010). Some presented a snapshot in time (e.g. Horizon Research, 2014), and others explored overseas consumers' perceptions about New Zealand's environment (e.g. Ministry for the Environment, 2001).

A long term triennial survey (1998-2006) was conducted on behalf of Environment Waikato[21] to investigate the environmental attitudes, awareness, and actions of residents in the Waikato (Environment Waikato, 2007). Respondents indicated their increasing concerns about regional water pollution, a perception that farming contributes to water pollution, and an increased perception that farming is the main contributor of pollution in the region's freshwaters. Eight surveys (2000-2016) of New Zealand adults' perceptions and attitudes of environmental issues were conducted by Lincoln University. An analysis of past results indicated an increasing trend of concern about the quality of some lowland streams, and that farming is 'blamed' for declining water quality (Hughey et al., 2010). In the most recent survey (2016), respondents believe water issues are the most important environmental challenge for New Zealand, and farming (farm effluent and runoff management in particular) is increasingly perceived as one of the three main causes of freshwater decline.

[21] Environment Waikato is the trading name for the Waikato Regional Council.

Fish and Game New Zealand commissioned a study[22] in 2014 to investigate New Zealand adults' perceptions of farming and the environment (Horizon Research, 2014). Some key results indicated that 69.9% of respondents believed the expansion of the dairy industry has reduced freshwater quality compared with 20 years ago, and just over half (54.7%) believed the dairy industry's environmental performance is adversely affecting New Zealand's global reputation and its 'clean green' brand. These survey findings were widely reported in the media and attracted widespread debate and criticism by dairy farmers, Federated Farmers, DairyNZ and by politicians. As reported in the media, the former group were critical of the report's lack of acknowledgement of on-farm mitigation strategies already adopted and the blame being attributed to dairy farmers when other sources also contributed to declining water quality (Hyslop, Sharpe, & Kirk, 2014). Some opposition politicians criticised the government's lack of action towards improving water quality (Scoop, 2014)

A study of overseas consumers' perceptions of New Zealand's environment found similar results to those from New Zealander studies. The Ministry for the Environment commissioned quantitative research in 2001, to explore international consumers' perceptions of the New Zealand environment and how that could benefit export trade (Ministry for the Environment, 2001). A key finding of this study was that consumers' perceptions of New Zealand's 'clean green' image is a driver of New Zealand's export value. However, the report also suggested that the impacts of dairy farming on freshwater quality could influence the purchasing behaviour of 'environmentally conscious consumers'.

These public perception surveys indicate similar findings. Both New Zealanders and overseas consumers perceive that freshwater quality is declining, and that dairy farming is one of the contributors to freshwater quality decline. The New Zealand respondents in particular identified an increasing concern about declining water quality, and an increasing concern about freshwater management. The Ministry for the Environment and Fish and Game commissioned surveys, both identified that public perceptions of declining freshwater quality could negatively impact on New Zealand's 'clean green' image and international trade.

Importantly, these public perception surveys provide evidence of increasing concern about declining water quality. The next section will explore the government, stakeholder and dairy

[22] This study was a survey of 3134 New Zealanders aged 18+ who are members of Horizon Research's HorizonPoll panel. This panel represents the adult population at the 2006 census. The survey had an overall margin of error of ±1.8%.

industry's responses to scientific evidence and increasing public concern about the impact of dairy farming on freshwater quality.

Government, stakeholder and industry responses to declining freshwater quality

In response to scientific evidence and increasing concern about declining freshwater quality, a range of water quality interventions were progressively introduced in New Zealand. This section presents central and regional government's role in managing the environmental impacts from land use, the actions taken by some stakeholders (Fish and Game's 'dirty dairying' campaign and the Land and Water Forum), and central government's response to these actions. The dairy industry's response to stakeholder action, and increasing concerns about the impact of dairy farming on freshwater quality, is also explored.

Central and local government's role: managing the impacts of land use on the environment

The New Zealand Government takes a regulatory and advisory role in managing the impact of agricultural land use on the environment. One of the first Acts, the Dairy Industry Act 1908, set hygiene standard for dairy sheds and allowed for regular dairy shed inspections by the Dairy Division of the Ministry of Agriculture (Warr, 1988). Increased hygiene standards necessitated the removal of animal waste from dairy sheds (Warr, 1988), and as dairy farms were usually located near waterways, digging a drain to the nearest waterway fixed the problem. These small volumes of effluent were point source discharges to waterways, and Blackett (2004) suggested that discharges to water were accepted dairy farm practice at this time ('everyone did it').

The Soil Conservation and Rivers Control Act 1941 appears to be the government's first approach to targeted environmental management. By focussing on soil conservation, this act directly addressed the relationship between land management and water quality. It aimed to prevent and reduce erosion, prevent flood damage, and encouraged farmers to adopt land uses and soil conservation practices that would achieve these aims (Ministry for the Environment, 1997). The act's voluntary approach encouraged farmer education and adoption of practices, rather than regulating land use. This Act also established the Soil Conservation and Rivers Control Council.

The Soil Conservation and Rivers Control Council established local catchment boards in the 1940s, with the purpose of minimising and preventing flood and erosion damage. The early boards had elected local members and members were recommended by the local authority. A government subsidy system was established, and catchment board staff worked collaboratively with farmers to help them with soil conservation work (e.g. retirement fencing and tree planting) (www.Teara.govt.nz). Board staff also worked with the community and established catchment control schemes. The boards' functions were advisory rather than regulatory.

Concerns about increasing water pollution from sewerage and industrial waste (point source pollution) in the 1950s, resulted in the passing of the Waters Pollution Act 1953. This Act established the Water Pollution Council, and their function was to prevent and abate water pollution (www.TeAra.govt.nz). There was little treatment or very basic treatment of wastewater at the time (Gilliland, 2009). A report on water quality in the Manawatu and Oroua Rivers by the Ministry of Works in 1957, contained some compelling observations:

> *'Sewage scum was visible on the water surface about half a mile below the stream* [Mangaone Stream], *while floating sewage particles and pieces of algae were evident in the broad slow moving reach immediately above the Longburn bridge'. (As reported in Gilliland, 2009, p.4).*

Increasing attention to the management of natural water resources continued during the 1960s and 1970s. Establishment of Water Pollution Regulations in 1963 set water quality standards in some areas, and these standards acted to control the level of contamination in these areas. Enactment of The Water and Soil Conservation Act 1967, led to the 1972 creation of the Water Resources Council, and in collaboration with the newly formed Regional Water Boards, assumed responsibility for water quality and pollution control.

Anecdotal evidence from a Manawatu Catchment Board employee during the 1970s, summarised the management of dairy farm effluent at this time. Farm dairy shed inspections were beginning, and dairy sheds were often located near to water sources to facilitate the discharge of untreated farm dairy effluent to waterways. The discharge of farm dairy effluent to waterways was recommended and accepted practice. He recounted:

> *'The Board's dairy shed inspectors were told that MAF dairy advisors recommended such locations because they provided easy water supply and wastewater disposal options'* (Gilliland, 2009, p.7).

He also shared his memories of the water quality in a creek near Eketahuna:

'*I recall compliance staff discovering several untreated discharges from dairy sheds into a small water body near Eketahuna during the initial inspection programme in the late 1970s. It was no surprise that this water body was known locally as Black Creek*'.

The monitoring of dairy shed wastewater disposal systems continued during the 1980s (Gilliland, 2009). The two main options for the management of farm dairy effluent were the discharge of untreated effluent to land and the discharge of treated effluent to waterways[23]. A two pond system was effective at removing carbon and suspended solids, but not as effective at removing nutrients (nitrogen and phosphorous) from effluent discharges (Wang et al., 2004).

During the 1980s, there was an increasing realisation that New Zealand's key environmental legislation needed to be reviewed in order to improve local environmental management (Environmental Defence Society, 2011). The New Zealand Government enacted legislation to control the effects of development on the environment with the passing of the effects-based Resource Management Act 1991 (RMA). The RMA provides a single piece of legislation for the management of soil, water and land in New Zealand, and its purpose is to sustainably manage natural and physical resources. Section Two of the Resource Management Act 1991 defines the environment, and this definition is used by local government in their strategies and plans:

(a) ecosystems and their constituent parts, including people and communities, and
(b) natural and physical resources, and
(c) amenity values, and
(d) the social, economic, aesthetic, and cultural conditions which affect the matters stated in paragraphs a to c of this definition or which are affected by those matters.

The RMA sets out the roles and responsibilities for central and local government. Central government administers the Act, provides national direction (prepares national policy statements to guide local government decision making), and responds to national environmental issues. Local government includes regional councils, territorial authorities (city and district councils) and unitary authorities[24]. New Zealand is divided into 16 local government regions, and each region's geographical boundaries approximately follow river catchment boundaries[25]. There are currently

[23] Dairy farmers traditionally used a two pond system design (anaerobic followed by an aerobic or facultative pond) for treatment of farm effluent before it was discharged to water (Wang, Magesan, & Bolan, 2004).
[24] A unitary authority is a district or city council that also performs the functions of a regional council.
[25] The catchment boards established in the 1940s were amalgamated and replaced by regional councils.

11 regional councils and six unitary authorities in New Zealand. Under the RMA, regional councils (and unitary authorities) are responsible for the integrated management of the natural and physical resources of their region, including the management of freshwater resources. Regional councils (and unitary authorities) manage their region's natural resources through the preparation of a regional policy statement and regional plans, and these regional policy statements and regional plans must 'give effect to' (implement) the objectives and policies of a national policy statement. A regional policy statement outlines the significant issues and sets the direction for environmental management in the region. A regional plan specifies the controls on natural and physical resources, and covers both permitted activities and those which require a resource consent. Under the RMA, activities are classified into six categories: permitted, controlled, restricted discretionary, discretionary, non-complying, and prohibited (Part 6, Section 87A). The different categories determine whether a resource consent is required for the activity under consideration, what must be considered, and whether a consent must, may, or may not be granted. A regional council (and unitary authority) is required to grant a resource consent for a controlled activity (with some exceptions), but can refuse to grant a resource consent for a restricted discretionary, discretionary or non-complying activity. A resource consent cannot be granted for prohibited activities. Rules in regional and district plans determine within which category an activity falls. The RMA also encourages public participation in council decision making processes, for example, submitting on a publicly notified resource consent application, submitting on a council plan, presenting to a hearings committee, and appealing a decision to the Environment Court.

The RMA gives regional councils (and unitary authorities) the option of producing statutory plans (regional plans) for freshwater management. Councils interpret the RMA in different ways and use different approaches to manage freshwater quality in their region. For example, Environmental Waikato developed a regional policy statement and a regional plan (Waikato Regional Plan). Variations of this regional plan are used to protect significant resources in certain areas of the Waikato region. Variation 5 of the regional plan was introduced to protect water quality in Lake Taupo by managing land use and nutrient discharges. In contrast, Horizons Regional Council prepared the One Plan, which is a combined regional policy statement and regional plan.

New Zealand's environmental legislation and regulation differs to that used in the European Union, in terms of approach and the provision of subsidies. European Union legislation provides for subsidies for farmers (e.g. AES) whereas New Zealand legislation does not. In addition, New Zealand's RMA uses an effects-based approach to environmental regulation, and focuses on managing the effects of an activity rather than managing the activity (a prescriptive approach). The RMA also adopts an enabling approach, and intervention occurs when activities are likely to result in unacceptable environmental outcomes (www.environmentguide.org.nz). Government bodies responsible for enacting the RMA (e.g. regional councils) determine the effect of an activity through their monitoring programmes, and act accordingly. The enabling approach of the RMA contrasts to the prescriptive approach used in European Union legislation (described earlier in this chapter). A prescriptive approach defines how an activity will be undertaken (e.g. what techniques will be used), for example, European NVZ regulations place restrictions on the quantity of and timing of nitrogen applications, and requirements for the storage of slurry, poultry and farmyard manure (Macgregor & Warren, 2016). Although the RMA is effect-based in approach, councils interpret the RMA differently and a council may introduce rules and regulations (e.g. to control land use) based on their understanding of the impact of an activity on the environment.

In line with legislative approach, New Zealand's method of nutrient management differs to methods used in the European Union. New Zealand uses an outputs-based approach, and under the RMA, each regional council sets quantitative water quality limits (e.g. nutrient limits) that will implement the objectives of the National Policy Statement Freshwater Management (Ministry for the Environment, 2014). An outputs-based approach assesses 'the quantity of nutrients leached from the root zone of land on the basis that their ultimate fate is surface or groundwater' (Duncan, 2014, p.381). This non-prescriptive approach to nutrient limits aligns with the effects-based RMA. In contrast, European NVZ regulations use an inputs-based approach to nutrient management, and focus on reducing inputs (e.g. nitrogen fertiliser) to improve water quality (Duncan, 2014). While both approaches aim to prevent nutrient losses, New Zealand's effects-based policy is different to the prescriptive approach used in Europe. Under an effects-based approach (the RMA) farmers and advisors are tasked with finding solutions, while under a prescriptive approach (e.g. NVZ) farmers are given the techniques to use.

The next section explores stakeholder's responses to declining water quality and increasing public concerns: the highly publicised 'dirty dairying' media campaign (contributed to the development of the initial dairy industry water accord), and formation of the Land and Water Forum (resulted in central government preparing a National Policy Statement for Freshwater Management and providing funding for regional water quality enhancement projects).

Stakeholders responses

'Dirty dairying' media campaign

Fish and Game NZ[26] are a not-for-profit organisation that works on behalf of anglers and hunters to maintain fish and game bird habitat. They were publicly outspoken and critical of dairy farming's contribution to declining water quality in the early 2000s. Frustrated with the dairy industry's perceived violations of water quality regulation, and concerned with declining water quality, Fish and Game launched a high profile 'Dirty Dairying' media campaign in 2001. In an initial press release, followed by newspaper announcements stating 'dirty dairying is a fact', Fish and Game were reported as strongly criticising the dairy industry for polluting waterways (Blackett, 2004). Fish and Game also criticised regional councils for insufficient regulation, and challenged dairy farmers and the dairy industry to accept responsibility. A swift and negative response from farmers, Federated Farmers, dairy companies and regional councils followed this emotive media campaign (Blackett, 2004).

Media discourse about water quality and dairy farming appears to have influenced the public's perception about dairy farming's impact on water quality. The 'dirty dairying' label is still used in social, visual (e.g. television) and print media, for example, attention grabbing headlines such as 'Dirty Dairying declining, or hidden?' (2016) and 'Dirty dairying dominates Waikato pollution figures' (2013). A google search of 'dirty dairying New Zealand' in 2017 returned almost 72,000 hits. A developing link between 'dirty' and 'dairy' was one of the drivers for dairy industry action, which led to the development of the Dairying and Clean Streams Accord.

Land and Water Forum: A stakeholder-led collaborative process

Key freshwater stakeholders[27] identified concerns and initiated discussions about freshwater management in the late 2000s. These stakeholders recognised society's increasing concerns about declining freshwater quality, and an increasing competition for water resources created by intensifying rural land use. They were also concerned that the voluntary dairy industry accord was not proving effective in preventing further water quality decline (Eppel, 2013). In 2008, ministers in the new National Government supported a collaborative governance process to recommend

[26] Fish and Game's role is described in Chapter Six.
[27] Included: environmental and agricultural organisations and iwi.

the reform of New Zealand's fresh water management. This process became known as the Land and Water Forum (LAWF). Using a stakeholder-led collaborative process, the LAWF aimed to develop a shared vision and a common direction for water management in New Zealand. The LAWF includes a wide range of stakeholders from more than 50 organisations: farmers, foresters, Fonterra, recreational and environmental NGOs[28], miners, tourism operators, power generators, irrigators, academics, scientists; and iwi (Eppel, 2013). Fish and Game, and Forest and Bird, were among the original stakeholders. Fish and Game resigned from the LAWF in 2015, and as reported in the media, resigned in protest at the government's perceived focus on development rather than environmental protection (Stewart, 2015). Forest and Bird and Federated Mountain Clubs resigned from the LAWF in 2017. Forest and Bird believe government has largely ignored LAWF's recommendations, and by continuing with LAWF, it signals that Forest and Bird supports government proposals they do not agree with (Hanger, 2017).

The LAWF's first report to central government in 2010 included a range of recommendations for the reform of land and water management in New Zealand (Land and Water Forum, 2010). Among others, this first report (Fresh Start for Freshwater) recommended a National Policy Statement for Freshwater Management under the RMA, in order to guide regional council decision making around freshwater management. The Forum's second and third reports were released in 2012, and the fourth report in 2015. The LAWF continues to assist government with the development and delivery of water policy reform.

Central government responded in two key ways to the suite of recommendations from the LAWF process. Firstly, central government released a programme of work[29] that detailed the direction of freshwater management reform in New Zealand. This work proposed the design of a national policy statement and provided funds for regional water management initiatives (e.g. Fresh Start for Fresh Water Clean-up Assistance Fund). For example, In the Manawatu-Wanganui Region, the stakeholder-led Manawatu River Leaders Accord received central government funding (Fresh Start for Fresh Water Clean-up Assistance Fund) in order to improve water quality in the Manawatu River catchment. One of the funded projects was a stream fencing subsidy for dairy and sheep and beef farmers, in order to exclude stock from waterways.

[28] Non-government organisations, e.g. Federated Mountain Clubs.
[29] New Start for Freshwater 2009 was renamed as Fresh Start for Freshwater 2010.

Secondly, central government set a national direction for water management when the National Policy Statement for Freshwater Management (NPSFM) came into effect in 2011, and revised in 2014. A national policy statement (NPS) enables central government to prescribe policies and objectives for matters of national significance, which are relevant to the Resource Management Act 1991. A NPS guides regional government decision making. The NPSFM set out the objectives and policies that direct local government to manage water in an integrated and sustainable way while providing for economic growth within set water quantity and quality limits (Ministry for the Environment, 2011, 2014). The next part of this section outlines the dairy industry's response to concerns about the dairy industry's increasing impact on water quality. The dairy industry developed a voluntary industry accord that promoted best management practices to improve water quality outcomes.

The dairy industry: a voluntary approach

The dairy industry responded to mounting media attention ('dirty dairying'), increasing concern, and mounting scientific evidence about the impacts of dairying on freshwater quality. The industry developed a voluntary industry initiative to reduce the impact of dairying on freshwater quality. A collaboration between Fonterra (the largest dairy company in New Zealand), regional councils and government (Ministry of Agriculture and Fisheries and the Ministry for the Environment), culminated in the signing of The Dairying and Clean Streams Accord (DCSA) (Fonterra et al., 2003). The DCSA was a statement of intent and a framework of actions to promote sustainable dairy farming in New Zealand, and focused on reducing the impacts of dairying on freshwater quality. TheDCSA contained five performance targets[30] and associated dates, and progress was measured against these targets.

Media reports highlight the various actors' perspectives at this time. From Fonterra's perspective, action was taken to address society's perception of 'dirty dairy' farming, and to assure international and domestic customers, dairy suppliers were working towards environmental goals (Morgan, 2003). The other Accord partners, central and local government, were understandably supportive of the industry's voluntary approach. Central government indicated that regulatory interventions to address declining water quality were a strong possibility, if the industry had not

[30] DCSA targets: stock exclusion from streams; bridges or culverts on stock crossing points; effluent discharge to comply with regional council conditions; systems to manage nutrient inputs and outputs; and regionally significant wetlands to be fenced.

acted accordingly. The then Parliamentary Commissioner for the Environment stated strong support for the accord and its collaborative process, and highlighted the growing worldwide concerns about declining freshwater quality (Parliamentary Commissioner for the Environment, 2002). In contrast, Federated Farmers and dairy farmers were in opposition to the DCSA. Some media reports suggested that dairy farmers were angry because of a perceived lack of consultation, lack of certainty and a perceived loss of control (Rural News, 2003). Other reports suggested some dairy farmers also believed Fonterra had no authority to develop an accord (duplicating regional government's role), and that there was no need for an accord because they believe dairy farmers are already implementing environmental practices (NZPA, 2002). Fish and Game were critical of the DCSA, described it as 'wimpy', and believe the long term targets will 'fail to resolve the environmental threat from dairying' (NZPA, 2003).

Annual assessments of progress against the DCSA's standards were reported in the Snapshot of Progress reports (Fonterra, Ministry for the Environment, Local Government New Zealand, & Ministry for Primary Industries, 2013). The progress reports relied on farmer self-reporting, and the results indicated good progress towards achieving the DCSA's targets. However, an independent survey prepared for the Ministry of Agriculture and Fisheries in order to measure progress towards reaching stock exclusion targets, found significantly lower levels of full stock exclusion than previously reported by Fonterra in the snapshot reports (Sanson & Baxter, 2011). This survey resulted in Fonterra contracting AsureQuality to audit and check the progress of dairy farm stream fencing (walk and GPS map).

Media reports again highlighted the various actors' perspectives near the end of the DCSA's ten-year lifespan. The Accord partners (Fonterra, central and regional government) agreed that dairy farmers were moving towards sustainable agricultural practices, but recognised that more changes were required. However, the partners were concerned about the percentage of dairy farmers that were non-compliant with regional council resource consent conditions. Fonterra's response to the lower than expected stock exclusion figures, was to announce that suppliers would be required to complete stream fencing by set dates, and indicated the threat of economic sanctions. Regional councils supported Fonterra's 'stronger' stance to achieving stock exclusion targets (Local Government New Zealand, 2011).

While recognising that some progress had been made, environmental organisations Forest and Bird, Fish and Game, were largely critical of the DCSA and of the accord's progress. Press releases noted their criticism of the lack of credibility and accuracy of progress results, the apparent ineffectiveness of a voluntary approach in achieving dairy farmer behaviour change, and called for independent monitoring of progress and regulation to address declining water quality (Fish and Game, 2011; Forest and Bird, 2011). Fish and Game in particular were highly critical of the accord's success, when they believed that the science at the time was indicating a continual decline in water quality.

The Dairying and Clean Streams Accord expired in 2012, and was replaced with the more comprehensive Sustainable Dairying Water Accord in 2013 (DairyNZ & DCANZ, 2013). An increased focus on water quality from central government (NPSFM), local government (regional plans) and the stakeholder-led approach (Land and Water Forum), necessitated some change from the previous accord. The Sustainable Dairying Water Accord is no longer a bilateral agreement between Fonterra and government (and only applicable to Fonterra suppliers), but broader to include the majority of New Zealand's dairy companies (as accountable partners[31]), DairyNZ, organisations with an interest in pastoral farming (e.g. Federated Farmers is a supporting partner) and other stakeholders who represent non-farming interests (e.g. Federation of Māori Authorities). In addition, new targets were added, existing targets tightened, and a more robust and independent performance monitoring system developed. The purpose of the accord, and the dairy industry's commitment to New Zealand, was to 'enhance the overall performance of dairy farming as it affects freshwater' (DairyNZ & DCANZ, 2013, p.3). The Accord sets out the good management practices that are expected of all New Zealand dairy farmers, and the Accord's signatories provide a legitimate account of the industry's activities and progress to the public. This accountability and transparency is a measure of the industry's social responsibility and is linked with the industry's stated values (in this example, stated values for freshwater in New Zealand). Media reports suggested that environmental organisations Forest and Bird and Fish and Game were critical of the 2013 Accord for its voluntary approach and lack of regulation, despite scientific evidence of a continuing decline in water quality.

Conclusion

A range of inter-linked international, national, regional and on-farm factors influenced the introduction of water quality interventions in New Zealand. At an international level, discussion

[31] Westland Milk Products is not an accountable partner but a friend of the Accord and supportive of its purpose.

and debate about the impact of agriculture on the environment, and an increasing international demand for products produced in an environmentally friendly manner, contributed to an increasing awareness about the impact of agriculture on the environment in New Zealand. An increasing international demand for milk powder, combined with a change in land use from sheep and beef to dairy in response to a change in government economic policy, contributed to the expansion and intensification of dairy farming in New Zealand.

More than two decades of scientific research, linked intensive agricultural practices with declining freshwater quality in New Zealand. Sediment, nutrient enrichment, and faecal contamination of waterways were noted. Since the early 2000s, scientific research specifically identified dairy farming as a contributor to freshwater decline. In addition, almost two decades of qualitative and quantitative public perception surveys highlighted both the New Zealand public's and international customers concerns about the negative impact of farming on water quality. Fish and Game's high profile 'Dirty Dairying' media campaign in 2001, strongly criticised the dairy industry for water quality decline.

In response to increasing scientific evidence and concern about dairy farming's impact on water quality, government and the dairy industry progressively introduced a suite of water quality interventions. At government level, central government set the direction for freshwater management in New Zealand by preparing a national policy statement and by providing funds for regional water management initiatives. These central government interventions were guided by the recommendations from the Land and Water Forum (a freshwater stakeholder group). Under the Resource Management Act 1991, central government freshwater quality policy guides regional government decision making about water quality management and choice of regional policy. In addition, the dairy industry introduced two successive voluntary dairy industry accords to reduce the impact of dairy farming on freshwater quality. The current industry accord sets out the good management practices that are expected of all New Zealand dairy farmers.

This historical chapter provides context for the remaining chapters in this thesis. Chapter Six follows, builds on the international and national context in this chapter, and presents water quality, dairy farm systems, water quality interventions and the regional actors involved in farming and water quality in the Manawatu-Wanganui Region. These two historical chapters provide context for the following two results, discussion and conclusion chapters.

Chapter Six
Regional Context

Introduction

This chapter explores the mix of regional programmes and policies put in place to address declining regional water quality, and to reduce the impact of dairy farming on water quality. This chapter builds on the previous chapter's historical context, sets the scene and provides context for the following two results chapters. Initially the Manawatu–Wanganui Region is described in terms of its physical characteristics and human factors (land use) that contribute to declining water quality. The nature of the regional water quality issue is then quantified. Horizon Regional Council's One Plan as a response to declining water quality is outlined, and accepted industry best practices to mitigate the impact of dairy farming on water quality are summarised. This part of the chapter then concludes with a description of the Upper Gorge Water Management Zone, which is the study site for this research.

A range of actors are involved in dairy farming and water quality in the Manawatu–Wanganui Region. Exploring the actor's roles and functions, and exploring relationships between actors and farmers and between various actors, provides context for the results chapters. A timeline describes the key events and development of regional water quality interventions, and, how these programmes and policies inform and influence dairy farmer behaviour change. Chapter Five's historical context explored the development of interventions since the 1940s, but this chapter focusses on the development of regional water quality interventions since the One Plan's inception in 2004. This chapter concludes with a description of the farm management systems on each of the participating farms. Data from farmer and key informant[32] interviews, Horizons Regional Council documents, media articles, and information from websites is used in this chapter.

[32] Key informants included staff from Horizons, Fonterra and DairyNZ and a TCEIS representative. These individuals were identified as having a role in this research by the farmer participants and other key informants.

The Manawatu-Wanganui Region

The Manawatu-Wanganui region covers a land area totalling 22,215 km^2 in the southern North Island of New Zealand. This area represents 8.1% of New Zealand's total land area and is the second largest region in the North Island (Horizons Regional Council, 2005). The region contains cities (Palmerston North and Wanganui), other urban centres, and smaller towns. The Manawatu-Wanganui region is divided into seven territorial local authority districts (Tararua is one district), and these districts are managed by their respective territorial local authority (district or city council). In terms of environmental management, Horizons Regional Council (commonly termed Horizons) has a responsibility to maintain and enhance the natural resources of land, water, air and coast within the region. In particular, Horizons has a responsibility to manage and improve the quality of lakes, rivers and streams in the Manawatu-Wanganui region.

As depicted in Figure Five, waterways (lakes, rivers and streams) dominate and define the Manawatu-Wanganui region. The region is shaped by three major river catchments (Manawatu, Rangitikei and Whanganui), five smaller catchments, a range of smaller coastal catchments and a series of natural lakes. The Manawatu River catchment is of particular interest in this study, and the research study site (Upper Gorge WMZ) is located within the Manawatu River catchment and the Tararua District. The Manawatu River (235 km long) is the major tributary of the Manawatu River catchment (5,898 km^2). The Manawatu River has its headwaters in the eastern Ruahine Ranges, and is fed by several smaller rivers (Mangatainoka and Mangahao) before it flows through the Manawatu Gorge, wanders across the plains, and meets the sea on the western side of the ranges at Foxton Beach.

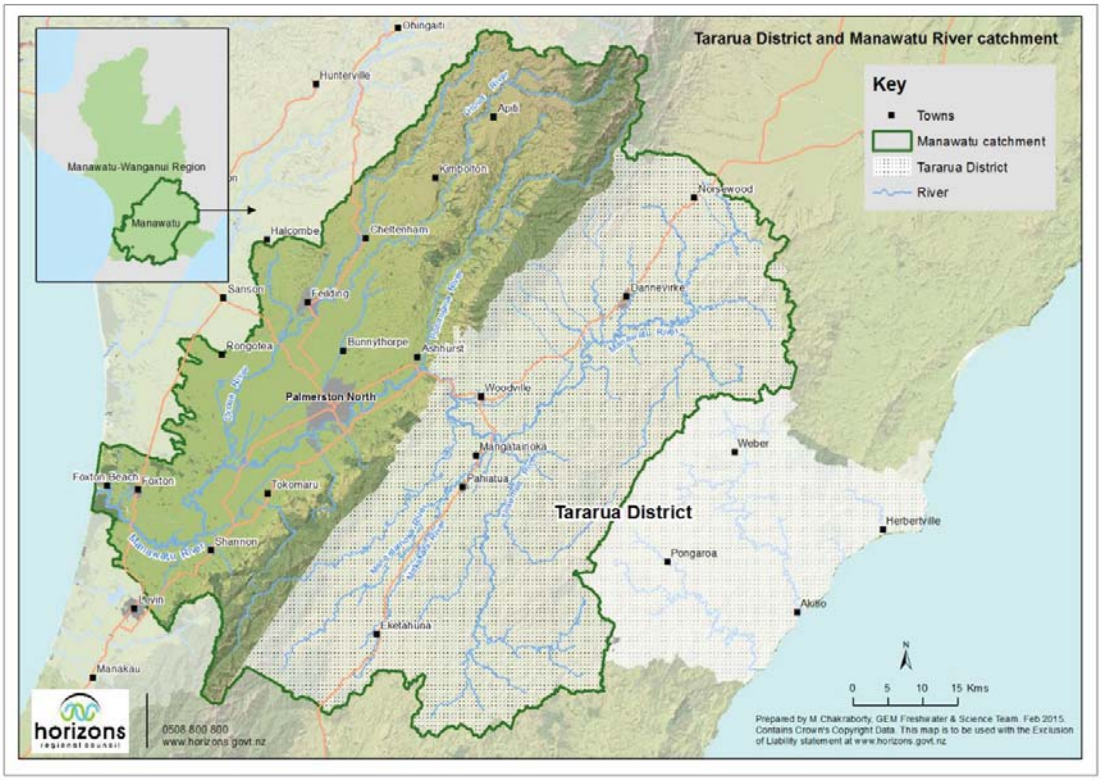

Figure 5: Tararua District and Manawatu River catchment.

Physical features (topography, rainfall, and land cover) can contribute to declining freshwater quality in the Manawatu-Wanganui Region. The 2013 Horizons Regional Council State of the Environment Report (Horizons Regional Council, 2013b), classified the majority (64.5%) of the Manawatu-Wanganui Region as hill country[33] and a small proportion (9.4%) as elite soils. NIWA's (National Institute of Water and Atmospheric Research) annual rainfall maps illustrate the annual regional rainfall pattern for a 30-year period (1981-2010). The mean annual rainfall ranges from approximately 5,000-6,000 mm in the Ruahine (headwaters of Manawatu River) and Tararua Ranges, to approximately 960mm on the flood plains of the Manawatu catchment, to approximately 800mm in the coastal areas of the region (e.g. near Levin).

[33] The Land Use Capability system (LUC) classifies hill country as LUC classes 5, 6 and 7 and elite soils as LUC 1 and 2 (Lynn et al., 2009)

Agricultural land use in the Manawatu-Wanganui Region

The Manawatu-Wanganui Region can also be described by the human factors (land use) that can contribute to declining freshwater quality. Modelled regional land cover data[34] for 2013 indicates that over half of the region is in pastoral cover (58.0%), and sheep and beef farming was identified as the major land use in the region (51.3%) (Horizons Regional Council, 2013b). Dairying utilised a comparatively small land area (6.7% of total land use), however, the expansion and intensification of dairying has been linked to declining regional freshwater quality (Horizons Regional Council, 2005).

The Tararua District dairying area and study site for this research, is currently the largest in the Manawatu-Wanganui Region (LIC, 2016) and one of the older dairying areas. A high and reliable annual rainfall in the Tararua District contributed to the growth of dairying in this area. Farmland was cleared and settled from the 1880s, and dairy farms were established around the towns of Woodville and Dannevirke. Milk production for domestic consumption slowly gave way to factory production, and the first dairy factories in the Tararua District opened around the early 1890s (www.KeteTararua. Peoplesnetworknz).

Dairy industry statistics[35] from the late 1990s (LIC, 1999) to the 2015/16 season (LIC, 2016), depict a continuing expansion and intensification of dairying in the Manawatu-Wanganui region. In the Tararua district, cow numbers increased by 14% over these 17 seasons, albeit with seasonal fluctuations. Consistent with the national trends depicted in Chapter Five, dairy industry data for the Tararua District indicates the number of herds is decreasing and the average herd size is increasing. Additionally, production per cow (kgMS/cow) and production per ha (kgMS/ha) have increased. The next section identifies and quantifies the water quality issue in the Manawatu-Wanganui Region.

[34] Horizons used data from the consent database, from the 2007 Agribase™ and from the Land Cover Database 2 to model regional land cover and land use. The data sources and method are specified in Clark and Roygard (2008).
[35] The published dairy industry data (LIC Dairy Industry Statistics) for the Manawatu Region was re-worked to reflect the regional council boundaries and to include the Tararua District (under Wairarapa in the LIC statistics).

Regional water quality: identifying and quantifying the problem

A change in the state of regional freshwater quality over time, necessitated increased water quality monitoring, and increasing intervention by the regional council. Baseline monitoring by the former Manawatu Catchment Board in 1978, indicated good water quality in the upper, and poor water quality in the lowland Manawatu River. Horizons initiated a regional surface water quality monitoring programme in 1989 (Roygard, Hurndell, Clark, & Nicholson, 2011), and continued to review and upgrade this programme. By 2007, Horizons established an extensive regional network of monitoring sites, and increased both the frequency of measurement and parameters to be measured (Snelder, Brooker, Unwin, Wood, & Wilcock, 2014). These sites monitor physiochemical (e.g. clarity, nitrogen and phosphate) and microbiological variables (*Escherichia coli - E. coli*), and biological indicators (periphyton and invertebrates). A Horizons' scientist explained how monitoring has improved Horizons' understanding of water quality, their ability to explore trend data, and to separate contributions from point source and non-point source discharges (J. Roygard, personal communication, March 22, 2016). Horizons use their regional surface water quality monitoring data to inform decision making about policy development (One Plan), and non-regulatory initiatives (e.g. subsidies, education and advice). This data also helps Horizons identify water quality state[36] and trends over time, and to explore and understand the cause/effect relationships between land use activities and the environment. Horizons monitors and reports on the state of their region's resources (State of the Environment - SOE) as a statutory requirement under the RMA (1991), and three SOE reports for the Manawatu-Wanganui Region have been released (1999, 2005 and 2013).

Increased nutrients, sediment, and the presence of pathogens are the three identified regional water quality issues[37]. The increased growth of nuisance (excess) periphyton[38]is attributed to an increased concentration of nutrients, and McArthur and Clark (2007) described nuisance periphyton as a significant regional environmental issue. Increased water nutrient levels also contribute to the growth of benthic mat forming cyanobacteria (blue-green algae), and this is an emerging regional issue of concern during low river flow conditions (Horizons Regional Council, 2013b). Some species of benthic cyanobacteria produce neurotoxins, and these neurotoxins are a health threat to humans and animals through consumption or contact with contaminated water (Wood & Young, 2011). The prevalence of benthic cyanobacteria and toxins in the regional rivers

[36] By comparing water quality variables and indicators at each monitoring site with the water quality targets set in the One Plan.
[37] These contaminants are defined in Chapter One.
[38] Periphyton is defined in Chapter One.

that are a source of town water supply, is of concern to Horizons' staff (Wood & Young, 2011). Encouraging and enforcing land management practice change and point source pollution control, reduces the concentration of nitrogen and phosphorous in waterways. Land management practice change is Horizons' primary mechanism to control regional periphyton and benthic cyanobacteria.

Water quality in the Manawatu River catchment

Snelder et al. (2014) conducted the most recent state and trend research on river water quality in the Manawatu River catchment. They assessed water quality state, and graded river water quality as either a 'pass' or a 'fail' based on a comparison of the monitored data for the year ended 2013 with the One Plan targets. Overall, water quality in the Manawatu River catchment was classified as poor. Approximately three quarters of the sites failed the phosphorous and nitrogen grades, and most failed the water clarity (sedimentation) and *E.coli* targets. These failures were broadly distributed over the Manawatu River catchment. Spatial modelling indicated that poor water quality (high nutrients and faecal pollution, and low visibility) was associated with pastoral cover, and Snelder et al. (2014) concluded that the current poor state of water quality in the Manawatu River catchment can be attributed to non-point source contributions from agriculture. Both long term (20 year) and short term (five year) trend assessments of water quality indicated a general overall trend for improving water quality (where results were significant). Over the long term, a general decrease in nutrient concentrations was noted. The five year trend data showed a similar trend in decreasing nutrient concentrations, but with increasing periphyton biomass. In summary, current water quality in the Manawatu River catchment is poor but improving. Water quality does not yet meet the One Plan targets.

Lag time is an inherent characteristic of a catchment under study, and is defined as the 'the amount of time between an action and the response to that action' (Meals, Dressing, & Davenport, 2010, p.85). Morgenstern et al. (2014) estimated the average lag time between rainfall infiltrating to groundwater, and the groundwater emerging in the Manawatu River channel. They found the average lag time ranges from 0-11 years during low flows, which indicates the average time for nutrients leached from the root zone to arrive in the Manawatu River. Morgenstern et al.'s (2014) research highlights that there will be a lag between changes in land management practices that reduce nutrients, sediment and *E.coli* to waterways, and their impact on water quality. The next section investigates Horizons' response to declining water quality.

The One Plan: Horizons' response to declining regional water quality

The One Plan is a combined regional policy statement[39] and regional plan[40], and prepared by Horizons in accordance with their functions under the Resource Management Act (1991) (Horizons Regional Council, 2014a). The One Plan was initiated to address declining water quality over time (among other issues). Dairy farmers' responses to the One Plan rules that relate to land use activities affecting surface water quality are of key interest in this study.

Horizons' regional monitoring programme identified declining water quality over time, and various non-regulatory and regulatory methods were progressively introduced to address this decline. Prior to 2004, Horizons had a plethora of documents to guide regional resource management: the regional policy statement, six regulatory regional plans and three non-regulatory management strategies. In addition to declining water quality, Horizons recognised that the overlaps and gaps between plans and strategies were creating confusion and uncertainty for resource users. In 2003, Horizons' staff discussed the concept of having one plan for the management of the region's resources (Anderson, 2009). The 'One Plan' was born.

Horizons' policy team prepared a discussion paper, and in 2004 invited public participation to develop a shared vision around environmental management. The paper asked the community for 'their concerns, what they wanted for the environment, and what Horizons should or could do to get there' (Horizons Regional Council, 2004). Declining surface water quality was one of the discussion themes and was extended to become one of the 'big four' keystone environmental issues in the One Plan[41].

The One Plan adopted a new and targeted approach to managing surface water quality. McArthur et al. (2007) developed a framework of geographic units termed Water Management Zones (WMZ) and Water Management Sub-zones (WMSZ) to enable this targeted approach. The One Plan divides the eleven parent catchments into 43 Water Management Zones, which are further divided into 124 Water Management Sub-zones. Each WMZ and WMSZ has a framework of surface water quality values, and each value is translated into targets. By comparing monitored water quality with the targets, waterbodies can be identified that meet, are close to, or are degraded and do

[39] A regional policy statement outlines the significant issues and sets the direction for environmental management in the region.
[40] A regional plan specifies the controls on natural and physical resource and covers both permitted activities and those which require a resource consent.
[41] The other three identified keystone environmental issues in the One Plan were: Increasing Water demand; Unsustainable hill country; and Threatened indigenous biological diversity.

not meet the targets (do not support the community's values) (Aussiel & Clark, 2007). Based on the state and trends of regional water quality, Horizons identified and targeted the WMZ and WMSZ where they believe the management of existing intensive[42] farming land use activities (which includes dairying) must be specifically controlled (targeted WMZ) (Roygard & McArthur, 2008). Figure Six illustrates the location of targeted catchments and the relative positions of dairy farm businesses in the Manawatu River catchment.

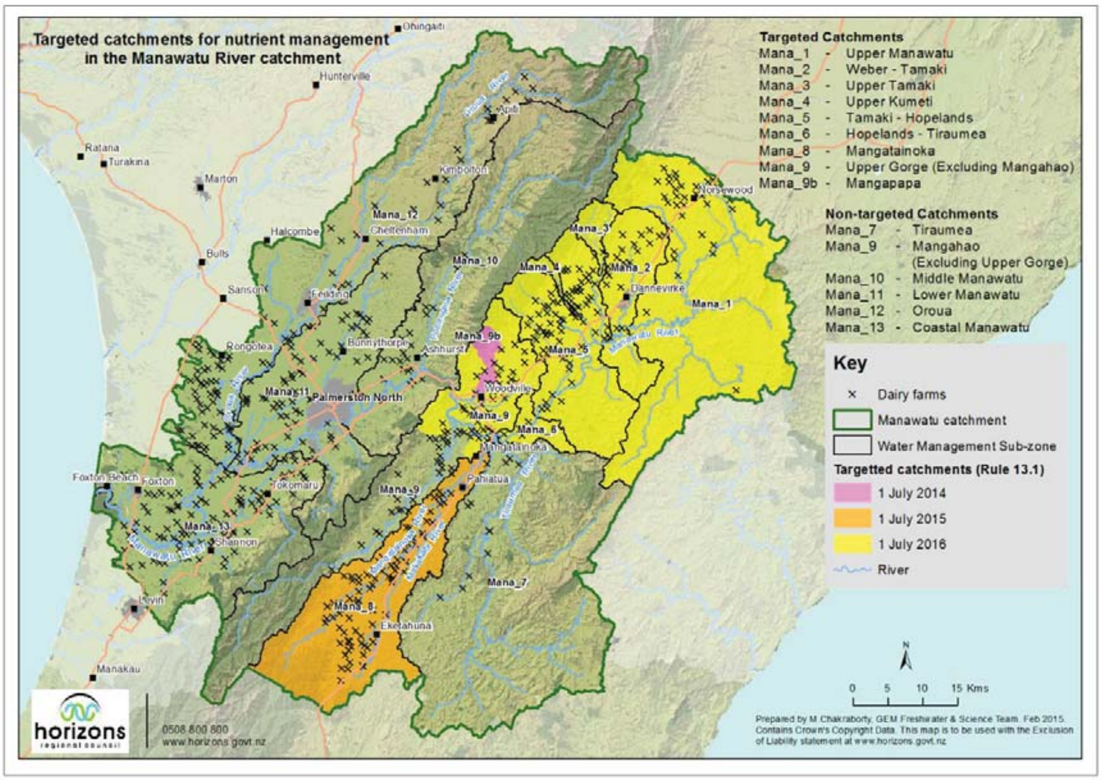

Figure 6: Targeted and non-targeted water management zones for nutrient management in the Manawatu River catchment.

Targeted WMZ (and WMSZ) are defined in the One Plan as 'those zones (and sub-zones) where collectively, land use activities are significant contributors to elevated contaminant levels in groundwater or surface water' (Horizons Regional Council, 2014a, p.5-13). Intensive farming land use activities in the targeted WMSZ are actively managed through regulatory (rules in the regional plan) and non-regulatory methods (e.g. fencing subsidies, education and advice), to reduce the nutrient, sediment and faecal contamination of surface waters.

[42] Intensive farming land use activities are 'activities that (either individually or collectively) make a significant contribution to elevated contaminant levels in the targeted Water Management Sub-zones' (Horizons Regional Council, 2014a, p.5-13).

Dairy farming under One Plan rules

The regional plan component of the One Plan sets out the regional rules which prescribe how activities controlled by Horizons Regional Council are regulated. When the One Plan became operative in December 2014, all other plans were revoked, and existing resource consents continued until they were renewed under the One Plan, or surrendered on the granting of a consent under the intensive farming land use provisions. The main rules for agricultural activities [43] applying to farmers in this region include:

1. Existing intensive farming land use (including dairy farming) within targeted WMZ, and conversions to intensive farming land use (including dairy farming) anywhere in the region, will require a Land Use Consent. The One Plan states the date that rules have legal effect, and this depends on the WMSZ a farmer is in (ranging from 2014 to 2016). Existing dairy farms in non-targeted WMZ are not required to obtain a land use consent.

2. One Plan policies and rules establish the annual nitrogen leaching maximum (kg N/ha/yr) for intensive farming land uses requiring a Land Use Consent (Table 14.2). Farmers requiring a Land Use Consent must prepare a nutrient management plan. This shows whether they can meet the nitrogen leaching targets described in Table 14.2 or not. The nutrient management plan also describes the mitigation measures the farmer has agreed to implement to reduce nitrogen leaching to waterways.

3. For intensive farming land use in targeted WMZ and new intensive farming land use anywhere in the region:
   (a). Exclusion of cattle from wetlands, lakes and beds of rivers that are permanently flowing or have an active bed width greater than 1 metre;
   (b). Bridging or culverting of rivers that are permanently flowing or have an active bed greater than 1 metre crossed by cattle.

4. All dairy farms, whether in targeted WMZ or not, are required to hold a resource consent to discharge dairy effluent to land.

[43] Chapter 14 of the One Plan: Discharges to Land and Water.

The One Plan does not regulate waterway fencing in non-targeted WMZ. This activity is included in the Sustainable Dairying Water Accord and Fonterra supplier conditions.

Good management practices: mitigation strategies

A range of dairy industry-agreed good management practices are available to mitigate[44] the impact of nutrients, sediments, and faecal contaminants (e.g. *E.coli*) on water quality. Table Five lists the more commonly suggested mitigation strategies. Many of these practices are used routinely by dairy farmers, and combinations of these can be adopted as water quality mitigation strategies (as required to obtain a Land Use Consent). The practices chosen by each farmer will depend on the farm system and any potential impact on-farm profitability.

[44] A mitigation is any action that results in the reduction of pollution of waterways.

Table 5: Mitigation strategies to reduce the impact of nutrients, sediment and faecal contaminants on water quality.

Management area	Mitigation strategy	Effect on contaminants
Fertiliser	Reduce annual N fertiliser use	Reduces N
	Avoid applying N fertiliser in winter and to waterlogged soils	Reduces N leaching
	Use N fertiliser when pasture is growing	Reduces N leaching (ensures N application is suited to plant growth)
	Soil test to identify nutrient levels	Ensures excess nutrients are not applied
	Use slow release phosphorous fertiliser	Minimises the amount of soluble P in the runoff
	Avoid fertiliser application close to waterways	Reduces N and P in receiving water
Supplementary feed	Change to a supplementary feed with a lower N content	Reduces N concentration in the urine
	Reduce amount fed and change where fed	Reduces losses of nutrients and sediment to waterways
Livestock management	Graze cows off in winter	Reduces N leaching (reduces the amount of N from urine and faeces)
	Cull cows early in autumn	Reduces the number of urinations per unit area
	Reduce stocking rate	Reduces the number of urinations per unit area
	Use off-paddock facilities (e.g. stand-off pads)	Reduces N leaching (intercepts nutrients from urine and faeces)
	Manage grazing of winter break-fed crops	Minimises nutrient loss
Pasture management	Optimise pasture cover	Reduces N and P runoff

Management area	Mitigation strategy	Effect on contaminants
Managing FDE (farm dairy effluent)	Application rate: avoid saturating the effluent block Match effluent application rate to soil moisture	Low enough to prevent nutrient loss below root zone Reduces N leaching
	Increase area of the effluent block, and spread effluent evenly	Reduces N loading
	Use effluent block for cropping	Reduces N leaching (greater utilisation of N)
	Efficient water use in the cowshed to reduce volume of FDE	Reduces P and N loading
	Pond size: sufficient effluent storage to avoid applying effluent to water-logged soils	Reduces N leaching
	Seal effluent pond	Prevents N leaching to groundwater
Winter crop management	Use a minimal or no till establishment method	Reduces N leaching, P loss and sediment to waterways
	Time grazing and use a grazing regime to prevent concentration of urine patches	Reduces N leaching
	Crop selection: choose a crop with less N	Reduces N concentration in the urine
	Paddock choice (e.g. no waterways or artificial drainage)	Reduces N leaching, P loss and sediment to waterways
Waterways	Fence waterways	Reduces N, P, sediment, *E.coli*
	Leave a grass buffer strip or riparian plant between the fence and waterway	Traps soluble and particulate P and nitrate N
	Install culverts and/or bridges at stock crossing points	Reduces N, P, sediment, *E.coli*
Soil management	Avoid pugging and erosion	Reduces runoff and losses of N, P and sediment
	Re-sew bare paddocks as soon as practical	Reduces erosion and leaching

Adapted from: (DairyNZ, 2012a, 2012b, 2014c, 2016)

Study site: The Upper Gorge Water Management Zone

The Upper Gorge WMZ is the research study site and one of the 13 WMZ in the Manawatu River catchment. Located on the eastern side of the Tararua Ranges, the Upper Gorge WMZ (52,640 ha) consists of five sub-zones[45]: three are classified as targeted and two as non-targeted. There are 10 dairy farms in this study, and two farms are located in each of these five sub-zones.

Waterways are a prominent feature of the Upper Gorge WMZ (Figure Seven). Three major tributaries (the Mangahao River, the Mangaatua Stream and the Mangapapa Stream) drain into the Manawatu River, and the Mangahao River flows from its source in the Tararua ranges to join the Manawatu River near the Manawatu Gorge. The majority (44.5%) of the Upper Gorge WMZ is classified as hill country[46], with almost a third (30.2%) of flat to rolling hill country, and one quarter (25.0%) in native cover in the steeplands of the Tararua Ranges (Clark & Roygard, 2008). Using NIWA modelled data[47], rainfall variation can be explained by topographical changes. The mean annual rainfall ranges from approximately 5,000-6000mm in the Tararua Ranges in the south of the zone (headwaters of Mangahao River) to 1,000 – 1,400mm on the flatter land near Woodville at the northern end of the zone. One of the farmers in this study farms near the ranges, and has an average annual rainfall of about three metres (3,000 mm). Based on modelled regional land use data[48], over half (57.9%) of the land area in the Upper Gorge WMZ is used for agriculture, of which 20.5% is used for dairying (37.4% is used for sheep/beef) (Clark & Roygard, 2008). The remaining 40% is in native forest. Figure Seven illustrates the five WMSZ, land use, monitoring sites, and the major tributaries in this WMZ.

[45] Upper Gorge targeted WMSZ: Mana_9a, Mana_9b and Mana_9c. Non-targeted WMSZ: Mana_9d and Mana_9e

[46] The Land Use Capability system classifies hill country as LUC classes 6 and 7, flat to rolling hill country as LUC class 4 or better and steeplands as class 8.

[47] NIWA rainfall model is based on climate data from 1878-2007.

[48] Horizons used data from the consent database, from the 2007 Agribase™ and from the Land Cover Database 2 to model regional land cover and land use. The data sources and method are specified in Clark and Roygard (2008).

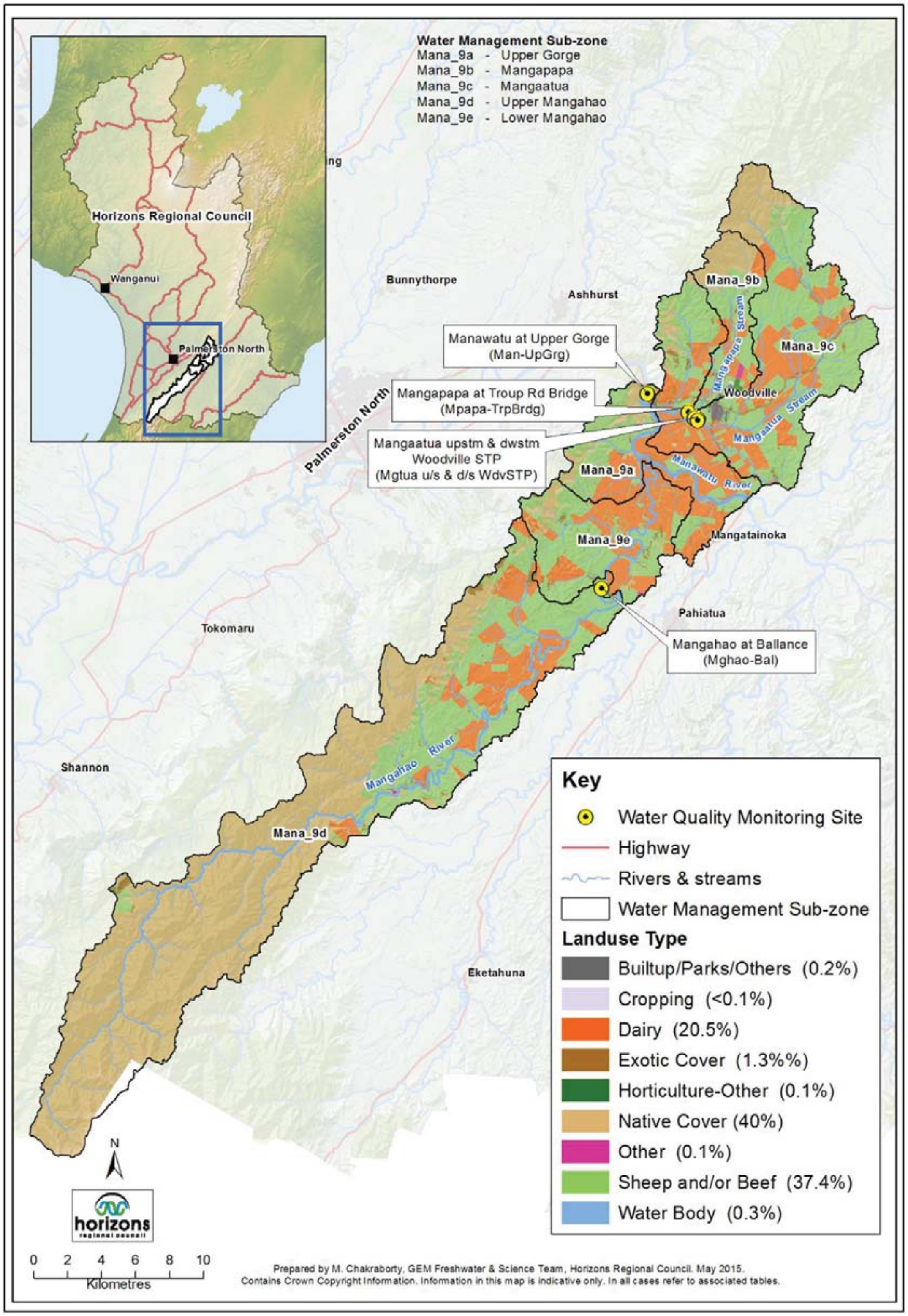

Figure 7: Upper Gorge Water Management Zone.

There are four water quality monitoring sites in the Upper Gorge WMZ (Figure Seven). A Horizons' senior policy analyst explained how water quality data was used to classify some sub-zones in the Upper Gorge as targeted and others as non-targeted. Horizons water quality data indicated that in-river nitrogen concentrations exceeded the One Plan water quality targets at some of the monitoring sites. Three of the WMSZ were classified as targeted to manage intensive land use and to reverse the increased nutrients in the Manawatu River. This policy analyst also explained that two of the WMSZ are non-targeted, because nitrogen concentration in the Mangahao River (which flows through these sub-zones) does not exceed the One Plan targets (B. Gilliland, personal communication, May 22, 2015). The next section introduces the individuals, groups and organisations (actors) involved in water quality in the Manawatu-Wanganui region.

Regional actors

A number of individuals, groups and organisations (actors) work with farmers and with each other around dairy farming and water quality in the Manawatu-Wanganui region. This section describes the roles and functions of the regional actors and introduces some of the relationships between actors and farmers, and between actors. The nature of the relationships between farmers and the regional actors are explored in detail in Chapter Eight (second results chapter). The organisations, groups and individuals in this section are presented alphabetically.

DairyNZ

DairyNZ is a levy funded[49] industry good organisation. As stated on their website (www.dairynz.co.nz), DairyNZ's purpose is 'to secure and enhance the profitability, sustainability and competitiveness of New Zealand dairy farming'. Environmental stewardship[50] (reducing the impact of dairy farming on water quality) is one of DairyNZ's stated objectives, and one they believe will contribute to sustainable dairy farming in New Zealand.

DairyNZ undertakes research and development, advocates, and provides information for New Zealand dairy farmers. DairyNZ's organisational structure includes a head office (Newstead, Hamilton) and a series of regional offices (including one in the Manawatu-Wanganui Region). The

[49] x cents/kg milksolids plus GST per dairy farmer.
[50] Environmental stewardship is 'the responsible use and protection of the natural environment' (DairyNZ, 2013b, p.33).

actors relevant to this study include national level staff (economist, policy and advocacy, sustainability, research and development, and people and business divisions) and staff from the Manawatu-Wanganui region (catchment engagement leader, environmental extension specialist, regional leader and consulting officers).

In terms of information relating to dairy farming and water quality, DairyNZ provides technical information and promotes best practice on topics including: waterway management (e.g. planning stock crossing points); controlling streambank erosion; fencing and planting waterways; and the management of farm dairy effluent (e.g. designing and upgrading effluent system and effluent application). DairyNZ staff provide information via personal interaction (e.g. farmer discussion groups, field days, seminars, focus farms and workshops) and via printed and web based resources.

In terms of research and development, DairyNZ established codes of practice around nutrient management, and also developed the Nutrient Management Adviser Certification Programme for New Zealand nutrient management advisers. A DairyNZ staff member in this study believes this programme provides regional councils with consistency and certainty that certified nutrient management advisers have the required level of knowledge to complete farm nutrient management budgets. DairyNZ is also involved in research about mitigation practices to improve water quality, including being one participant in the Pasture 21 Programme[51]. In terms of advocacy, the advocacy and policy team work with regional councils, farmers and other regulators to ensure sound regional policy development.

In this study, head office and regional DairyNZ staff worked with farmers, groups, organisations and regulators in the region around farming and water quality. DairyNZ was a submitter on the POP, but not involved in the court process. A few head office staff worked closely with the Tararua Community Economic Impact Society (TCEIS), and provided support, technical advice (economic and policy), resources, and access to contacts. Some DairyNZ head office staff also worked with Horizons staff around the One Plan's implementation, including: a research project on the socio-economic impacts of the Proposed One Plan; developing nitrogen loss targets that will achieve both environmental and farm profitability goals; and developing and piloting the application

[51] Pasture 21 is a five-year collaborative farm programme that was established in four regions (including the Manawatu-Wanganui). The programme aimed to provide proven and profitable farm systems that lifted production and reduced nutrient loss.

process for Land Use Consents (including publishing a resource booklet). DairyNZ subsidised the cost of the Land Use Consent pilot programme for participant farmers[52].

Some regional DairyNZ staff are involved in farming and water quality, and in the implementation phase of the One Plan. The Catchment Engagement Leader works with dairy farmers, staff from other organisations (e.g. Horizons, Fonterra, fertiliser companies and Federated Farmers), nutrient management consultants, farm consultants, members of the TCEIS and other stakeholders. This individual's role is to assist farmers in targeted WMZ obtain a Land Use Consent. Among other tasks, this individual facilitates the collection of baseline information from farmers in targeted WMZ; is involved in the One Plan farmer information meetings (applying for a Land Use Consent); and works with Federated Farmers' policy staff on issues that face regional dairy farmers. The environmental extension specialists work with farmers, rural business people and local body representatives about the regulations and requirements involving nutrient and effluent management.

Regionally based DairyNZ Consulting Officers run regional dairy farmer discussion groups. Although traditionally production focussed, topics relating to water quality and mitigation strategies are also discussed. Regional field days are also run on topics relating to water quality. Among other tasks, a DairyNZ regional leader was involved in the Tararua Dairylink project and facilitated a farmer strategic planning and governance discussion group.

Federated Farmers

Federated Farmers of New Zealand Inc. formed in 1945, and is a member based organisation that represents the interests of New Zealand farmers. Farmer membership of Federated Farmers is voluntary. As stated on their website, Federated Farmers' role is 'to provide responsible and credible advocacy on the important policy issues that face agriculture and farming' (www.fedfarm.org.nz). Federated Farmers' operating structure includes staff (e.g. regional policy advisors) and a network of elected farmer representatives at a national (e.g. Chairperson of the Dairy Industry Group) and regional level (e.g. provincial president). The regional policy advisors and elected representatives are the actors relevant to this study.

[52] A DairyNZ staff member commented that the pilot farmer participants only paid the application fee to Horizons, and DairyNZ covered the consultant's costs.

From farmer and key informant comments, Federated Farmers' policy advisors and elected representatives were advocating for farmers and challenging the POP. Federated Farmers were part of Horizons pre-notification stakeholder consultation process, and after notification, attended POP meetings and made submissions and presentations on behalf of farmers to the One Plan hearings panel. Federated Farmers were part of the Environment Court mediation process, one of the appellants to the Environment Court, and one of the appellants to the High Court where they challenged the POP on points of law. From notification to the operative version of the One Plan taking legal effect, Federated Farmers worked with farmers, Horizons (staff, councillors and lawyers), Fonterra, DairyNZ and members of the TCEIS. These relationships have continued during the implementation phase, and the Federated Farmers' regional policy advisor meets regularly with Horizons' staff to discuss policy, and works with some Tararua dairy farmers during the preparation of their Land Use Consents.

Fertiliser company representatives

Fertiliser representatives (reps) are employed by a fertiliser company and work with farmers around their soil nutrient requirements. Fertiliser reps commonly use soil test results and provide a personalised recommendation for maintenance and capital fertiliser application (to either maintain or increase soil nutrient levels). Fertiliser reps can also assist with the preparation of a farm's nutrient budget that models nutrient inputs and outputs.

Fish and Game New Zealand

As stated on their website, Fish and Game New Zealand is a 'not-for-profit organisation that manages, maintains and enhances sports fish and game birds and their habitats for anglers and hunters' (www.fishandgame.org.nz). Fish and Game are primarily concerned with fishery habitat protection, and state they are an advocate for freshwater quality. Fish and Game's role in instigating the 'Dirty Dairying' media debate, and scientific research into freshwater quality, was explored in Chapter Five. This section examines Fish and Game's regional role in the POP process, and their more recent criticism of Horizons' implementation of the One Plan.

In terms of the POP, Fish and Game were a submitter to the hearings panel, an appellant to the Environment Court, were part of the Environment Court mediation process, and an interested party in the High Court process. A report to the High Court summarised that Fish and Game strongly supported the regulatory approach from the notified version of the POP, which was in contrast to Federated Farmers preferring less regulation and more focus on good farm management practices ("Horticulture New Zealand V Manawatu-Wanganui Regional Council," 2013)

Media reports and comments from some of the farmers and key informants, suggest Fish and Game have taken a negative stance towards dairy farming and water quality. Fish and Game's stance in the implementation phase was reported in the media, which stated they were critical of Horizons for not implementing the One Plan as stated in the High Court judgement (Wilson, 2015). This article also claimed Fish and Game believe Horizons were issuing more restricted discretionary consents than expected, and are not requiring dairy farmers to reduce their N leaching losses sufficiently. In 2015, Fish and Game threatened legal action against Horizons Regional Council. In late 2016, Fish and Game and the Environmental Defence society lodged declaration proceedings[53] against Horizons Regional Council in the Environment Court. These two organisations were seeking clarification of how restricted discretionary consent applications for intensive land use were being assessed. Horizons' chairman was reported as 'feeling hugely disappointed' with Fish and Game's actions (Horizons Regional Council, 2016). Fonterra, DairyNZ and Federated Farmers generally opposed the declaration sought.

Fonterra

Fonterra Co-operative Group Ltd (Fonterra) is a New Zealand multi-national dairy company owned by New Zealand dairy farmer shareholders. As New Zealand's largest dairy company, Fonterra represents most dairy farmers. In recognition of the dairy industry's contribution to declining water quality, Fonterra were one of the signatories of the Dairying and Clean Streams Accord (Fonterra et al., 2003), and the Sustainable Dairying Water Accord (DairyNZ & DCANZ, 2013). Fonterra also developed a programme of on-farm initiatives in order to reduce their suppliers' environmental footprint (Supply Fonterra).

Supply Fonterra is an educational intervention programme that supports and encourages dairy farmer behaviour change in order to improve environmental performance (Fonterra, 2013). Supply Fonterra supports the voluntary dairy industry Sustainable Dairying Water Accord[54] and

[53] Declarations are a way of getting judicial direction on a matter that is in dispute between a local authority and another individual or organisation.
[54] The Sustainable Dairying Water Accord was described in Chapter Five.

regional council rules and regulations. The programme uses a mix of information (e.g. fact sheets), social learning processes (e.g. shed meetings), and one-on-one advice in order to minimise environmental impacts and to ensure compliance with regulations. The components of Supply Fonterra of relevance to this research include the annual Farm Dairy and Environmental Assessment (FDEA), Effluent Management, Nitrogen Management and Waterway Management. Supply Fonterra encourages best management practice, for example, the Nitrogen Programme attempts to raise farmer awareness and understanding of how farm management decisions can influence nitrogen loss, and the need for regional council rules.

The annual Farm Dairy and Environmental Assessment (FDEA) is an integral part of Fonterra's Supply Fonterra Programme. As summarised on their website and in the Supplier Handbook, Fonterra contracts independent Quality Consultants New Zealand Ltd (QCONZ) inspectors to undertake an assessment of each Fonterra supplier's dairy shed and wider property. The FDEA ensures every farm in the region is meeting environmental standards in relation to water quality. This process involves: checking farm dairy effluent systems are capable of 365 days compliance with regional council regulation (Effluent Management Programme); recording farm systems information for the Nitrogen Management Programme; and monitoring stock exclusion from waterways (Waterway Management). Fonterra's Dairy Diary is a key component of Fonterra suppliers' recording systems, and suppliers record their daily farm activities in their Dairy Diary. Specific areas of the diary (e.g. animal health records) must be filled into to comply with food safety requirements and these are checked by the QCONZ assessor at the FDEA. Farmers must also fill in their N recording pages (for the Nitrogen Management Programme), and these are collected by the QCONZ assessor. Information from the N recording pages produces a report on nitrogen leaching risk and nitrogen conversion efficiency for each farm. These reports allow farmers to compare their nitrogen management with other farmers. Fonterra also contracted AsureQuality inspectors to independently audit stream fencing practices on their supplier's farms (Sanson & Baxter, 2011).

Fonterra also state in their Suppliers Handbook that they may suspend milk collection if one of their suppliers receives a critical hazard during their FDEA assessment, and if this hazard is not rectified within an agreed period of time. A breach of Fonterra's environmental minimum requirements can be rated as a critical hazard. Farmers' responses to Fonterra's threat of suspending milk collection is explored in the first results chapter (Chapter Seven).

The main regional Fonterra actors in relation to farming and water quality in this study, are the Fonterra contracted QCONZ inspectors, the Area Managers, and the Sustainable Dairy Advisors. The dairy farmers in this study are all Fonterra suppliers. All farmers in this study interact with their QCONZ inspector during the annual on-farm inspection (FDEA). The QCONZ inspector provides an environmental assessment for Fonterra, and also provides information for farmers about future changes to the FDEA. All farmers interact with their Fonterra Area Manager around milk production and water quality matters. Fonterra described their area managers as the relationship builders with farmers and with the wider local community, and a Fonterra staff member described the area managers as 'the jack of all trade sorts of people'. Based on geography, the Tararua District is shared by two Fonterra Area Managers: half of the farmers in this study work with one area manager (targeted WMZ) and the other half with another area manager (targeted and non-targeted WMZ). From farmer and key informant comments, the Fonterra Area Managers support their farmer suppliers and provide information and farm-specific knowledge in order for the farmer suppliers to comply with the One Plan and Supply Fonterra conditions. The Sustainable Dairy Advisors focus on the Supply Fonterra programme, and provide advice and support to their farmer suppliers to help them meet regulatory requirements. One farmer in this study had a historical interaction with a Sustainable Dairy Advisor.

Fonterra, and some staff in particular, worked with the other regional actors on water quality in a number of ways. Fonterra were part of Horizons pre-notification stakeholder consultation process and present at POP farmer meetings. Members of Fonterra's environmental policy team produced Fonterra's submission on the POP, but were not involved in the court processes. Some Fonterra staff worked with DairyNZ and Horizons' staff to run a series of One Plan farmer information meetings. The Tararua Area Manager also interacted with a range of other actors, including the TCEIS, some of the nutrient management consultants, fertiliser representatives, Federated Farmers policy and elected representatives, one of the Horizons' councillors and some Horizons' policy staff. Fonterra staff are also part of a national working group with regional councils (including Horizons), DairyNZ and other organisations. This project aimed to provide information and advice to organisations who are using or considering using Overseer for resource consent processes (Freeman et al., 2016).

Horizons Regional Council

Horizons Regional Council[55] (commonly termed Horizons) is responsible for meeting the current and future needs of the Manawatu-Wanganui Region's communities. As stated on their website, Horizons' purpose is 'to create opportunities for the region to grow economically and socially in a way that preserves or enhances agreed environmental and cultural values' (www.horizons.govt.nz). Twelve elected councillors from twelve constituencies act as 'the council', and their role is to provide overall governance for the organisation. Among other duties, the regional councillors are responsible for developing council policy and strategy; for monitoring the performance of the council; and employing the chief executive, who in turn employs the Horizons' staff. Horizons' organisational structure of relevance to this research includes the strategy and regulation team (policy, consents, consent monitoring and rural advice to landholders) and the environmental management team (biosecurity protection, land management, freshwater and science). The farmers in this research interacted with a range of staff, including consents staff, effluent inspectors, compliance officers, monitoring staff, rural advisors, land management staff, members of the freshwater team, and the Tararua regional councillor.

Of relevance to this research, Horizons has a responsibility to maintain and enhance the natural resources (land, water, air and coast), and in particular, to manage and improve the surface freshwater quality (lakes, rivers and streams) in the Manawatu-Wanganui region. Horizons' staff interact with a range of other organisations (e.g. Dairy NZ, Federated Farmers and Fonterra), science providers (e.g. NIWA, Massey University, Cawthron Institute) and individuals (e.g. nutrient management consultants) in order to manage freshwater quality in the region.

Horizons uses regulatory (regional plans and the regional policy statement) and non-regulatory methods (e.g. provision of subsidies, education and advice) to manage freshwater quality. In terms of their regulatory function, Horizons prepared the Proposed One Plan in accordance with their functions under the RMA, and monitors a consent holder's compliance with the conditions of their resource consent. If a consent holder breaches the conditions of their resource consent, Horizons can choose to take informal action (discuss with the consent holder), issue an infringement notice (fine), issue an abatement notice (requires consent holder to stop the activity), or prosecute the consent holder (court). In terms of a non-regulatory approach, Horizons

[55] Horizons Regional Council is the trading name. The Manawatu-Wanganui Regional Council is the gazetted legal name of this organisation.

offers economic incentives, for example, subsidies for stream fencing materials to exclude stock from waterways, which aim to improve water quality.

Nutrient management consultants

The nutrient management consultants in this study are dairy farm systems consultants that have obtained a formal certification in nutrient management through Massey University. This course gives the accredited advisor an in-depth understanding of nutrient cycling in New Zealand's farming systems, and is also a component of the Nutrient Management Adviser Certification Programme. The Nutrient Management Adviser Certification Programme website states:

> Nutrient Management Advisors are required to have successfully completed the Intermediate and Advanced courses in Sustainable Nutrient Management in New Zealand Agriculture via Massey, plus demonstrate their skills and knowledge meet required standards through a competency assessment (www.nmacertification.org.nz).

At the time of this study, nine accredited nutrient management consultants (10 had started with the pilot programme) were working with dairy farmers, DairyNZ and Horizons' staff. Two of the DairyNZ staff members interviewed for this study, described the key criteria used by DairyNZ and Horizons' staff to select the nutrient management consultants. Firstly, the nutrient management consultant must be a local experienced dairy farm consultant, who is able to understand and evaluate the impact of reducing farm nitrogen loss on dairy farm production and profitability. Secondly, the nutrient management consultant must have completed the Sustainable Nutrient Management in NZ Agriculture courses from Massey University. The nutrient management consultants in this region follow the consistent process developed during the Land Use Consent pilot programme, which ensures they will produce consistent outcomes for their dairy farmer clients. The farmer can choose one of these nine nutrient management consultants, or choose another professional (who is equally trained). One of the DairyNZ staff commented that choosing one of the nine nutrient management consultants was more likely to result in an accurate application that was accepted by Horizons.

Nutrient management consultants work with dairy farmer clients, Horizons' consents staff and DairyNZ staff in the preparation of a Land Use Consent application for each dairy farm in a targeted WMZ. The regional DairyNZ Catchment Engagement Leader (or an individual contracted by DairyNZ) collects the farm baseline information and Overseer file, and supplies this to the nutrient management consultant. The nutrient management consultant uses this information to investigate the mitigation options to manage the farm's nutrient, sediment and bacterial losses to water; develop a nutrient management plan with the farmer; complete the consent application; and send the completed application to Horizons for processing.

The Tararua Community Economic Impact Society

The Tararua Community Economic Impact Society (TCEIS) is a community collective action group that formed in 2013 to represent the wider Tararua community. The group is led by three local dairy farmers and a local Dannevirke businessman. The TCEIS worked with a wide range of staff from organisations (e.g. DairyNZ, Fonterra, Federated Farmers) and with individuals (e.g. accountant, lawyer, Member of Parliament, bank manager, scientist) to inform and involve the community about the economic impact of the POP on the Tararua community. The next section examines the development of regional water quality interventions.

Timeline and water quality interventions

Historically, regional water quality management focussed on point source discharges from factories and sewerage treatment plants to water. In the 1950s, attention was focussed on mechanical methods to prevent 'gross pollution from solid material', (Knight, 2014, p.183), such as blood, fat, and wool (Gilliland, 2009). In the 1970s and 1980s the focus shifted to increased treatment of organic waste, and a Horizons' Policy Analyst stated in his Section 42A report[56] that this form of pollution had begun to alter the chemical properties of the river (oxygen depletion), reduce fish life and water clarity (Gilliland, 2009).

During the 1990s, the public's aesthetic concerns about the Manawatu River (sewerage fungus and algae), and perceived health risk from swimming were growing. Regional council monitoring data identified nutrients and sediment as the main contributors to declining water quality. After a public consultation process, the Manawatu Catchment Water Quality Regional Plan became operative in 1998 (Manawatu-Wanganui Regional Council, 1998b), and was the council's first regulatory approach to water quality management. This regional plan provided a framework to

[56] Section 42A of the RMA allows a Horizons' officer to provide a report to the decision-maker on a resource consent made to the council, and allows the decision-maker to consider the report at the consent hearing.

direct consent decisions on activities in the catchment that affect water quality, and five years later Horizons followed this with another regional plan[57] that contained stronger rules around farm dairy effluent management. These two regional plans contributed to a significant decrease in the number of dairy effluent discharges to water. In his Section 42A report, a Horizons' Policy Analyst calculated that in the early 1980s, approximately half of the consented dairy effluent discharges were to water, and that this had reduced to 2% in 2009 (Gilliland, 2009). In 2012, there were no consented dairy effluent discharges to water (Horizons Regional Council, 2013b). These figures indicate a significant shift from water to land based disposal of dairy effluent across the Manawatu-Wanganui region. In combination with regulatory methods during this period, the Manawatu-Wanganui Regional Council strongly promoted a non-regulatory approach to water quality management. The council adopted three non-regulatory management strategies[58], and in particular, the Land and Riparian Management Strategy, recognised that 'inappropriate land management can impact on water quality'. Council staff worked with land managers and promoted sustainable land management practices (e.g. tree planting for erosion control). A timeline from 1998-2014 (Figure Eight) illustrates the key national and regional events, and water quality interventions of relevance to this research.

[57] Land and Water Regional Plan.
[58] Whanganui Catchment Strategy (1997), Lake Horowhenua and Hokio Stream Catchment Management Strategy (1998), and the Land and Riparian Management Strategy (1999).

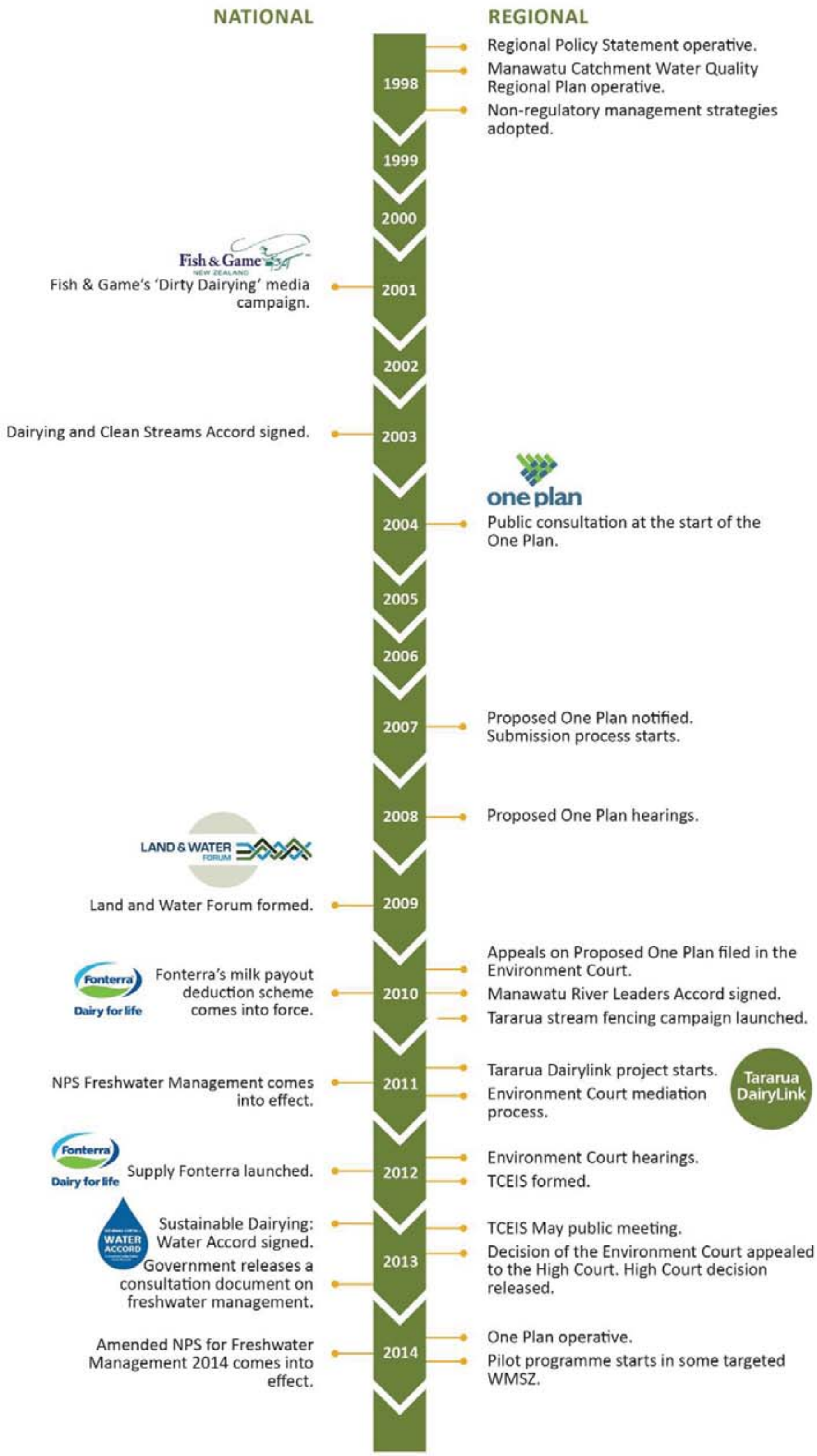

Figure 8: Timeline of national, industry and regional water quality interventions.

A severe storm in February 2004 produced a catastrophic flood and caused extensive erosion in the Manawatu-Wanganui Region (Fuller & Heerdegen, 2005). At this stage, Horizons had a plethora of planning documents to manage the region's resources, and the storm's impact, combined with recognised gaps and overlaps between the existing plans and strategies, encouraged Horizons to develop a single plan. This single plan became known as the Proposed One Plan (POP). Horizons' public consultation process in 2004 identified the community's concerns about the region's resources (Horizons Regional Council, 2004), and as a result, four keystone environmental issues were identified. These keystone issues were confirmed by Horizons' science team's research (State of the Environment Report). Declining water quality was identified as one of the keystone environmental issues in the POP.

Declining regional water quality was again highlighted in the second regional State of the Environment Report (Horizons Regional Council, 2005). This SOE report acknowledged the excellent water quality in the headwaters of the region's catchments, but noted declining water quality throughout the catchments. The council's monitoring programme identified nutrient enrichment as a major issue, and sedimentation and pathogens as a moderate issue in the Manawatu River catchment (Aussiel et al., 2005). This SOE report claimed intensive agriculture, and in particular increased dairying, was a contributor to the declining regional ground and surface water quality.

Horizons ran a stakeholder consultation process during preparation of the draft POP. A communications consultant described the consultation as an iterative process: a series of 'stapled versions' (unfinished working drafts) were sent to stakeholders, which ensured that feedback from the first draft was incorporated into the next working version (or iteration) of the plan (Anderson, 2009). The Proposed One Plan (POP) was publicly notified in May 2007, followed by a public consultation, submission and hearings process (2008-2009). A hearings panel of elected councillors and independent commissioners reviewed submissions, evidence, technical and Section 42 reports, then reported back to Horizons in 2010 with their recommendations on the plan. The hearings panel recommended a number of significant changes to the notified POP. Significant to this research, the panel recommended:

> An exemption of intensive sheep and beef farming, cropping and commercial vegetable growing from nitrogen leaching regulation. Only new dairy farming (and existing dairying in targeted water management sub-zones) would be regulated. The Land Use Capability control system was largely abandoned, in favour of 'reasonably practicable farming practices'. ("Horticulture New Zealand V Manawatu-Wanganui Regional Council," 2013).

Horizons adopted these recommendations and notified the decision version of the POP in August 2010. Over 20 parties, including Federated Farmers, Fish & Game and Horticulture New Zealand, filed appeals on the POP to the Environment Court later in 2010. The Environment Court is a specialist court operating under the RMA, hears appeals, and makes decisions on local council planning matters. An extensive Environment Court mediation process during 2011 enabled many of the matters raised by submitters to be resolved. The Environment Court released their interim decision on the POP mid-2012, and their decision restored the plan and required council to rewrite the POP. A Federated Farmers press release described the Environment Court version as 'unimplementable', and instead, called for a focus on good management practices to minimise N loss, faecal contamination and sediment (Federated Farmers, 2013). After the Environment Court decision was released, Federated Farmers and Horticulture New Zealand continued as appellants to the High Court on points of law.

While the POP was being debated, two research studies released by external science providers (NIWA and the Cawthron Institute) reported declining regional water quality. The NIWA study found regional water quality was poor compared with national data, and, the recorded nitrogen and phosphorous values in the Manawatu River catchment were among the highest in the country (Ballentine & Davies-Colley, 2009). Similarly, a research study led by an internationally recognised Cawthron Institute freshwater scientist, found parts of the Manawatu River with metabolic rates indicative of very poor ecosystem health (initial 2009 report replaced by Young & Clapcott, 2010).

After the Cawthron Institute report was released, freshwater scientist Dr Roger Young was interviewed by a Dominion Post reporter. He recalled saying to the reporter 'the measurements from the Manawatu were higher than had been seen elsewhere in the world' (R. Young, personal communication, January 12, 2015). These comments resulted in emotive media coverage and headlines including 'Manawatu River among 'worst in the west' (Morgan & Burns, 2009) and 'Manawatu River tops dirty table' (Anonymous, 2009). Dr Young posted a Manawatu River health report on the Cawthron website, and he did this 'in an attempt to get some of the facts back into the media storm' (R. Young, personal communication, January 12, 2015). Dr Young's report stated:

> Our research DOES NOT indicate that the Manawatu is the worst in the western world. Nevertheless, our results do indicate that the Manawatu is very unhealthy. Other indicators of river health (examples given) also indicate the poor status of the Manawatu River (Young, 2010, p.2).

The emotive media attention dragged Manawatu River water quality into the national spotlight. As a consequence of this report and ensuing media attention, Horizons' chairman invited key leaders from iwi, local government, farming, industry and environmental groups to meet and discuss the state of the Manawatu River. These leaders agreed that the current state of the river was unacceptable, and later in 2010 signed the Manawatu River Leaders Accord[59] and publicly pledged to take action and work together to improve the state of the Manawatu River and catchment. The Accord developed an action plan, established the Freshwater Clean-up Fund, and sourced funding from territorial authorities, Horizons and the Ministry for the Environment's Fresh Start for Freshwater Clean-Up Fund[60]. Stream fencing was one of the Accord's Clean-Up Fund Projects (2012-2014), and a 50% materials subsidy was offered to sheep and beef farmers. One of Horizons' Freshwater Coordinators commented that this subsidy was later extended to streams on dairy run-off blocks (L. Fergusson, personal communication, February 16, 2015).

The Manawatu River Leaders Accord funded stream fencing programme (2012-2014) was complementary to Horizons earlier Tararua Dairy Farmer Stream Fencing Campaign (2010-2012). A 2012 Dairying and Clean Streams Regional progress report[61] highlighted Horizons' concerns that although dairy farmers were making progress towards meeting stock exclusion targets, progress was 'possibly not fast enough to reach it without significant further work' (Ridler, 2012, p.5). The Tararua Dairy Farmer Stream Fencing Campaign used direct mail, flyers and word of mouth to raise awareness of stock exclusion, and offered materials subsidies[62] to encourage waterway fencing. One of the Horizons' Freshwater Coordinators described the 'massive oversubscription' (L. Fergusson, personal communication, February 16, 2015) to the fencing campaign, which meant some projects were deferred to the following financial year and the planned one year campaign ran over two years (Horizons Regional Council, 2010). Horizons discontinued their financial support for dairy farmers in 2012, to target the exclusion of non-dairy cattle from lowland streams.

Other educational projects around dairy farming and water quality were underway at this time. The Dairylink Project between Tararua dairy farmers, community leaders, DairyNZ and Horizons, ran from 2011-2012 (Parminter, Ridsdale, & Riley, 2013). In the Project Manager's opinion, the

[59] The Manawatu Rivers Leaders Accord was signed by 27 groups.
[60] The Government's Fresh Start for Freshwater Clean-Up Fund was proposed by the Land and Water Forum (Chapter Five), and established to help councils and communities clean-up nationally significant water bodies polluted by historic management.
[61] This regional report assessed progress towards targets set in the Dairying and Clean Streams Accord (DCSA). The DCSA was described in Chapter Five.
[62] Subsidies: 50% for individuals and 75% for 4 or more neighbours.

farmer led project aimed to improve on-farm productivity, and to reduce the impact of dairy farming on water quality in the Manawatu River catchment (T. Parminter, personal communication, January 14, 2015). The project manager also commented that Dairylink encouraged dairy farmers to explore the link between their farm systems, and the impact of nutrients, sediment and pathogens on water quality. Dairylink was centred around three learning hubs (dairy farms) in the Tararua District, ran on-farm field days and produced newsletters.

After the Environment Court decision was released in 2012, a small group of concerned Tararua dairy farmers and a local businessman discussed the potential negative impact of the POP on their farm businesses and on the local Tararua economy. To meet the nitrogen leaching loss limits in the Proposed One Plan (Table 13.1)[63], it was anticipated most dairy farms may need to reduce cow numbers with an associated reduction in milk production (kgMS) and farm income. The Dannevirke businessman prepared an economic impact analysis[64], and this analysis estimated a loss of income and jobs and income to the Tararua community. Based on these figures and growing concerns, the Tararua Community Economic Impact Society (TCEIS) formed later that year.

As the One Plan moved through the court processes, an upgrade to the computer model Overseer® (Overseer 6) was released in August 2012. Overseer is a computer software model that calculates and estimates the nutrient flows in a farming system (kg/ha/yr) (Watkins & Selbie, 2015)[65]. The new version of Overseer estimated N loss from dairy farms to be higher than estimated by the previous version (Overseer 5). Horizons estimated that as a result of model changes, fewer farms would comply with controlled activity status and would need to apply for a restricted discretionary consent (Horizons Regional Council, 2015). These consents are described in the next section. In summary, farms that meet the controlled activity status will receive a longer term consent than farms with a restricted discretionary consent. There were no assurances that existing farmers would be able to continue farming within the target WMZ.

At a similar time to formation of the TCEIS in 2012, a research report was released on the water quality policy scenarios that could achieve the regional nutrient reduction targets (Daigneault & McDonald, 2012). The scenarios indicated that farm profits could drop between 1% and 43%, and the resulting media storm suggested the POP could reduce farmers' profit by up to 43%. The then

[63] Table 13.1 in the POP became Table 14.1 in the operative version of the One Plan.
[64] The results of the economic impact analysis are described in Chapter Seven.
[65] Overseer is also described in Chapter Seven.

Minister of Agriculture (David Carter) stated his concerns in the media that the POP would ‘restrict the farming sector’, and Federated Farmers labelled the POP ‘Farmergeddon’ because of the expected impacts on farmers’ incomes (Grocott, 2012). Horizons’ chairman quickly issued a press release ‘calling for calm’, stating that in his opinion the scenarios in the Landcare report did not accurately reflect the One Plan (Horizons Regional Council, 2012). The chairman further commented ‘this type of misinformation was extremely disappointing and caused unnecessary distress for the farming community’.

In May 2013, a TCEIS organised public meeting in Dannevirke with over 300 people in attendance discussed the potential economic impacts of the POP. The group’s economic analysis was presented. A range of national and regional newspaper articles reported on the potential impacts of the POP using emotive words such as ‘disastrous’ and ‘catastrophe’, and with headings such as ‘Economy faces $60M hit’ (McKay, 2013a). Horizons and DairyNZ agreed to jointly undertake a Cost Benefit and Economic Impact Analysis of the POP, to investigate the claims of potential economic loss to the Tararua community (Bell, Brook, McDonald, Fairgray, & Smith, 2013).

The High Court released its decision on the POP in September 2013, and dismissed appeals. A Federated Farmers’ press release stated ‘the High Court version gives farmers assurance that they will be able to continue farming because unachievable N loss limits will not now be applied to their farms’ (Federated Farmers, 2013). The One Plan became operative in December 2014, and the next section describes the implementation of this plan.

Farming under the One Plan: Implementation of the plan

In June 2013, Horizons passed resolutions on implementation of the One Plan. These resolutions state how the policies and rules concerning discharges to land from intensive agriculture would be implemented, and guide Horizons’ staff in plan implementation. These policies and rules are termed the nutrient management provisions of the One Plan. These resolutions established two consent pathways[66]: controlled activity, and restricted discretionary for farms that could not meet controlled activity status (Horizons Regional Council, 2015). The length of the consent issued depends on the farm’s ability to reduce nitrogen losses: farms that meet the controlled activity status will receive a longer-term consent than farms with a restricted discretionary consent.

[66] Controlled activity: farms that can meet the cumulative N leaching maximums as set in Table 14.2. Restricted discretionary: farms that cannot meet the targets in Table 14.2.

Horizons quickly reassured farmers that <u>all</u> intensive farms in targeted catchments would be issued a Land Use Consent, and Horizons' chairman stated in a press release: (Horizons Regional Council, 2013a):

> The decision council has made today means that all farmers have the security to keep on farming as they will be given a consent while they make the changes on farm to reduce nitrogen entering waterways.

DairyNZ and Horizons staff are working together to implement the nutrient management provisions of the One Plan. Their collaborative goal was to maintain economic sustainability for dairy farmers, and contribute to an improvement in water quality. Horizons' and DairyNZ staff developed a framework to calculate the average percent reduction in nitrogen loss required per dairy farm, and a process to implement this framework. This implementation process incudes a pilot programme, the Land Use Consent application process, and collaborative farmer information meetings run by Horizons, DairyNZ and Fonterra staff, with support from some farmer members of the TCEIS.

A pilot programme to develop the Land Use Consent application process was initiated in 2014. The pilot programme involved a DairyNZ head office staff member, some Horizons' staff, the accredited nutrient management consultants, and 50 dairy farmers from several targeted WMSZ (initially Mangapapa and Waikawa, then extended to the Mangatainoka WMZ). The Mangapapa WMSZ is in the Upper Gorge WMZ, and the study site for this research.

The collaborative pilot programme trialled, modified, and re-trialled a data collection system, with the aim of developing a consistent process across farms. One of the DairyNZ staff in this study stated that alignment ('getting everyone on the same page') would contribute to a consistent approach to reducing on-farm nitrogen use, and a consistent process and cost structure for farmers. In order to develop this consistent data collection system, DairyNZ contracted and funded the ten nutrient management consultants to each prepare a consent application for five farms, and applications were then compared across farms. DairyNZ's financial contribution resulted in a cost saving of several thousand dollars for each farmer involved in the pilot, because each farmer only paid the consent application fee to Horizons and did not pay for the consultant's time. During the pilot programme, regional DairyNZ and Horizons' staff also published an information booklet for dairy farmers (*Dairy farming under the One Plan*) (DairyNZ & Horizons Regional Council, 2014). This booklet broadly explains the process for obtaining a Land Use Consent for an existing dairy farm, including the pricing schedule of costs to complete a consent application document. The data collection system developed during the pilot programme is now used by regional DairyNZ staff and nutrient management consultants in the Land Use Consent application process.

One of the DairyNZ staff in this study described the key stages in the application process. Firstly, farm production data from the 2012/13 season is collected from each farm (termed a 'baseline'[67]), and includes a series of farm maps (Land Use Capability, soils, and paddock area maps), data on physical infrastructure, and a description of management practices and inputs (DairyNZ & Horizons Regional Council, 2014). Either a regional DairyNZ staff member, a DairyNZ contractor, or another professional collects the baseline data, and a regional DairyNZ staff member then checks the accuracy and consistency of the data. One of the regional DairyNZ staff members found that data collected by non-DairyNZ staff members or contractors was not always consistent with Horizons' data protocols, and admitted there was an extra cost to a farmer obtaining a consent, because DairyNZ was subsidising the baseline collection. The regional DairyNZ Catchment Engagement Leader noted if DairyNZ staff and the farmer believe that the 2012/2013 season was not a fair reflection of the farm's production (e.g. due to drought), Horizons will permit use of either the 2011/2012 or the 2010/2011 season data to generate the baseline (A. Duker, personal communication, March 21, 2016).

In the second stage of the consent process, a regional DairyNZ staff member prepares an information document for each farm. This document includes: the baseline farm data, an Overseer file, farm consents data (from Horizons), fertiliser data (e.g. from Ravensdown and Ballance) and waterway fencing audits (from Fonterra). DairyNZ staff follow Horizons' protocols and Overseer input standards to check the information's accuracy and consistency, then pass the information document (and information check) to the nutrient management consultant selected by the farmer. The DairyNZ regional staff member considers his role is to maintain the integrity, accuracy and consistency of information and process, which he thinks will result in on-farm mitigation strategies that are based on accurate data.

Finally, the certified nutrient management consultant uses the information document and works with their farmer client to prepare the consent application. The nutrient management consultant and farmer investigate potential on-farm mitigation strategies that can be used to manage nutrient, sediment and bacterial losses to water. The nutrient management consultant then

[67] The baseline is a reference position of a farm's nutrient management status.

develops a farm plan with the farmer, completes the application, and sends the completed application to Horizons for processing. Some of the Horizons and DairyNZ staff in this study used the same phrase - 'low hanging fruit' - to describe the mitigation strategies initially explored by the nutrient management consultants with their dairy farmer clients. These staff described the 'low hanging fruit' as 'easy gains', or mitigation strategies that are less costly and/or able to be effectively implemented to obtain the nitrogen reductions that will contribute to improving water quality. Some examples of 'low hanging fruit' include not applying nitrogen in winter, changing the type of bought in supplementary feed, and changing summer crop. The last section in this chapter investigates the ten farms, and the diverse farm management systems used by the twelve farmers in this study.

The farms and farm management systems

This section summarises the diverse range of farm management systems that operate on the 10 farms in this study. The farmers interviewed were asked to describe the aspects of their farm systems that can impact on water quality, and the changes in these management practices over the past five years (or so). The collected farm management data includes: business structure, farm area, support land, peak cow number milked, milking frequency, supplementary feed policy, wintering policy, pasture management policy, cropping policy, effluent management policy, fertiliser policy, and farm infrastructure such as milking shed, feedpads, and the use of irrigation.

Nine farms are run conventionally, and one farm runs a low-input non-conventional system. While most are existing dairy farms, one farm was recently converted from sheep and beef (last five years), and one converted about 10 years ago. Table Six illustrates the range of farm management systems operated by the farmers in this study. The ten farms operate under a diversity of ownership structures. Four are owner/operator businesses, three are owner/sharemilker businesses, two are family companies, and one is an equity partnership. For the three sharemilking businesses, two are 50:50 and one is a lower order (31%) sharemilking position. The lower order farm owner works part-time on the farm (older and semi-retired), and the 50:50 farm owners are both older retired farmers who live off-farm. Three of the farms are inter-generational: one of the owner/operator and two of the sharemilking businesses. The family farm life cycle stage of the 12 farmers can be classified as entry, growth (e.g. expansion) or exit (e.g. retirement) (Boehlje & Eidman, 1984). Based on this classification, 10 farmers in this study are in the growth stage and two are in an exit stage.

Table 6: The farm management systems operated by the farmers in this study.

	Jack	Fred	Max	Paul	Owen/ Steve	Roy	Tom	Owner[1]/ Ian	Ken/Stu	Jim
One Plan classification[2]	T	T	T	T	T	T	NT	NT	NT	NT
Land Use Consent[3]	In process	✓	X	X	X	✓	N/A	N/A	N/A	N/A
Ownership structure	Owner operator	Family company	Equity partnership	Owner operator	Owner/ *50:50 sharemilker*	Family company	Owner operator	Owner/ *50:50 sharemilker*	Owner/*31% sharemilker*	Owner operator
Intergenerational ownership	✓							✓	✓	
Family farm life cycle stage	Exit	Growth	Growth	Growth	Growth/ *growth*	Growth	Growth	/ *growth*	Exit/ *growth*	Growth
Milking platform area (ha)[4]	50-100	50-100	251-300	101-150	50-100	101-150	101-150	151-200	50-100	251-300
Own or lease a runoff block	✓	✓	✓	✓		✓	✓	✓	✓	✓
Herd size (peak milked)[4]	150-200	250-300	750-800	350-400	200-250	300-350	200-250	350-400	250-300	550-600
Stocking rate	2.43	3.0	2.69	2.96	2.72	2.41	1.74	2.06	2.94	1.93
Milking frequency[5]	TAD	TAD (some OAD)	TAD (some OAD)	TAD	TAD	TAD	16 hour	OAD	TAD	TAD (some OAD)
Has an effluent storage pond	✓	✓	✓			Being installed	✓			✓
Has a feed pad		✓	✓		✓	✓				
Has water irrigation										✓
Summer crops	✓	✓	✓	✓	✓	✓	✓	✓	✓	
Winter crops				✓			✓*	✓		
Makes own supplements	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Buys in supplements		✓	✓	✓	✓	✓	✓	✓	✓	✓

[1] Owner was unavailable and not interviewed.
[2] T : targeted. NT: non-targeted.
[3] N/A: not applicable. Land Use Consent not required. X: yet to obtain a consent
[4] Range used to ensure confidentiality.
[5] TAD: twice a day. OAD: once a day.
* Tom was trialling a winter crop for the 2015 season.

Farm size (also termed milking platform and dairy platform) is defined in this study as the total farm area used for milk production. The farm sizes in this study ranged from 70 ha to 300 ha. Both the smallest and largest farms are owner/operator businesses. The equity partnership was also a larger unit, with a milking platform of between 250-300 ha (range used to ensure confidentiality). Six of the ten farms in this study have a milking platform between 70 ha and 125 ha. According to dairy industry statistics for the 2015/16 season, the average dairy farm size (effective hectares) in the Tararua District is 123 ha (LIC, 2016).

Herd size in this study is defined as the peak number of cows milked during the current season. Herd size ranged from 170 cows to a farm running between 760-790 cows (range used to ensure confidentiality). Most farms in this study (seven out of the ten) peak milked between 210 and 375 cows this season. These figures correlate with the dairy industry statistics for the Tararua District of an average herd size of 327 cows (LIC, 2016). The stocking rate (cows/ha) was calculated using the accepted dairy industry definition of the average number of peak cows milked per milking hectare (DairyNZ, 2014a). The current stocking rate for the farms in this study ranged from 1.74 cows/ha to 3.0 cows/ha. Most farms in this study (seven out of ten) have a stocking rate between 2.0 and 3.0 cows/ha.

Nine of the ten farms own or lease run-off blocks (also termed support blocks), ranging in size from 30 ha to 400 ha. Almost all of the run-off blocks are in the Tararua District. Many blocks are either part of the home farm (e.g. the hills that are not milked from) or in close proximity to the home farm (e.g. on the same road). The run-off is mainly used for grazing young stock (replacements), and some farmers use this for grazing dry stock (e.g. bulls and bull beef), wintering-off milking cows, and making supplementary feed for use on the milking platform.

Milking frequency contributes to the volume of dairy effluent produced each day. The ten farms in this study are all seasonal supply. Eight out of the ten farms milk their cows twice a day (TAD), one farm milks once a day (OAD), and one milks on a 16 hour rotation. Of the eight farms milking TAD, three of these farms will change between TAD and a OAD milking system depending on factors such as cow condition and weather, or have different mobs within the milking herd on different milking frequencies.

All farmers in this study use either supplementary feed they have grown (crops), or made (hay or silage), or have purchased and brought into their farm system. All of the farmers make their own silage, baleage (baled silage) and/or hay on their milking platform or support block. One farmer grows a range of other crops (including maize, oats, peas, fodder beet and kale) on their support block for use on the milking platform. One farm only uses supplementary feed grown on the milking platform, and does not buy in other feed. Nine of the ten farms buy in supplementary feed, and all nine purchase Palm Kernal Extract (variously termed PK or PKE). Other purchased supplementary feeds include grain (various mentioned) and silage (both grass and maize). Supplementary feed is used in a number of ways: some farmers use it for identified pasture shortages (e.g. in early spring), others use it for improving cow condition (e.g. before mating), and some use it regularly throughout the season. Depending on the product used and the time of year, supplements are fed using a range of methods: in-shed feeders, some use a feed-pad and others feed in the paddock.

Dairy farmers may choose to winter their dry cows (not producing milk) either within their existing farm system (on the milking platform or support block) or send them to another farmer and pay for grazing (external grazing). The majority of farmers in this study winter either some or all of their milking herd within their own system (milking platform and/or runoff). Most use both the milking platform and the runoff to winter their herd. For example, one of the farmers in this study uses the support block for six weeks, and the milking platform for the rest of the dry period. One farmer uses external grazing for all of his herd, and one uses external grazing for some of the herd.

Four out of the ten farms have concrete feed pads that were built for supplementary feeding reasons. Three of the farmers also use these feed pads on various occasions as stand-off pads in winter, for example, to stand the cows off wet soil to prevent pugging damage in winter. While not having a stand-off pad, other farmers may stand cows off on the race for short periods if needed to prevent soil damage. None of the farms in this study have barns or stalls. Only one of the ten farms in this study uses irrigation on the farm's free-draining shingle river flats on the milking platform (20% of the farm's milking platform).

Nine out of ten farms have a ryegrass/white clover dominant pasture. The farmers on these farms are also trialling a range of other species, including plantain, chicory and high sugar grasses. The tenth farm increased pasture diversity by changing from a ryegrass/white clover pasture to a mix of 12 different pasture species, including plantain, chicory and phylaris. Nine of the ten farms have a re-grassing policy that is linked to their forage cropping programme. One farm does not re-grass (staying with older pastures that the farmer found have increased persistence) or use forage crops. Of the nine farms with forage cropping, all sow a summer crop: eight use summer turnips, two have grown maize, and two are using chicory. Two farms usually sow a winter forage crop (e.g. oats and choumollier), and one farm is trialling a brassica crop (non-specified) for the upcoming season.

The dairy farmers in this study all apply fertiliser, and their fertiliser policies contain both maintenance and nitrogen (N) components. Maintenance nutrient fertiliser rate is defined as the estimated amount of fertiliser required to maintain soil tests at the current level, assuming all other inputs are constant. All farmers soil test and maintenance fertiliser is usually applied per the soil test recommendations, either once (spring or autumn) or twice a year (spring and autumn). The commonly used maintenance fertiliser products are sulphur based and may contain phosphorous, potassium (potash) and nitrogen. Some of the commonly mentioned fertiliser products include sulphur super, potash super, super phosphate, sulphate of ammonia and Dicalcic. Eight of the ten farms apply nitrogen as either a single dressing in spring, or a split-dressing in spring and autumn, or regularly over the growing season. Two farms do not apply nitrogen. The quantity of nitrogen used per farm varies, as does the form of nitrogen applied (e.g. urea, LessN® and sulphate of ammonia). Urea is the most commonly applied form of nitrogen.

The two farms with a larger herd size use a rotary cowshed, and the remaining farms use a herringbone. All farms apply farm dairy effluent (FDE) to land. The FDE systems on these farms consist of collection and land application components, and some systems also store effluent in a pond or an above ground tank[68]. Four farms have simple FDE systems, and on these farms, effluent is pumped directly from a sump in the yard to an effluent storage facility that holds between one and three days of effluent. Five farms have an effluent pond or tank for effluent storage, and on one farm, the farm owner was installing a Kliptank™[69]. Farmers without storage apply effluent regardless of weather and soil conditions, while those with storage apply effluent to land in ways to minimise effluent ponding. Eight of the ten farms use a traveling irrigator, one uses an irrigator and a slurry tanker, and the other only uses a slurry tanker for effluent application.

[68] Effluent is stored until it can be safely applied to land to cause the least environmental contamination. Effluent applied to wet soils, while raining, or during winter, can pond and run-off. Ponding occurs when effluent pools on the soil surface because there is too much for the soil to absorb. Effluent ponding is a non-compliant activity under the One Plan.

[69] A Kliptank™ is an above ground farm dairy effluent storage tank. The other FDE storage option is a lined pond.

Conclusion

The Manawatu-Wanganui Region is large, geographically diverse, and defined and dominated by waterways. Over half of the region is in pastoral land use, of which dairying comprises a comparatively small land area compared with sheep and beef farming. The Tararua district is the oldest established dairying area in the region, and characterised by reliable rainfall and pasture growth. Dairy farm size and business structures within the Tararua district are diverse, ranging from owner/operator farms, to owner/sharemilker businesses, to equity partnerships. The farm systems operated by the farmers on these farms are equally diverse.

The intensification and expansion of dairying within the region contributed to declining water quality, and a range of water quality interventions were introduced to address this decline. Horizons Regional Council shifted from a non-regulatory to a regulatory approach to water management and publicly notified the Proposed One Plan in 2007. This regulatory intervention adopted a targeted approach to water management, and identified the WMZ where intensive land uses will be actively managed through regulatory methods. The ensuing farmer and community resistance to the POP, and to the introduction of controls over land management activities, is of key interest in this research. Horizons also used non-regulatory methods, such as fencing subsidies (economic incentives) to encourage farmers to fence waterways. In addition, DairyNZ provides information and advice to farmers, Fonterra encourages and supports farmers via their Supply Fonterra programme (educational intervention), and dairy farmers are encouraged by the dairy industry's voluntary Sustainable Dairying Water Accord to adopt best management practice. These interventions aim to influence farmer behaviour around farming and water quality. From the regional context in this chapter, the next results chapter focuses on farmers' individual and collective responses to the water quality interventions designed to improve water quality. This first results chapter takes a narrative approach and explores what happened over time, who was involved, and how historical events shaped farmers' current responses to these water quality interventions.

Chapter Seven
Dairy Farmers' Responses to Water Quality Interventions

Introduction

New Zealand dairy farmers are required and expected to change their farm management practices to improve water quality. This first of two results chapters explores the first research question: *How and why have New Zealand dairy farmers responded to water quality interventions?* In this first results chapter, data from documents is interwoven with the farmers and key informants' stories of response. Pseudonyms and direct quotes are used extensively to share the richness of the participant's stories, and to lend meaning to the themes and sub-themes identified during data analysis. In addition, this results chapter strategically uses 'asides' or alternative writing spaces. These asides are italicised and placed within a shaded box to clearly signify those moments of interpretation and reflection. These asides identify farmers' individual and collective responses to water quality interventions and link these stories of response to the theoretical concepts discussed in Chapters Two and Three.

Although the farmers in this research were asked about all water quality interventions, they discussed Horizons One Plan (regulatory intervention) and the impact of this plan on their farm businesses in more detail. As a result, this chapter focuses on farmers' responses to the One Plan, with less focus on other interventions such as Supply Fonterra, Tararua fencing subsidy, the industry accords and educational material and events. The farmers' focus on the One Plan resulted in the first two sections of this chapter being organised around a before-after chronology of events centred on the One Plan's development. The initial section investigates key events pre- and post-Horizons' notification of the Proposed One Plan (POP). This section explores what happened, how the farmers felt, factors influencing farmer opposition to the POP, and explores the actions of the community action group that formed in opposition to the POP (Tararua Community Economic Impact Society - TCEIS). The second section investigates farming under the operative One Plan. This section explores: farmer awareness of and knowledge about Overseer and nitrogen loss; beliefs about the impact of the One Plan on farm values; and how farmers learnt about nitrogen loss and Land Use Consents. The third and final section in this chapter explores the changes farmers made to their farm management systems in relation to water quality, and the drivers identified by the farmers as shaping these changes. This final section is structured around the management of waterways, nutrients, farm dairy effluent, and livestock and crops.

Farmers' responses to the One Plan: a shift to rules and regulations

Before the One Plan was notified, Horizons favoured a non-regulatory approach for managing diffuse discharges, and a regulatory approach for point source discharges. Land use activities (farm management practices) were historically managed via education and information (voluntary management strategies[70]), and diffuse discharges were not regulated. Point source discharges to land and water (e.g. farm dairy effluent) were managed via a regional policy statement and regional plans. Simon (Horizons) remembered how dairying and water quality were being debated nationally ('*I think it was becoming a really big issue'*), and how the media were highlighting the public's concerns around water quality, and, the Manawatu River in particular[71].

The Proposed One Plan (POP) was publicly notified on 31 May 2007. The POP adopted a regulatory approach to manage diffuse discharges to water, and Horizons was the first regional council in New Zealand to use land use controls to manage water quality in waterways other than lakes[72]. Horizons' communications consultant outlined the extensive consultation with stakeholder groups before the POP was notified (Anderson, 2009). Staff interviewed from Horizons and Federated Farmers, believed farmers and industry expected the POP to continue with a non-regulatory approach, and were surprised by regulatory controls over farm management practices. Mark (Horizons) remembered the discussions between Federated Farmers and Horizons' staff about farm management practices that could reduce nutrient leaching. He felt the POP did not reflect these discussions, and Chris (Federated Farmers) believed Federated Farmers' staff and farmers '*felt short changed'* because the shift in council policy did not consider Federated Farmers' input and impact on farmers. Mark (Horizons) thought the Horizons' policy manager found the non-regulatory process too time consuming, and he shares his impressions of what happened:

[70] Voluntary management strategies to enhance water quality were introduced in 1997 and 1999. Two regional plans (1998 and 2003) included regulatory requirements for management of farm dairy effluent.
[71] This staff member recalled media headlines that stated the Manawatu River is 'the most polluted river in the western world'. Chapter Five investigates the research report that sparked this media attention.
[72] Environment Waikato was the first regional council to introduce controls over land use (Regional Plan Variation 5, operative 2011) in order to reduce the amount of Nitrogen entering Lake Taupo.

'O*ur group manager at the time simply got sick of waiting, and he had a timeframe in which he needed to deliver the plan and at some point made a decision that…if we can't get a non-regulatory approach then we'll put a regulatory approach in the plan. I think that that came as a surprise when the plan came out.'*

Recalling when the POP was notified, the farmers in this study remembered feeling surprised and concerned at Horizons' regulatory approach. Horizons' staff were aware of farmer discontent, and understood why farmers were concerned, as Simon (Horizons) explains: '*requiring a consent to be able to farm the land was pretty on the nose - it wasn't the way that New Zealand operates*.' The farmers interviewed felt that by introducing rules, Horizons were telling farmers how to farm. Max said '*you have to cut this and reduce that*', Ken believed Horizons were '*forcing them [farmers] to cut down stock numbers',* and Roy felt Horizons '*were running around like enforcers'*. Paul thought Horizons did not have the experience or knowledge to dictate farm practice, and in his opinion, '*they [Horizons] didn't know what they were talking about'*. Some farmers did not take Horizons' regulatory approach seriously, and others, Tom recalls, were '*like, well like hell, that's not going to happen*'.

Some farmers in this study described their strong negative emotions and opposition to what they saw as controls over farm practices. These farmers used words like concerned, worried, frustrated, annoyed, disgusted, upset, shocked, frightened and scared to describe how they felt. Doug (TCEIS member) remembers how he and other farmers felt about Horizons' approach after the POP was notified:

'The culture of Horizons was you'll do as you're told, we know what we're doing and if you don't do it right we'll nail you, seemed to be the way. How did the farmers feel about that? Very aggrieved, bugger [Horizons], I don't want to be told what to do, they can't tell us we're going to have to do all of this, who do they think they are?'

The farmers' strong negative emotions indicate resistance to the POP.

Not all farmers felt negative towards the POP. Some farmers, like Jack, felt positive about the POP when it was notified, because he realised he would not need to change his farm system. The N loss from their low input non-conventional system met the POP nitrogen leaching targets (Table 13.2), and his words reflect this realisation:

'*Once the One Plan came out, we were quietly celebrating in our head we don't have to change anything, we're already meeting all these targets.*'

Some farmers felt they and others were in a fight with Horizons. This is evident in the language farmers used to recall events. Ian felt '*people were fighting to change the rules',* and Owen thought farmers were '*set up to fight'.* Jack likened farmers' conflict with Horizons to Gallipoli trench warfare: '*we don't want to climb out, because we're going to get our head shot off*', and Ian maintains '*Horizons came in like Hitler and got everyone offside'*. The farmers acknowledged they were not alone in their fight against Horizons, and they recognised the support and assistance of Federated Farmers ('*they were against it [the POP] and fighting it [the POP]' – Fred)* as well as Fonterra and DairyNZ. Federated Farmers were considered to have listened to and supported farmers by organising farmer meetings, attending POP meetings, researching the science behind the POP, consulting with Horizons' staff, and challenging the POP through the court process. .

> *'Fighting' indicates resistance.*

The next section investigates the factors contributing to the farmers' negative emotions and opposition to the POP.

Factors contributing to farmer resistance to the POP

'No discussion, no feedback, no engagement'

Recalling when the POP was notified, some farmers in this study felt Horizons had not consulted with them and others felt unaware of the POP ('*we didn't know it was being developed'* – Max). Some farmers, like Paul, thought Horizons were telling farmers what to do rather than consulting with or caring about farmers:

> *'[Horizons] just told everyone what we had to do, and they didn't really consult - they might have thought they did, but it was more oh you're going to have to cut your stocking rate, cut back on your fertiliser, we don't really care if it's going to affect you economically or anything like that, that's what you're going to have to do*.'

Other farmers, like Jim, felt Horizons did not discuss the POP with farmers, and he also thought Horizons' communication with farmers was dictatorial and one-way:

> *'It [the POP] was presented as a fait accompli, this was how [Horizons] were going to manage the region and [Horizons] are going to target N leaching at this level. It was totally inflexible, there was no discussion, no feedback, no engagement and it was going to be enshrined in law and you [farmers] were going to jump through hoops to meet it*'.

These stories indicate a perception of increased control ('telling us what to do') and a lack of care. Trust declined between Horizons and farmers.

Hearing about the POP

The farmers in this study heard about the POP from a range of sources. Some talked to other farmers, some talked with their advisors (e.g. farm consultant), and others with staff from organisations (e.g. Fonterra Area Manager and Federated Farmers). Some heard or read about it from the media, and others went to organised farmer meetings. Pete (Fonterra) remembered a Horizons' led farmer meeting after the POP was notified, which attracted a strong farmer turnout, and he recalls there '*would have been about 70 farmers there'*. Pete believes the Horizons' staff present did not provide the information farmers wanted, nor did they provide evidence to justify the POP being introduced:

'Well one farmer at the meeting asked specifically for quantified nutrient levels at Horizons testing sites in the upper Manawatu. [Horizons staff member] said quite adamantly that it was on the website, these figures. You know, pretty basic information the farmers were wanting to know. But they were not on the website, they were not - Horizons were trying to promote the need to take all these tonnes of nitrogen out of the upper Manawatu, but not back it up with a fact sheet. They did not deliver the farmers the information they needed for farmers to come on board. Out of that meeting a whole bunch of fairly disenfranchised farmers went away thinking "well hell. I've got to spend a lot of money getting consent to farm, when I haven't really had it explained to me why".

Sam (Horizons) also raised some concerns about how Horizons communicated the practical implications of the POP to farmers. Sam admitted they did not hold enough farmer workshops, and conceded the information provided was '*too high level*' which allowed farmers to speculate and interpret the information incorrectly. Sam believes Horizons' ineffective communication increased farmer opposition to the POP:

'So, there was a whole lot of rumours and scaremongering within the farming community that everyone was going to have to destock and this was going to happen and that was going to happen. The perception of what the rules were going to mean for them was just way off and extreme. But because there was no communication coming from the council around what's actually going to happen, they were free to have those thoughts and discussions within the communities'.

'I don't know how the POP will impact on me and my farm'

The farmers in this study were unsure how the POP would affect them and speculated about what changes they would need to make on their farms. Ken reads the newspaper and watches TV and believes the media sensationalised the impact of the POP: '*The media can hype things up, and farmers read that at night and think, wow, what's this going to do to us*?' Owen remembers how he felt: '*I think I got caught up in the hype that was going around that said we cannot farm, we're going to be broke, we're going to be everything else'*.

> *The farmers felt un-informed and the media sensationalised the potential impacts of the POP. These factors contributed to resistance to the POP.*

'Horizons cares about the environment. They don't care about farmers'

When the POP was notified, some farmers in this study believed Horizons were focusing on the environment, and not concerned about or interested in how the POP would impact on farmers and the community. In Jack's opinion, '*this wasn't just a plan to clean up the river, this is going to actually diminish life in our region'*. Some farmers believed a few Horizons' staff drove the POP's environmental focus. Ian said: '*one guy had this idea and told everyone else that's how it's going to be'*, and Paul believes the staff involved were more interested in the environment than farmers:

> *'The people that instigated the One Plan were environmental officers basically, that was their narrow little focus, they were going to clean up the environment, no matter what the cost [to farmers].'*

'We're being unfairly targeted'

The farmers in this study believe the POP and the operative One Plan unfairly targeted and blamed dairy farmers, even though other land users contributed to declining water quality. Some farmers described how city and district council treatment stations are allowed to discharge pollutants to water, and Jim feels this is unfair: '*The Pahiatua Treatment Station can dump into the river, the Dannevirke Treatment Station can dump in the river. We can't, but if their consent expires, Horizons don't get on their back*.' Simon (Horizons) understands that farmers feel they are being blamed for declining water quality, and comments: *'in my view, a feeling - particularly from the dairy sector, that they were being victimised over other sources of in-river pollution. So waste* *water treatment plants for example*'. Similarly to Jim, Ken strongly feels dairy farmers are unfairly targeted, and councils are treated more leniently than dairy farmers:

> *'Did you see in the paper last night where all Manawatu's effluent from the city, it's just pouring in and polluting our river something terrible? They're allowed to get away with it…That's what they're doing to the cockies, and yet city council can just let it go straight into the river, and that gets our back up really bad'*.

Other farmers think the One Plan is unfair because dairy farms are targeted (e.g. streams fenced), yet sheep and beef farmers run the same stock type (cattle) and their farm management practices are not regulated (not required to exclude stock from waterways). Tom strongly expresses his frustration about seeing beef cattle in waterways while driving into town: '*It pisses me off, it does, because there's one rule for dairy farmers and one rule for sheep and beef farmers*'. Roy similarly shares his opinion:

> '*I can't believe how the media say that we have to fence all our streams off, yet I've got sheep farmers beside me with 50 steers on the same creek. They must be different animals to my cows, I just can't believe it.'*

> *The farmers felt their cultural norms around fairness and equity were being violated. Trust declined. Resistance increased.*

'We're going to court'

After the POP public consultation and hearings process (2008-2009), a modified version of the POP was released in 2010. Federated Farmers and other interested parties (including Fish and Game) filed appeals to the Environment Court, a mediation process ensued (2011), and after the Environment Court decision was released in 2012[73], Federated Farmers continued as an appellant to the High Court. Fish and Game were an interested party in the High Court process. This section describes the court processes from the point of view of some Horizons and Federated Farmers' staff involved.

> *'Going to court' illustrated the community's resistance to the POP.*

[73] The Environment Court process and decision is discussed in Chapter Six.

Some farmers in this study were aware of the court processes involving the POP, but none were personally involved. The nature of the environment court processes was evident in the language used by some Federated Farmers and Horizons' staff. Chris (Federated Farmers) described the environment court processes as an '*awful experience*', thought the mediation was '*aggressive*', and felt Federated Farmers were '*massively outgunned*' by other organisation's resources. Simon (Horizons) described the court process as '*disempowering for communities and the council'*, and believes it created '*a lot of tension*' in the community and within council. Mark (Horizons) wryly remembers, when referring to Horizons, Fonterra and Federated Farmers, '*we didn't like each other very much during the court process*'. Additionally, Chris (Federated Farmers) feels the court process judged farmers, their care for the environment, and their farm knowledge. Using heartfelt emotion, Chris (Federated Farmers) remembers the environment court process from a personal and farmer perspective:

> *'The people that I was sitting there with, my farmers, who were amazing support, it was their moral fibre that was in question, and these were awesome people, hard-working. Because horrible accusations for being environmental Nazis and being this and that and the other. It gets dirty, really dirty…and some bloody city slicker is telling them how to do it and telling them that they're dirty bastards and they don't know their own farms. Can you imagine? Terrible, terrible, horrible - really, really felt for these farmers. I felt really angry about it because I just felt that the people that were sitting in judgment, including the Environment Court judges, had absolutely no clue about what they were asking people to do and the expectations they were placing upon them*.'

> *The farmers took pride in their farms and in caring for the environment. They felt they were being judged and accused of being 'bad farmers'. They felt the POP violated their personal norms of stewardship and the cultural norms around relationships (lack of respect). Trust declined. Resistance increased.*

The Environment Court's ruling set limits around N loss. Dairy farmers in targeted WMZ would be required to decrease milk production in order to meet the N loss targets. The next section explores the community's response to the Environment Court's decision, increasing regulation, and a deteriorating relationship between farmers and Horizons.

Re-shaping and re-building relationships: The Tararua Community Economic Impact Society

'What can we do?'

After the Environment Court decision was released in August 2012, a few concerned Tararua dairy farmers met and discussed the economic impacts of the POP on their farm businesses. Unsure of their options, Doug (a farmer) used his existing personal relationship and sought advice from a DairyNZ staff member, because he felt: '*we're [farmers] getting shafted here, what can we do*?' The dairy farmers also discussed their concerns with a '*local prominent businessman'* (in Doug's opinion) and the DairyNZ staff member met and discussed possible actions with the dairy farmers and businessman.

The farmers used their social networks for information, advice, resources, support and new contacts. Social networks were pivotal to enabling this collective response to the POP.

The businessman prepared an economic impact analysis on the effect of the POP on one farm[74], and extrapolated this loss across the 289 dairy farms in the Tararua District (from Norsewood to Eketahuna). This economic analysis estimated a loss of 9 million kg MS from dairy farmers in the Tararua District, and at a payout of $7-8/kg MS, this lost production was estimated to result in a loss of $63-$72 million of total gross income per year and approximately 300 jobs in the community (with more over time) (DairyNZ, 2014b). The DairyNZ staff member checked the calculation. Doug (TCEIS) remembered how they then approached a local respected accountant to check their figures, and he believes using local respected professionals increased confidence in the TCEIS:

> '*[The community] were confident in our numbers because we used people who were respected, the numbers were respected, and that we were right in our basis of thinking*.'

This story indicates competency (accountant's numeracy skills). Trust was built.

[74] To meet the nitrogen loss limits in the POP (Table 13.1), dairy farmers would be required to reduce cow numbers which would result in reduced milk production (kg MS).

'The POP affects everyone – not just farmers'

The Tararua Community Economic Impact Society (TCEIS) formed in 2013. In Jack's opinion, the TCEIS formed because '*people*' thought the POP was just a farmer problem ('*the farmers are bitching again [about the One Plan], this is just the farmers'),* whereas he believes the POP affects the wider community: '*you hurt farmers you hurt everyone'*. Chris (Federated Farmers) holds similar views about the public's opinion of Federated Farmers' and farmers' reaction to the POP: '*the city people - they just think we're a pack of moaning farmers*'. As Doug (TCEIS) remarked, the TCEIS knew river nitrogen levels were high, and they knew river nitrogen levels needed to reduce. The TCEIS disagreed with Horizons' method to reduce nitrogen levels ('*reduce milksolids and the number of cows'*); they believed that Horizons did not understand the POP's impact on the community ('*they [Horizons] said we've got it all sorted and you guys [farmers] will still make as much money, which wasn't right*'); and they believed that Horizons were not working collaboratively with farmers ('*we're going to solve it and this is what you guys will do*').

The formation of a farmer-led collective action group (TCEIS) was a collective response (resistance) to the POP.

In Max's opinion, the TCEIS represents '*all the community*, *not just the farmers*'. Doug (TCEIS) described the wide range of individuals and organisations involved with and represented by the TCEIS: farmers; agricultural service providers; past and present mayors; district council staff; Dannevirke and Pahiatua business owners; professionals (e.g. accountants, lawyers, bank managers); members of the Chamber of Commerce; and their local Member of Parliament. Fish and Game were not involved, and Doug (TCEIS) believes this is because Fish and Game are '*anti dairy farmers*'. Fonterra, DairyNZ and Federated Farmers supported the TCEIS. Doug and the other TCEIS leaders recognised the POP would have a negative economic impact on dairy farmers, and on the Tararua community as a whole. Doug recalls:

> '*We [TCEIS] said let's approach this from a way of not the dairy farmers getting up and grizzling about something as dairy farmers, let's say the effect would be this great on the community so what would the community think about it? So, when you get the community saying no to something, then there's a bigger impact.'*

The TCEIS leadership group comprised local well-known dairy farmers and the Dannevirke businessman. The leaders were supported by local professionals, including, as Doug describes, '*one of the most prominent lawyers in town'.* Roy recalled the personal contribution and commitment made by the farmer leaders, and comments: '*Good on them. They put all their time and effort into it, and they're busy people too*'. Doug (TCEIS) acknowledged the support from family, staff and other farmers, which enabled the dairy farmer leaders to be off-farm involving and informing the community:

'*We tended to spend most of our time, people looked after our farms which was great, our staff they were good. We just every day we had an agenda and [name] would ring, we'd get in the car and we'd go and visit different people'*.

Roy's and Doug's comments illustrate cultural norms of reciprocity. The TCEIS farmer leaders were 'doing good for others', and in return, others were helping the leaders ('people looked after our farms').

Informing and involving the community

The TCEIS members talked individually with local service providers, professionals, business people and local farmers, went to farmer discussion group meetings, and ran public meetings. Ross (DairyNZ) went to a number of meetings ('*we had everybody coming, so it was the community'*) and recalls the size of these meetings: '*we had little community meetings, they would fill that little church'*. One thing Ross (DairyNZ) remembers: '*we were getting people interested and talking'*. The TCEIS leaders presented the results of their economic impact analysis, informed farmers about the economic impact of the POP on their businesses (reduced milk production), and business people about the potential impacts of reduced milk production on their businesses and the regional economy. The DairyNZ staff member was often present to provide scientific information and a dairy farming perspective. Roy and Jim went to a TCEIS meeting, and they share their memories:

'I went along to one of them [a meeting], and they [TCEIS] just used all the facts, what it's going to cost the local economy, local businesses. A lot of the local businesses opposed it [the POP], just people who relied on the dairy industry and said this is just unacceptable.' (Roy)

'*I remember [local farmer] spoke, and he spoke up there, and he said to the businesses in Dannevirke, he says, "This is what this One Plan's going to do for our farm, but we'll survive, we'll survive because we'll change, and we'll have to survive." But he said, "I don't know if you'll survive." They all looked at him, and he says, "Well we won't be coming to town to buy a car, we won't be buying tractors, there'll be no money for that*". (Jim)

Ross, Roy and Jim's stories illustrate examples of social learning – accessing information and sharing knowledge with others.

The TCEIS strategically used the media to inform and create awareness about group meetings and how the POP will impact on the community. Doug (TCEIS) remembers how they used the media: '*We didn't want to fight it through the press but we wanted people to know*', and how they formed a partnership with selected journalists: '*we made sure that they weren't dirty dairying type people who were going to say that all the time, because we wanted a balanced view'*.

The TCEIS leaders met new people and developed new relationships with individuals within and outside the agricultural industry. Contact lists were created, and Doug (TCEIS) recalled how the group used these lists to inform people about upcoming meetings and information. These new relationships in turn provided access to other individuals, skills, resources and support, and Doug (TCEIS) remembers how a local accountant enabled access to their boardroom for meetings: '*they supported us, gave us cups of tea and food'*. Fonterra and Federated Farmers provided support, and Pete (Fonterra) describes their contribution: '*We've helped fund them a bit too with lunches and hall hireage and stuff, because they're not a money-making outfit or anything*'. The DairyNZ staff member continued to support the group, and through his contacts, the TCEIS gained access to new contacts, new knowledge, support and verification, for example, '*we got [economist] from DairyNZ who did a financial analysis to support ours, and it came out with the same result'* (Doug, TCEIS). Through the process of informing others, the group members also learnt about the scope of the issue, and who was involved: '*we realised we need to involve the banks because it's going to affect the capital asset of the farms, the ability to repay, and what's the bank's position going to be on it*?' (Doug, TCEIS). The TCEIS sought information and support from individuals outside the Tararua community, for example, the Minister for Agriculture, staff from Rabobank, an ANZ economist and a Ravensdown scientist.

The TCEIS leaders used their existing networks and built new networks to access information, skills, support and resources ('lunches and hall hire').

The meetings raised awareness, encouraged involvement, and created learning opportunities. From what Ross (DairyNZ) saw and heard at the meetings, he believes as the farmers learnt they developed ownership, felt empowered, and felt increasingly comfortable to ask questions and challenge Horizons:

> *'People started to learn, and once people started to learn then you don't have to keep defending it anymore, everybody starts to own it. They go to meetings and they say to the regional council. "But you're telling me farmers will be profitable, but the volume's going to be halved, what about me?" The regional councils have to answer it, and that's what all this is really about was giving - empowering people to ask the right questions*.'

> *Collective social learning contributed to an individual change, or in Ross's words: 'empowering people to ask the right questions'.*

'The turning point' – a public meeting in May 2013

In Pete's (Fonterra) opinion, the TCEIS organised public meeting on 6th May 2013, was the '*complete and utter turning point*' in the relationship between Horizons and farmers. Doug (TCEIS) described what happened. Before the meeting, the Horizons' chairman rang Doug, and in Doug's words said to him: '*I hear you're going around scaremongering the people with all these economic stuff*'. The chairman requested an opportunity to talk with the community, a meeting date was set, speakers organised, agenda circulated, and the TCEIS members informed the community about the meeting. The TCEIS leaders expected about '*30-40*' people, but as Doug (TCEIS) recalls: '*The farmers became so passionate they went around and just got an overwhelming response of people to come to the meeting. So, we ended up with 400 people there*.' Pete (Fonterra) described how the TCEIS '*got the grapevine going*' and he shares his recollection of the angry tone at the meeting:

> *'A lynching mob of 400 farmers turning up to a meeting, 400 farmers haven't turned up to a meeting in the Tararua for 100 years, they haven't…Well it was a lynching, it was string up Horizons, they're going to put us out of business*.'

At the May meeting, the community expressed their heartfelt emotion and anger with Horizons. Simon (Horizons) remembers the anger, the '*pain in the room',* and the raw emotion he saw and felt: '*there were some tears*' and '*some got pretty grumpy*'. A reporter described the meeting as 'emotionally charged' (McKay, 2013b). A vote of no confidence in Horizons' chairman was put to the community, but the motion failed to pass (McKay, 2013b). Thinking back to the meeting, Simon (Horizons) thinks the vote of no confidence was the community's way of expressing their '*powerlessness*' and their opinion that the POP was '*not implementable'*. Doug (TCEIS) firmly believes the vote of no confidence showed the community's anger with Horizons and was the start of building the relationship between TCEIS and Horizons:

'In hindsight and I guess from that, we had to be very careful that we didn't burn all of our bridges in our relationship with Horizons, but we had to give them, if you like, enough of a clip around the ears that they were going to listen, so you could have follow-up discussions.'

The vote of no confidence is an example of the community sanctioning Horizons for a perceived violation of cultural and personal norms.

As a result of the May meeting, an independent cost-benefit and economic impact analysis of the POP's nutrient management provisions was undertaken by Nimmo-Bell (Bell et al., 2013). Ross (DairyNZ) and Simon (Horizons) recalled how Horizons and DairyNZ staff worked collaboratively to set the terms of reference for this joint study, and to comment on the draft report. The Nimmo-Bell report verified the initial economic analysis undertaken by the Dannevirke businessman. As Ross (DairyNZ) summarises: '*this wasn't all just about farmers whinging that this was tough',* it was about the '*dramatic affect'* of the POP on the community.

Building relationships

After the May meeting, a relationship was built between Horizons' staff and the TCEIS leaders. Simon (Horizons) recognised the TCEIS had '*legitimate concerns'* about the Tararua's future, and as a result believes open and honest communication between Horizons and the TCEIS has developed. The May meeting, in Pete's (Fonterra) opinion, was '*a watershed',* and be believed it influenced the implementation of the One Plan, and the relationship between farmers and Horizons:

'It made Horizons instead of standing back and saying no, no the One Plan's going to happen as it is, it made them employ a guy like [name] and get rid of [name] and get on and talk to farmers and dumb down the One Plan basically, you know, started to consent anyone'.

Horizons was encouraged to change their behaviour, and this change ensured the cultural norms around relationships were not violated. Trust was built.

The next section explores how dairy farmers are adjusting to One Plan rules, their understanding of nitrogen leaching, and how organisations are working together to support farmer learning through this change.

Farming under the One Plan

'Who needs a Land Use Consent?'

Based on the impact of existing intensive farming land use activities on water quality, the One Plan classified the 43 WMZ (and 124 WMSZ) in the Manawatu-Wanganui Region as either targeted or non-targeted[75]. Farmers in targeted WMZ are legally required to obtain a Land Use Consent and introduce mitigation strategies to reduce their farm nutrient losses to waterways.

Seven farmers in this study farm in a targeted WMSZ and they are aware they require a Land Use Consent. Fred, Roy and Jack were involved in the pilot Land Use Consent programme[76]. Fred and Roy have a consent and Jack is negotiating the consent terms with Horizons. The four other farmers who farm in a targeted WMSZ are yet to obtain a consent. These farmers are at different stages of the information seeking and consent planning cycle. Max is aware of what he needs to do to obtain a Land Use Consent and has identified mitigation strategies; Owen sent his farm consultant to a One Plan meeting and his consultant is exploring mitigation strategies; Steve went to a One Plan meeting; and Paul has little information and is waiting for a meeting.

Jack and Roy both negotiated the terms of their consent with Horizons. Jack was in the process of selling their farm and negotiated with Horizons for the new owners to apply for the farm's Land Use Consent. Jack farmed a low input system that had low levels of N leaching. He was concerned that their farm's lower N loss levels would restrict future options for the new owners and would limit the price the purchaser was willing to pay. Roy purchased a neighbouring targeted farm, and their farm consultant negotiated with Horizons for a slightly higher N leaching loss (kg N/ha/yr) for the 'new' farm, so Roy could run the 'new' and 'home' farms on the same system[77]. Jack and

[75] Targeted WMZ and WMSZ are described in Chapter Six.
[76] The pilot Land Use Consent programme was described in Chapter Six.
[77] The 'new' farm had a lower N loss and run on a different management system to the farmer's existing 'home' farm.

Roy were satisfied with the outcome of their negotiations, which for Roy ensured continuance of a profitable farming system, and for Jack, a realisation of their asset.

Five farmers farm in a non-targeted WMSZ, and do not require a Land Use Consent under the current version of the One Plan. Three of these farmers know they do not require a Land Use Consent, while the other two are unsure. Ian remembers '*we did get something in the mail about this consent thing, but it wasn't clear*'. Ian is also not sure if the One Plan is '*finished going through the* court'. Although the One Plan states only intensive farming land uses in targeted WMSZ, and land use conversions (anywhere in the region) require a consent, some targeted and non-targeted farmers believe all dairy farms will require a Land Use Consent in the future. Max's misconception is similar to that voiced by other farmers:

> '*From what I understood of it is that there's a roll out, and everyone needs it over time, and they're starting on the really bad ones, and then they're working through after that.*'

Awareness of and knowledge about Overseer

OVERSEER® Nutrient Budgets (hereafter referred to as Overseer for simplicity) is a computer software model that calculates and estimates the nutrient flows in a farming system (kg/ha/yr) (Watkins & Selbie, 2015). Overseer is used by a range of organisations for regulatory and advisory purposes. For example, Fonterra use Overseer to generate a Nitrogen Report for each supplier's farm, which compares the farm's N conversion efficiency and leaching loss to other farms in the region. Fertiliser company representatives use Overseer to produce an annual nutrient budget, which assists with maintenance fertiliser recommendations. DairyNZ use Overseer to prepare a baseline[78] nitrogen (N) loss for each farm in a targeted WMSZ as part of the Land Use Consent process. Horizons use Overseer for regulatory purposes, which determines the length of consent a farmer can be issued, and the extent to which these farmers are required to change their farm management practices to reduce annual N loss to water.

Farmer awareness of and knowledge about Overseer varied. Some farmers, like Max, could describe Overseer: '*I know the things that influence Overseer, and I know how to change my management to make a difference'*. Some farmers, like Jim, have heard of Overseer and how it works: Jim knows farm data is inputted and a nutrient budget is produced. Other farmers, like

[78] The baseline is a reference position of a farm's nutrient management status and described in Chapter Six.

Tom, have a little knowledge ('*it's a computer module which spits out figures'*), and some, like Roy, have limited knowledge (*'I don't know a lot, I don't use it*') and rely on their consultant's knowledge and advice. Some farmers have personal experience with Overseer, for example, from a nutrient budget prepared by their fertiliser representative or nutrient management consultant, and others have limited personal experience. Henry (DairyNZ) recounted an anecdote he heard from a regional DairyNZ staff member, who was discussing a conversion consent with a local dairy farmer. The regional staff member advised the farmer '*we'll have to run some numbers through Overseer and see what the Overseer file said*', and the farmer's response was '*Who's this Overseer chap you keep on talking about?'* Henry (DairyNZ) recounted the story because he was '*incredibly surprised*' at this farmer's lack of awareness and understanding of the connection between Overseer, farm nutrient loss, and the One Plan's impact on the farmer's business.

Some farmers in this study raised concerns about Overseer. These farmers are concerned about changes to Overseer and the impact of changes on their farm systems, for example, Paul comments: '*I know they're always upgrading it, it always seems to get worse each time they upgrade it. It [the limits] gets harsher and harsher'.* Jim is concerned that an operator can generate different nutrient loss figures from the same farm data ('*she could generate an N leaching, anything from 18 to 30 for this farm, by massaging the figures*'), which in his opinion, reduces the credibility of Overseer and plans based on Overseer. Max thinks most farmers are negative about Overseer because it is inaccurate, theoretical ('*farmers hate not being able to see a number…they can't see a cup full of 26 N per hectare*'), and used to control their farm practices: '*Overseer's a stick that's been put in and it's not accurate …but it's used to create a number that has to be stuck to*'.

These stories indicate reduced trust in the technology. Trust was reduced by a perceived lack of consistency and accuracy.

Other farmers were surprised when their farm's annual N loss (kgN/ha/yr) prepared by their fertiliser company, differed from that prepared by other sources (e.g. Horizons, Fonterra's Nitrogen Report). Fred's Ravensdown-prepared nutrient budget calculated the farm's N loss of around 18 kgN/ha/yr, and based on this information, Fred proactively applied to do his Land Use Consent early because he thought the process would be '*easy and trouble free'*. Fred was surprised when Horizons calculated the farm's annual N loss to be 36 kgN/ha/yr, which was almost double that calculated by Ravensdown ('*whoa there's a big difference, I didn't expect that*'). Fred's experience highlights how conflicting information from seemingly the same farm data informed and influenced his decision making:

> *'Naively, going on our nutrient budgets we used to get from Ravensdown each year, thought well we'll hose in, we won't have any problem. We fenced all our waterways off, we're not excessive fertiliser, we don't use any nitrogen, and all these things, and I thought we're going to sail through, but that wasn't the case'.*

Pete (Fonterra) explained why he thinks these Overseer-generated N loss figures can differ. He understands that Fonterra and the fertiliser companies rely on farmers supplying information ('*some farmers throw in the run-off for our lot and they don't throw in the run-off for another lot*'), whereas Horizons' data collection is more accurate and detailed: '*they sit down with the farmer and sight everything and run through it for up to four hours at a visit*'. Pete shares his experiences with farmers: '*You can sit with a farmer and he'll show you his [Fonterra] nitrogen report and it says leaching 32 and he'll have his Dairy NZ baseline saying leaching 42 or whatever*.'

Awareness of and knowledge about nitrogen loss

From the language farmers used, it is evident their awareness of and knowledge about nitrogen loss is changing. Pete (Fonterra) works with dairy farmers, and he describes the changes he has observed over the past few years:

> '*Even 19 years ago you talked nitrogen to a farmer, his eyes sort of glazed over and said, "Oh yeah, I use a bit of urea, that's all right." N loss and that wasn't on the radar, it's rapidly become so'*.

The farmers in this study are aware that nitrogen loss through leaching[79] is undesirable. Some farmers described the impact of nitrogen leaching. Tom farms in a high rainfall area, and he understands that leaching should be reduced: '*they [Horizons] want you to drop the cow numbers so you don't leach as much*'. Stu understands '*the lower that number, the less it's leaching, so supposedly the better the water quality'.* Other farmers, like Roy and Steve, described the farm practices that can contribute to and increase or decrease N leaching. Roy knows not to '*irrigate [effluent] over wet areas, when it's wet and when there's high leaching*', and Steve knows you can

[79] In agriculture, leaching refers to the loss of water-soluble plant nutrients from the soil, due to rain and irrigation.

'*negate nitrogen leaching'* by the way you '*shape your paddocks around drains, so that there's not a lot of run-off*'.

Farmer awareness of and knowledge about their farm's annual N loss varied. Some farmers, like the consented farmers, know their current N loss (kgN/ha/year), their targeted N loss, and the amount of reduction required to meet the One Plan N loss targets[80]. These farmers learnt this through the Land Use Consent process. For example, Roy said '*we're at 36 and the new farm's at 40'* , and from Fred: '*I'm at 36 and have to go to 35'*. Fred understands that '*go to 35'* means drop 1 kg N/ha/yr. Some consented farmers know other farm's annual nitrogen losses, for example, Jack comments: '*Our neighbours have consented at early 30s, 32*' and '*the other farm - they had a nitrogen leaching of 74 units of N'.* For some of these farmers, N loss is becoming part of farmer conversation. Other farmers, like the non-consented farmers, do not know their N loss figure, thought they knew it, or stated a range ('*about 14 or something, or 18*' - Steve) rather than an exact number. These farmers learnt about their N loss from other sources (e.g. their fertiliser company annual nutrient budget). Max thought he knew the number ('*I'm 26 or 28 or something*') and then admits '*I should be aware of what it is now, and be thinking about it, because it's coming up*'.

Value ('good' or 'bad') was attributed to the N loss number by some farmers. Some of these farmers described the value of a N loss number from an environmental perspective and others from a business perspective. From an environmental perspective, some farmers think a low N loss number is 'good' because it means the farm is leaching less nitrogen ('*I think we're about 14 or something, or 18, which he [fertiliser rep] said was actually damn good*' - Steve). For other farmers, a high N loss is 'bad', because these farmers believe high nitrogen use is an unaccepted farm practice. Roy heard '*some of the top ones in Taranaki or Canterbury are up to 110, 115*', believes this is through excessive N use ('*use N every rotation through the irrigators*'), and thinks using high levels of nitrogen is unacceptable and should be monitored:

> '*That to me is not normal farming practice that they are just piling this nitrogen on, and yet if you want a four cow stocking rate, four cows to the hectare, you've got no option you have to pour it on*.'

> *Roy is questioning current practice because it differs from what he thinks is accepted farm practice. Questioning is part of the process whereby new practice norms are formed.*

[80] Table 14.2 states the One Plan targets for N leaching loss and described in Chapter Six.

From a farm business perspective, some farmers think a low N loss is 'bad' and a high N loss is 'good'. These farmers believe farms with a high N loss will have more development options and a higher capital value than a farm with a low N loss. These feelings of inequity are amplified when a farmer considers selling their property. John (DairyNZ) remembered being contacted by a real estate agent who wanted a farm baseline as information for prospective purchasers of a dairy farm. John shares his story:

> '*So, I did a baseline for him [the agent] and it came out in the 50s, and he [the agent] was "yippee this is awesome", it's going to sell really well, because they know that if it's a high number they only need to make a 10 to 15 percent reduction and then they've still got a high number that they can operate to. So, he was away laughing, and then he came back about a month later and said: "This number in the 50s, when I'm looking at scenarios of potential purchasers, they can't double the stocking rate and double the production because the number goes up to about 70*."

Jack's farm has a low N loss which is beneficial to the environment, however, he feels disadvantaged compared to other farmers and he thinks it's unfair:

> *'I'm at 19, I have to show a 10 to 15 percent reduction, because you all have to show a downward trajectory. So, where's the equity in someone being able to farm at 74 minus seven. So they'd be around the 60 I suppose, they have to get to. But I still have to farm down here.'*

The opinion of some farmers, like Max and Roy, is that high N loaded farms will benefit more than low N loaded farms during the consent process. Max thinks if he reduces his N leaching before the consent ('*don't want to make it look too good now*'), he will '*end up getting nailed out the other end'.* Roy has been through a consent, and he advises:

> '*So, the farmers out there that haven't been through this process, go for it, load yourself right up*… Y*eah, because once you've got it, they're [Horizons] only going to take so much off you.'*

'Will the One Plan affect the value of my farm and farm sales?'

The farmers held a range of opinions about the impact of the One Plan on farm value, farm sales and farm purchases. In particular, the farmers held different opinions about whether they believe the One Plan will affect the value and sales of farms in targeted WMZ differently to farms in non-targeted WMZ. Some farmers believe the value of targeted farms will fall because the One Plan rules will prevent future development and production opportunities. Steve shares what he heard other farmers discussing at a meeting: '*my farm's only got a cap of this, so it's more flexible so it's worth more*'. Similarly, a New Zealand agricultural economist concluded that environmental constraints on farming will reduce the opportunity to intensify production, and as a result, could affect the speculative component of land value (Journeaux, 2015). Tom held a similar opinion to other farmers, and believes the One Plan will require a drop in cow numbers, thereby reducing production, which will reduce farm value:

'*If you've got a farm that milks 400 cows, and all of a sudden you can only milk 320 cows, that's not as appealing, is it, it's not going to be as profitable, so the land price is going to drop, because essentially your land prices were down per kilo. So if you don't produce the same amount of kilos, you're drop in money on your land prices*.'

Other farmers believe targeted farms without a Land Use Consent will receive a lower price. Jim's neighbour farms in a targeted WMSZ, is getting older, wants to sell the farm, and Jim thinks the farm will be worth less because he doesn't have a consent: '*If he hasn't got a consent to farm, if he hasn't done all the paperwork, for approval by the One Plan, why would you buy it without a discount*?' Max thinks the One Plan is making farmers more aware of the '*due diligence'* needed before farm purchase, for example, finding out the farm's N loading. In his opinion: '*If there's a farm that's not sorted, or if there's a farm that's not permitted or whatever, it will impact its sale price'*.

Other farmers, like Jim and Tom who farm in a non-targeted WMSZ, believe the lack of rules and regulations for non-targeted farms could attract purchasers. Jim believes his farm will be '*more attractive'* because there are no constraints over his farm practices, and comments: '*there would be more buyers interested in our farm, than a farm that has got a contract that says you can't*'. Tom has already decided that if he wanted to sell the farm tomorrow, he would '*market it as a farm that's not in the One Plan*' because he thinks he would get more interest.

Some farmers, like Ken, Jim and Jack, speculated about how the One Plan might impact on farm value and farm sales. Ken heard from other farmers '*there were some sales actually put off because of the One Plan'*. Jim thinks a converted dairy farm in a targeted WMSZ near Mt Bruce is '*unsaleable*', because it's got '*horrendous N leaching'* and '*it would struggle to be a dairy farm, so you wouldn't pay dairy farm prices*'. Speculation about farm value influenced Jack's family's decision to offer their farm for sale, because Jack believed the farm's low N loss levels would result in a lower farm value, lower capital gains, and be more difficult to sell. Jack shares his concerns:

'*My issue, particularly in the sales scenario, which farm - is a conventional farmer which is 99 percent of the potential buyers are farms, which one are you going to buy? One that has a* *leaching limit that's high, because that gives you options of how you're going to farm it. You come and buy one that's under 20, what are your options as a conventional farmer?*'

> *Jack is in an exit life cycle stage: they decided to offer their farm for sale and stop farming. Jack speculated about the impact of the One Plan and decided to exit earlier than planned.*

Other farmers, like Roy and Paul who farm in a targeted WMSZ, based their opinions on farm sales data rather than speculation. Roy and Paul are expanding their farm operations, and recently purchased neighbouring farms in a targeted WMSZ. Based on the price they paid rather than speculative value, Roy and Paul do not believe the One Plan will affect farm value and farm sales. Roy admitted: '*I've just paid a record price for a farm in the district*' and is '*totally confident'* he will achieve production levels, ensure profitability and farm within the N loss targets negotiated in their Land Use Consent.

Tom is also planning to expand, and his decision to purchase extra land was influenced by the One Plan's rules and regulations**.** Tom farms in a non-targeted WMSZ, but purchasing more land in a targeted WMSZ next to his farm would change the farm's status[81] from non-targeted to targeted and the farm would require a Land Use Consent. The first thing Tom said he would do is '*find out what Horizons wanted us to do, to comply with the One Plan*', because he's worked out that the cost of required practice change ('*drop cow numbers'* '*a million dollar herd home*') will not be offset by the income from increased production.

> *Roy, Paul and Tom are in a growth life cycle stage (expansion). While the One Plan had no influence over Roy and Paul's decision to expand, the One Plan influenced Tom's decision not to expand further at this stage.*

Learning about nitrogen loss and Land Use Consents

The farmers in this study learnt about nitrogen loss and the practices that can reduce leaching from a range of sources. Some, like Stu, learnt from their Fonterra N report: '*we've got to send in our nitrogen use for the year and we get sent back a report that has converted all that into how*

[81] Tom's farm currently has 19% of land area in a targeted WMSZ and 81% in a non-targeted WMSZ and is classified as non-targeted. More than 20% of farm area in a targeted WMSZ classifies the farm as targeted.

much we've actually leached', and others from their fertiliser company prepared nutrient budget. Some, like Roy, learnt from discussions with their nutrient management consultant: '*He [consultant] found out that the cropping had quite big leaching'*. Others, like Jack learnt from a Dairylink[82] field day: *'being able to increase your effluent area so you're spreading it over a bigger area, so the nutrient loading was less'.* For some, like Steve who was involved in the dairy industry awards, he thought about the practices that can reduce nitrogen leaching when presenting his effluent management to the Sharemilker of the Year judges: '*because you have to present that to judges, it makes you look at your business, and go what can we do better?*'

In terms of Land Use Consents, the information seeking behaviour of the farmers in this study varied. Some non-targeted farmers are not seeking information, while others, like Jim, are being proactive. Jim farms in a non-targeted WMSZ and attended a farmer One Plan meeting even though he doesn't require a consent, because he thinks they may become a targeted WMSZ in the future. Some targeted farmers, like Paul, are waiting for information: '*Well I'm hoping they're going to have more of these meetings that pertain to our zone, and I'll go along to one of those.*' Other targeted farmers, like Steve, Owen and Max, are proactively seeking information and advice. Steve went to a farmer information meeting out of his zone: '*I felt like I should go to one, to be a bit responsible, to find out what I should be doing'.* Owen asked his farm consultant to attend a meeting on his behalf out of his zone, and he also talked to his Fonterra Area Manager: '*he's going to, he said, get some information to me*'. Some farmers, such as Max, are talking with farmers who have a consent, and observing their practices. As a farmer in a targeted WMSZ, Max is due to get a consent and he prefers to use other farmers rather than Horizons for advice:

> '*I'd talk to the fellas that are going through it now, and that's where I'd get a lot of the advice from, or just how are you going with it. Then I would then talk and use that as a comparison to whichever - I wouldn't talk to Horizons. They're there to tell me the legal black and white, I wouldn't use them for advice*'.

These stories show examples of social learning: farmers accessing information and exchanging knowledge through their social networks.

[82] Dairylink, an educational programme run by Tararua dairy farmers, community leaders, DairyNZ and Horizons, is described in Chapter Six. Dairylink aimed to inform farmers about the impact of dairy farming on water quality.

Some targeted and non-targeted farmers in this study attended the farmer Land Use Consent information meetings (termed nutrient management workshops by some staff). These meetings involve staff from Horizons, DairyNZ and Fonterra, and some TCEIS farmer leaders working together to inform and support farmers through the consent process. John (DairyNZ) believes the TCEIS farmer leaders provide value through their personal perspective on the consent process, and comments: '*Farmer to farmer has got real power to get people on board*'. Some meetings were initiated by DairyNZ with Horizons' speakers and supported by Fonterra staff, while others were Fonterra-run shed meetings[83] with Horizons and DairyNZ staff presenters. Pete (Fonterra) recalled a series of Fonterra shed meetings that involved a nutrient management consultant, and how the consultant presented farmer case studies on farms he had consented. Staff from the organisations work together, and John (DairyNZ) works with the Tararua Area Manager from Fonterra, because he recognises: '*Fonterra have got a real good relationship especially over in the Tararuas, so we use their networks to get the farmers there*'. Working together means the meetings are successful and valuable, John (DairyNZ) believes, and he explains:

> *'I think the real crux of success for this project is all of these parties working together, and to be able to demonstrate that to the farmer that we're working together is really valuable. They get a sense of we're all in it together and everyone is on the same page, there's a common direction*.'

Knowledge about the Land Use Consent process varied among the targeted farmers in this study who require a consent. Some farmers, like Max, know what is required to obtain a Land Use Consent and have mitigation strategies in place. He continues:

> *'I know I need to get a whole farm assessment done, and I need to get a consultant…I know that cropping and turnip crops for example, with certain ways they manage it is really bad. I know the things that influence Overseer, and I know how to change my business, or to change my management to make a difference. It'll cost me $5000, it's just life.'*

Other farmers, like Steve, have attended meetings about the consent process. Steve thinks Horizons will use their 2013 farm records to estimate their farm's historical nitrogen leaching, but he worries about his historical farm records and the data collection stage:

> '*Honestly, I don't know what I'm going to do when that day comes around, because I've got records, but they're not as good as they are, than my current records. So, I'm like okay, I'm not dreading that day, but I'm not looking forward to it, the day that the Horizons' person comes around here and expects me to have everything ship-shape and have all my records up to scratch,*

[83] 'Shed meetings' are smaller informal on-farm meetings, to inform farmers about production matters.

and I'll be like well I don't know the answer to that one, what are you going to do about it, put me in prison?'

The last section in this chapter explores the farm management changes farmers have made in relation to water quality, and the various drivers for change.

Farm management practice change

Introduction

This section explores the farm practice changes made by the farmers in this study over the past five or six years, and the drivers identified by the farmers as shaping these changes. These farm practice changes are explored in four key areas: management of waterways; nutrient management (nitrogen and phosphorous); farm dairy effluent (FDE) management; and the management of livestock and crops. Each intervention's requirements are initially outlined for each of the four management areas, then practice changes described. The drivers for farm management practice change varied. Some farmers made changes for practical management or economic reasons, some in response to a water quality intervention, others made changes for water quality reasons, and some for a combination of reasons. Where practice change was driven by a practical management reason, there is evidence that farmers are aware of the impact of farm management practices on water quality.

The management of waterways

The One Plan requires, the Sustainable Dairying Water Accord (SDWA) and the terms and conditions of supplying Fonterra expect, that permanently flowing waterways[84] and significant wetlands[85] will be fenced to exclude stock access, and culverts and bridges will be installed at regular[86] stock crossing points. The SDWA also expects farmers to prepare a riparian management

[84] Permanently flowing waterways and artificially created drains greater than one metre in width and deeper than 30 cm are required to be fenced. Ephemeral waterways that flow during or immediately following extreme weather events are not required to be fenced.
[85] A significant wetland is identified as significant in an operative regional policy statement or regional plan.
[86] Regular is defined in the SDWA where dairy cattle cross to access the milking shed, then return following milking, more than once per month

plan[87]. The One Plan only applies to targeted WMSZ; the Accord applies to all dairy farms; and Fonterra's terms and conditions of supply apply to all Fonterra farmer suppliers.

All farms in this study are bisected by waterways of varying size and flow (drains, streams or creeks) and some farms border rivers (Mangahao and Manawatu). The farmers in this study clearly described the waterways on their farms. Drains (also termed stormwater drains) can be manmade or natural, not named, and only flow after rain or for part of the year. A stream or creek is bigger than a drain, often named, and flows permanently. The SDWA's definition of a drain[88] (permanently flowing water) differs from the farmers' description of a drain (flows sometimes). The SDWA's definition of a drain is more akin to the farmer description of a stream or creek. Additionally, the One Plan and SDWA definitions of what is required to be fenced differ[89]. Although dairy industry interventions do not expect ephemeral waterways on dairy farms to be fenced, their expectation is that drains will be fenced. This difference in definition and expectation created confusion and frustration for some farmers in this study. As a result, the farmers fenced waterways (streams, creeks and drains) regardless of waterflow and size.

The farmers in this study changed their management of waterways. As illustrated in Table Seven, all farmers have fenced either all or almost all of their waterways: drains, streams, creeks and river boundaries. In addition, Ken fenced farm dams (for duck shooting), and Ian fenced some wetlands because '*I've had a few cows die in them'*. Some farmers have riparian planted (flaxes and trees), and others are leaving the riparian margins with unmanaged grass. At stock crossings, culverts have been installed as required. Max and Fred installed a bridge over the main tributaries that bisect their farms.

[87] A riparian management plan records the species and area of fenced waterway to be planted.
[88] The SDWA defines a drain as an artificially created channel designed to lower the water table and/or reduce surface flood risk and which has permanently flowing water but does not include any modified (e.g. straightened) natural watercourse.
[89] Horizons define a waterway as: may or may not be permanently flowing but has an active bed width greater than 1 metre. The SDWZ defines a waterway as: A lake, spring, river or stream (including streams that have been artificially straightened but excluding drains) that permanently contains water and any significant wetland.

Table 7: The farm management practice changes made around the management of waterways.

	Jack	Fred	Max	Paul	Owen/ Steve	Roy	Tom	Ian	Ken/ Stu	Jim
One Plan classification[1]	T	T	T	T	T	T	NT	NT	NT	NT
Fenced waterways	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Fenced dams									✓	
Fenced a wetland								✓		
Culverts installed	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Bridge installed[2]	✓*	✓	✓							
Riparian planting	✓		✓	✓	✓	✓		✓		

[1]: One Plan classification: T - targeted; NT - non-targeted

[2]: Refer to footnote No. 36

*: Jack had already installed a bridge.

The farmers discussed the benefits of excluding stock from waterways on water quality. Fencing, and installing bridges and culverts excludes cows from water. The farmers are aware of the impact of cows on waterways: '*cows walk through, make a hell of a mess'* (Max) and '*cows wee and poo in the river'* (Tom). Some farmers discussed how riparian margins can improve water quality, and Jim adds that a riparian margin will '*filter sediments, nitrogen, phosphate and probably even E.coli'*.

From the language farmers used, waterway fencing is now an accepted farm practice. Stu believes '*fencing is common knowledge, it's accepted now',* and he was highly critical of farmers he believes '*farm unethically*', and do not fence or encourage stock in waterways. Waterway fencing is reinforced by a number of sources, including Horizons' fencing subsidies, the Dairy Diary, Fonterra's fencing checks, and changes made by other farmers. Jim talked about another dairy farmer on his road, believes he has little contact with Horizons and Fonterra staff, yet he has fenced his waterways. Jim laughingly comments:

> '*Old [name] up there fenced his waterway, and you think, oh god, if you can get a reluctant old bastard like that to fence the waterway, maybe we should be following suit (laughs)'.*

> *These stories illustrate a collective change in what farmers consider to be accepted practice (a change in practice norms). Stu was critical ('farm unethically') of those who do not adopt practice norms. Criticism reinforces accepted practice.*

The reasons why the farmers changed their management of stock around waterways varied. Some farmers fenced waterways for practical management reasons, such as preventing stock losses (drowning), preventing stock getting stuck (e.g. in soft-bottom creeks), ease of management when break-feeding, and improved cow and pasture control. Some farmers fenced or installed a bridge to improve water quality and others in response to a water quality intervention requirement (e.g. to obtain a Land Use Consent). Other farmers, like Max and Jim, changed their waterway management for a combination of reasons. Max fenced waterways primarily for cow management reasons, but also recognised the benefits to water quality:

> '*I didn't want cows walking through [waterways], making a hell of a mess. Part of it was just management, we were having to drive through these muddy bogs, cows were falling in them and dying of milk fever, and it was just a stupid idea. Yeah, it had to be done …management of the place was difficult. What was my main reason? To be honest, cow management*.'

Jim, a non-targeted farmer, is not required to fence under One Plan rules, and has ephemeral drains which are not required to be fenced under dairy industry expectations. Jim cites practical management and water quality as reasons to fence waterways:

> '*I've fenced off a large number of them [drains] that I think are either animal hazards, or would benefit from excluding stock from. Well, we are told that if stock have access to them, the water quality is degraded. So by fencing them, one would assume that would improve the water quality'*.

Some farmers, like Max and Fred, cross a main tributary when walking their herds to and from their dairy sheds, and are required to install a bridge for stock access. Other farmers may not cross a tributary and a bridge is not required. Max installed a bridge primarily for management reasons: animal health (lameness) and animal hazard ('*cows getting washed away when the river was flooding'*), but also recognised that a bridge would benefit water quality (stop '*cows making a mess'*). Fred built a bridge in preparation for his Land Use Consent and to prevent stock fouling waterways. He knew the One Plan would prevent him walking his herd through the stream. Fred justifies his decision making:

> '*I never liked walking the cows across the creek, it's quite an expensive bridge for five hectares, you can see. So, it's not an easy judgment, but the fact that I'm happy we made that choice, because like I say, I didn't like walking across the creek, and now we don't have to.'*

Fonterra's involvement in waterway fencing, and/or the dairying accord, was discussed by the farmers in this study. Many farmers believe Fonterra were trying to take control: '*it was forced on us*' (Ken), '*they push you until you do it'* (Owen), '*they're imposing it'* (Roy) and '*they tell us we* *have to fence off*' (Max). Through the annual farm dairy inspection[90], Fonterra monitors and records (check and GPS mapped) that waterway fencing is implemented. Fonterra introduced an enforcement mechanism for unfenced waterways (suspend milk collection)[91]. Jack thinks this is a '*threat*' with little substance ('*I don't think Fonterra's bite's as bad as their bark when they talk about fencing waterways*' – Jack), and he has not heard of instances where Fonterra have not picked up a farmer's milk for unfenced waterways.

> *The farmers felt Fonterra were telling them what to do. They perceived their cultural norms around autonomy were being violated.*

Horizons contributed fencing material subsidies[92] to support waterway fencing on dairy farms and run-off blocks in the Tararua district. These economic incentives were not a driver for the farmers in this study to start fencing because most were already fencing when the subsidies were introduced. Farmers' uptake of the fencing subsidy varied. Some farmers, like Ian, Fred and Max, contacted Horizons, obtained a subsidy, and used it as assistance to fence more waterways at one time or to finish fencing already started. Jack obtained a Horizons' fencing subsidy through an earlier incentive programme. Other farmers chose not to apply for a subsidy. Some of those who did not apply did so for practical management reasons, including waterway fencing being part of an ongoing farm fencing programme (e.g. farm upgrade or redevelopment), and small areas left to fence. Others did not apply for reasons related to Horizons: to avoid paperwork (Ken); avoid interaction with Horizons' staff (Jim); and Paul wanted to avoid Horizons dictating the size of the farm's riparian margin: '*there was distances you had to fence back from the drain to actually be eligible'*. Tom was unaware of the fencing subsidy programme. The changes farmers have made to their nutrient management is explored in the next section.

Nutrient management

All water quality interventions require farmers to manage their farm systems to reduce losses of nitrogen (N) and phosphorous (P) to ground and surface water[93]. Under the SDWA all dairy

[90] Fonterra's Annual Farm Dairy and Environmental Assessment is described in Chapter Six.
[91] Terms and conditions of Supply as described in Chapter Six.
[92] Horizons' fencing subsidy programme is described in Chapter Six.
[93] Industry recommended mitigation strategies to reduce N and P loss to water are listed in Chapter Six (Table Five).

farmers must provide accurate farm system information to their dairy company to enable the company to model N loss and N conversion efficiency (using Overseer) and then provide comparative performance data back to farmers (e.g. Fonterra's Nitrogen Report). For Fonterra suppliers, this is a requirement under the terms and conditions of supply. The One Plan rules require that farmers in targeted WMSZ prepare and provide an annual nutrient management plan to Horizons, and either meet the N loss targets set in the One Plan or use mitigation strategies to reduce the farm's average annual N loss. Farmers in non-targeted WMSZ are not legally required under the One Plan to reduce P and N loss. The One Plan also states that fertiliser must not be discharged directly into surface waterbodies.

The farmers in this study described the current maintenance[94] and nitrogen components of their fertiliser policy. In terms of maintenance fertiliser, many farmers use the fertiliser company Ravensdown, others use Ballance, and Paul uses TerraCare. Jack and Tom use other fertiliser companies and products (Probitas and Kiwi Fertiliser). Jack thinks the products he uses are more '*natural*' and Tom believes the products he uses are '*not organic but closer to organic than conventional'* because they '*don't contain hard out phosphates'* and as a result, '*do less damage to waterways'*.

Some farmers recently adjusted their maintenance fertiliser programme for financial reasons. During this study farmers were receiving low milk prices, and this was putting dairy farms under financial pressure. Max changed to individual paddock soil testing to '*reduce costs and avoid putting on nutrients unnecessarily'* and Tom comments: '*we had no money to put any fert on this year'*. Any changes to the maintenance programme were not made for, or linked to, water quality considerations. The other farmers did not change their maintenance fertiliser programme.

In terms of nitrogen use, all farmers except Ian and Tom, changed their nitrogen policy in some way. Tom stayed with the nitrogen fertiliser policy he instigated when he moved to the region six years ago. Ian maintained his current maintenance and nitrogen fertiliser policies, and with Ravensdown, the fertiliser company that the older farm owner (a family member) has been with for over 50 years: '*I know he doesn't like changing'.*

[94] Maintenance fertiliser rate is the estimated amount of fertiliser required to maintain soil tests at the current level, assuming all other inputs are constant.

The other farmers made a variety of changes to their nitrogen policy. Some changed the amount of N applied (either less or no longer applying), some changed the application rate, some changed the product used (LessN®[95] and coated urea[96]) and others changed the timing of the application (not in winter or on wet soils). These changes were made for a combination of reasons: economic (e.g. as a result of reduced payout), management (e.g. feeding out farm-made supplements in spring rather than using nitrogen) and for water quality reasons. Table Eight illustrates the farm management practice changes made around nutrient management for farm management and for water quality reasons.

Table 8: The farm management practice changes made around the management of nutrients.

	Jack	Fred	Max	Paul	Owen/ Steve	Roy	Tom	Ian	Ken/ Stu	Jim
One Plan classification[1]	T	T	T	T	T	T	NT	NT	NT	NT
Stopped applying N*	✓	✓								
Lowered N application			✓	✓	✓	✓				✓
Changed N application frequency			✓							
Changed N product used				✓					✓	
Changed when applied N					✓					✓
Changed product to reduce P*	✓						✓			
Changed to individual paddock testing			✓							

[1]: One Plan classification: T - targeted; NT - non-targeted
*: N- Nitrogen. P- Phosphorous

[95] LessN® is a microbial bioactive product promoted as increasing nitrogen response in pasture, and Paul uses LessN® in combination with weed spray.
[96] Coated urea is a controlled release non-reactive product. Stu uses this product because he can mix urea with the maintenance fertiliser in the spreader truck and can apply both products at the same time.

The farmers in this study are aware that N fertiliser can reduce water quality. Fred explains: '*we have high winter rainfall and that washes our nitrogen into the river*'; Ken knows '*urea gets into the waterways by leaching';* and Owen asserts that '*overuse is just ridiculous, because nitrogen will leach down into water*'.

Some farmers, like Fred and Jack, stopped applying nitrogen for management and water quality reasons. Fred farms in a targeted WMSZ, chose to stop applying nitrogen, and to replace the feed grown using N with supplementary feed made on the farm (baleage). This change was one of the mitigation strategies suggested by his nutrient management consultant during the Land Use Consent application process, and a strategy Fred chose to reduce the farm's annual N leaching. Jack introduced a low input non-conventional production system and stopped applying urea because of what he observed ('*It [pasture] was turning green after a dump of urea, the cows would eat it and it was yellow'*) and what he believed ('*I didn't like it*' and '*it was like an addiction to drugs'*). Jack's decision to stop applying N for management and personal reasons resulted in a low annual farm N loss, and ensured the N loss met the One Plan targets (Table 14.2). Jack believes other farmers judged them when they changed from what was considered accepted farm practice at the time (applying N to increase pasture growth):

> '*Because you're being watched you're now a hippie, what the hell are you doing, wrecking a good farm? They expect you to be out there in jandals hugging trees and things'*

Other farmers are applying less nitrogen for management, economic and water quality reasons. Max changed his urea policy to '*little and often*', which to him means reducing the N application rate and increasing the frequency of application to increase pasture response. He believes excess N fertiliser is an economic and environmental cost:

> *'So if you drop your rate by 20 percent, you add one more rotation every five…well in theory you get more response, and if you put on too much it could get washed out and it's just a waste of - it gets leached and it doesn't look good and it's a waste of money and it's a waste, it's a pollutant*.'

Paul changed from solid to dissolving urea (LessN®) five years ago, because he wanted to spray weeds and apply urea at the same time. He found he's now applying less urea ('*like a half rate'*), and over time became aware that applying less urea reduces the farm's N loss. He later explained he uses Fonterra's Nitrogen Report to compare his N leaching to other farmers ('*we were slightly above the average*'), and to indicate whether his N loss is reducing. Paul thinks farmers are required to reduce N loss (*'meet our nitrogen target')* to obtain a Land Use Consent. The next section explores the changes farmers have made to managing farm dairy effluent.

Farm dairy effluent management

The SDWA and Fonterra's terms and conditions of supply defer to regional council rules and resource consent conditions, and state that dairy farms will be compliant with regional council effluent management rules 365 days of the year. The One Plan rules state that all dairy farms are required to hold a resource consent to discharge farm dairy effluent (FDE)[97] to land, and that there must be no discharge or run-off into a surface water body.

All farms in this study hold a current Dairy Effluent Discharge Consent, and all discharge FDE to land. Mark (Horizons) explained how effluent discharge resource consent conditions have changed over time. Before the One Plan became operative, the regional policy statement (Manawatu Wanganui Regional Council, 1998) stipulated that dairy-shed discharge consents to land would be issued for up to 25 years, and FDE storage was not required. FDE storage and deferred irrigation were not a requirement under the POP, but were introduced in the decision version of the One Plan in 2010. The One Plan stipulates that FDE storage facilities are required for all new effluent discharge consents and for the renewal of existing discharge consents. Farmers without FDE storage are not required to install FDE storage until their current consent expires. The volume (m^3) of FDE storage required is farm specific, and storage allows effluent to be withheld during periods of wet weather and to be differentially irrigated to prevent ponding and run-off.

The farmers in this study agree that effluent in waterways is not accepted practice. As Jim reiterates: '*There's absolutely no way you put effluent into a waterway*'. FDE management practices have changed over time[98] ('*I know it's not going in the drains like it used to when I started farming*' – Paul) as have FDE storage practices. Some farmers described how farmers historically had storage ponds, were advised to remove and install sumps, and now are required to install storage ponds. Stu shares his experiences as a farm worker on several farms in the region, and remembers cowsheds being renovated and effluent systems expanded: '*When the cowsheds were going up we were all being pushed towards fill in our ponds and go to these sort of effluent systems [sumps], that was what was happening in 2002, 2003.*' Max is frustrated because he took out an effluent pond, put in a sump, and now he needs to put the pond back in. He thinks other farmers '*hate Horizons' guts because of that*'.

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[97] Farm dairy effluent consists of cattle faeces and urine diluted with wash-down water and is a by-product of cattle spending time in the milking shed, yards and on feed-pads.
[98] The history of effluent discharge changes from water to land is outlined in Chapter Six.

'Not going in the drains like it used to' is an example of a change in what is considered to be accepted practice (practice norm).

The farmers in this study are aware that FDE storage is required. They also understand that storage means effluent is not applied to wet soils (or when raining), and that this reduces N leaching. Roy understands: '*Storage means that you're not irrigating over wet areas, when it's wet and when there's high leaching. They say there's higher leaching when it's really wet during the winter months*.'

As illustrated in Table Nine, all farmers except Paul, Owen/sharemilker Steve and Ken/sharemilker Stu, have made some change to their storage and/or management of effluent in the past five or six years. In terms of effluent storage, the quantity of FDE storage varied on the ten farms in this study. Five of the ten farms in this study have additional FDE storage (e.g. an effluent pond), and Roy was installing additional storage at the time of interview. Jack's farm had existing storage, and the other four farms installed additional FDE storage within the past six years for management reasons, rather than installing storage in order to renew the farm's Dairy Effluent Discharge Consent. Max was converting a farm from sheep and beef to dairy, Tom was upgrading a run-down dairy farm without storage, and Jim was upgrading from two herringbones to a new rotary shed. Fred received an abatement notice for effluent ponding and decided to upgrade the farm's FDE system rather than wait until the effluent consent expired. Roy was installing a Kliptank™ [99] effluent storage system in order to renew the farm's Dairy Effluent Discharge Consent[100]. Installing storage will mean he can increase the FDE application area, and increased FDE application area is one of his farm's Land Use Consent mitigation strategies.

[99] A Kliptank™ is an above ground farm dairy effluent storage tank. The other FDE storage option is a lined pond.

[100] Roy's Dairy Effluent Discharge Consent is due for renewal 18 months after the interview date, and he is required to install 600m³ of FDE storage.

Table 9: The farm management practice changes made around the management of farm dairy effluent.

	Jack	Fred	Max	Paul	Owen/ Steve	Roy	Tom	Ian	Ken/ Stu	Jim
One Plan classification[1]	T	T	T	T	T	T	NT	NT	NT	NT
Installed additional storage	*	✓	✓			✓	✓			✓
Increased/new irrigator line		✓				✓	✓			
Buried irrigator line		✓								
Changed the irrigator		✓	✓							✓
Changed to a slurry tanker	✓									
Increased irrigation area		✓				✓	✓			
Changed where effluent applied								✓		

[1]: One Plan classification: T - targeted; NT - non-targeted
*: Jack's farm had an existing storage pond

Four of the ten farms in this study have limited FDE storage (one to three days) and will require additional FDE storage when their current effluent discharge consent expires (within the next five to ten years). These farmers know they need storage, and Stu explains how storing effluent is now accepted practice: '*everyone's saying in our climate here with our very free draining soils, that we've got to have some storage periods'*. These farmers learnt that FDE storage is best practice from Horizons (in order to renew their consent), from other farmers changing practice, and from other farmers' expectations of their behaviour. Paul does not have a pond, and comments: '*Probably there is an expectation of my neighbours that I should put a pond in, which I will in due time*'. Two farms without additional storage are sharemilking businesses. These sharemilkers know that applying effluent in the rain is not accepted practice and they would prefer their farm owners to not wait until the consent expires before they install additional storage. One of the farm owners, Ken, is semi-retired from farming and still lives on the farm. Stu, his sharemilker, believes Ken is avoiding a decision about storage:

> '*I'm not sure how long his consent is for; he's not at all concerned. I think he thinks he's going to die before it comes up, so he's not at all concerned about it*."

Ken is upset. He thinks '*Horizons are forcing people'* to put in storage, storage is expensive, and he believes he is conscientious about effluent. Ken does not think their farm requires storage because they have free-draining soils, and even when it is wet, he does not see effluent ponding or run-off:

'*I've got to put in a big $200,000 holding tank here, where this farm doesn't need it, well I don't think it needs it. Because if it was really wet, and a little bit did wash off the paddocks, that's only in a case like they had in Dunedin the other day with five inches of rain or six inches of rain. Sure, we had one here the other day, but there's that much water that's going to flush that little bit of effluent straight out to sea at any rate*.'

Ken is in an exit life cycle stage, semi-retired, and planning for his son to take over farm ownership. Ken's life cycle stage contributed to him 'avoiding' installing effluent storage.

Ian's farm is also without FDE storage, and he faces a difficult decision. He's estimated he won't have space for an effluent pond ('*It has to be a certain distance away from everything, like neighbours, creeks, and we don't really have anywhere that fits'*), and thinks that in 2024 '*we won't get a consent to keep dairying on this farm'*. Ian talked with his accountant, his accountant advised him to sell, but Ian feels an obligation to retain ownership of a farm that has been in the family since the late 1800s:

'*I don't know, I'll probably just have to go dry stock. I've talked to my accountant, he reckons we should probably sell up and let someone else worry about it. But this farm's been in the family for years, but I don't know. He said the sooner the better, before people realise there's a problem (laughs)*.'

Some farmers made a change to their FDE management system. These FDE management system changes include: a new irrigator line; increasing the length of the line; burying irrigation line; and improving or changing the FDE applicator. Some farmers changed the FDE system infrastructure while upgrading and/or increasing an existing system, and others changed to renew their effluent discharge consent. Tom installed new irrigator line while upgrading the FDE system, and Roy and Fred increased the amount of irrigator pipework to enable a larger area to be irrigated. Fred buried two and a half to three kilometres of pipe and hydrants as part of the farm's effluent system upgrade, and this increased the effluent application area by 10 hectares.

Some farmers, like Jim, Fred and Jack, changed their FDE application method to increase control over their effluent application. Jim was served an abatement notice for ponding under the irrigator, so changed to a variable speed irrigator to control FDE application rate and prevent ponding. Fred upgraded the farm's effluent system after an abatement notice and changed to a spitfire irrigator. Jack changed from using a contractor (FDE spread once a year) to purchasing and using a slurry tanker. Jack previously used a contractor to annually pump out the effluent pond, the application area was limited by the contactor's pipe length, and Jack was concerned about N leaching from large amounts of effluent spread on a small area ('*nutrient hotspots'*). Jack's previous negative experiences with travelling irrigators and effluent ponding encouraged him to retain personal control over effluent application: '*we thought we don't want to be cocking up like that, so the only time effluent is going to be spread, is when we're there*'. Jack learnt about effluent efficiency at a Dairylink field day ('*increase your effluent area so you're spreading it over a bigger area, so the nutrient loading is less'*) and this knowledge influenced his decision to purchase a slurry tanker which he now uses to apply effluent over 85% of the milking platform.

Some farmers changed their FDE application practice to gain control over where they apply effluent. Jack knows from Horizons' rules that '*you're not allowed to go [apply effluent] within 50 metres of road boundaries, or neighbour's boundaries, or waterways'*. Ian does not have FDE storage, learnt from Horizons not to apply effluent to sloping paddocks, and describes how he changes where he irrigates to minimise effluent run-off to waterways: '*certain paddocks that I only irrigate in the summer, certain paddocks that are away from creeks, and certain paddocks I irrigate when it rains*'.

While all farmers have control over where they apply effluent, only some farmers have control over when they apply effluent. Farmers without FDE storage pump directly from an effluent sump in the yard[101], and apply effluent in all weather and soil moisture conditions. Steve comments: '*It could be pissing down with rain and we're spreading effluent*'. In contrast, farmers with FDE storage can choose when to apply FDE. Max relies on '*the mental water balance in my head'*, the weather and his knowledge of Horizons' rules ('*no ponding'*) to decide when to apply effluent. Fred assesses soil moisture condition ('*by sight walking across them')* and applies effluent '*after October and when the soil, virtually when the soils can take it'.* The next section explores changes made to livestock and forage crop management.

[101] An effluent sump is typically a concrete holding tank that initially captures effluent generated at the farm dairy. Effluent from the sump is pumped to an application system or to a storage facility.

Livestock and forage crop management

The One Plan, SDWA and Fonterra's terms and conditions of supply do not directly address the management of livestock and forage crops for water quality reasons. However, a variety of educational material[102] prepared by a range of organisations (including DairyNZ, Fonterra and Horizons) suggest mitigation strategies[103] that can reduce faecal, sediment and nutrient contamination of surface water. These mitigation strategies include best practice for livestock and forage crop management.

Some farmers in this study changed their animal management (stocking rate, wintering-off and their use of feed-pads), and others changed their forage crop management (reducing area of forage crops and changing species used) in recent years. While the majority of these changes were made for management reasons, the farmers are increasingly aware of and discussed the benefits of these changes on reducing N leaching and improving water quality.

Livestock management

As illustrated in Table Ten, some farmers reduced their stocking rate. While most changed stocking rate for management reasons (e.g. decreased stocking rate to improve per-cow feeding), some farmers recognised that decreasing stocking rate can reduce N leaching. Jack reduced stocking rate when he changed to a low-input farm system, and then used the reduced stocking rate as one mitigation strategy in his farm's Land Use Consent. On the advice of his nutrient management consultant, Roy, will reduce herd size by 10-15 cows over a three-year period to reduce the farm's N loss. Stu wants to decrease stocking rate for management reasons (to increase cow condition and spend less on supplementary feed), and he also recognises the impact of the change on water quality:

> *'My ideal would be to winter 260 and peak milk 245. Well, lower stocking rate there's less nutrient leaching, so that's always going to be working in our favour by dropping it more'.*

[102] Educational material includes information (e.g. web pages and fact sheets), training and group events (e.g. field days, meetings and workshops) and one-on-one advice.
[103] The suggested mitigation strategies are listed in Chapter Six.

Table 10: The farm management practice changes made around the management of livestock and forage crops.

	Jack	Fred	Max	Paul	Owen/ Steve	Roy	Tom	Ian	Ken/ Stu	Jim
One Plan classification[1]	T	T	T	T	T	T	NT	NT	NT	NT
Decreased cow numbers	✓	✓	✓			✓			✓	
Changed wintering-off policy										✓
Built a feedpad		✓	✓		*	*				
Feedpad used as a standoff pad		✓	✓		✓					
Decreased area of summer turnips		✓				✓				
Changed crop type			✓			✓				

[1]: One Plan classification: T - targeted; NT - non-targeted.
*: Roy's and Owen/Steve's farms have an existing feedpad.

In terms of wintering off, most farmers in this study have not changed their current policy. The wintering off policies vary between farms, and individual farm policies also vary between seasons. Some farmers winter all their milking herd on their run-off, others winter some on the milking platform and some on the run-off, and Steve winters all the milking herd off the farm to an external grazier. Some farmers make minor seasonal changes for management (e.g. cow condition, feed quality and quantity) rather than water quality reasons. For example, Tom wintered some cows off the farm when the payout was high, and depending on feed levels, Roy adjusts the balance of cows going to the run-off and those staying on the milking platform. In contrast to the other farmers in this study, Jim changed his wintering-off policy because he realised that if he wintered 600 cows on the milking platform '*our N leaching would go through the roof, because all that urine N*'. Jim proactively purchased a support block to reduce N leaching, even though he is not legally required to change practice to reduce N leaching (he farms in a non-targeted WMSZ). Jim's Fonterra Area Manager told him the One Plan will progressively cover the region and Jim believes their farm will become targeted, yet, he was reassured by Horizons councillors at a One Plan meeting that his farm won't be targeted in '*his lifetime*'. Jim talked with targeted farmers, and realises he can't ignore and pretend the One Plan will not influence his farming practices:

'We're not in a targeted catchment, and if I listen to [Horizons' councillor] and the Horizon executives, at this meeting, we won't be targeted probably for the next 10 years, 20 years, because they're so slow doing the targeted catchments now. But we can't stick our head in the sand and say what they're trying to do, and what they're trying to achieve, is not going to influence us. Well, if we did nothing, and ultimately we became a targeted catchment, we'd have a steep learning curve to go up. So, it's the trickle down.'

The farms owned by Fred, Max, Owen and Roy have a feed pad primarily built for management reasons (supplementary feeding). In the past five years, Max installed a feed-pad while converting the farm from sheep and beef to dairy, and Fred built another feed pad '*so we can totally winter the cows off if it's wet'*. The feed pads on Owen and Roy's farms were pre-existing. Fred, Max and Steve (Owen's sharemilker) are also using their feed-pad as a stand-off pad for environmental reasons (to prevent soil damage). These farmers are aware of the environmental benefits from using a stand-off pad to reduce pugging damage to wet soils, and Max comments: '*We were doing damage to the pastures, we need somewhere to stand the cows off while it was wet*'.

Forage crop management

As illustrated in Table Ten, all of the farmers in this study except Jim, plant an annual summer crop (e.g. turnips, chicory). Paul and Ian usually plant an annual winter crop (e.g. brassicas, oats), and Tom is trialling a winter crop this season (brassica). Jim does not crop for management reasons and is aware of the added benefits for water quality by not cropping ('*there's a spin off in reducing our N leaching'*).

Some farmers have not changed their forage cropping policy, while others, such as Stu, Max, Roy and Fred, have made some change. Stu changed from summer turnips to chicory for management (timing of feed supply) rather than water quality reasons. While Max increased the variety and area of crops grown for management reasons, he is also aware that some crops, and the break feeding of these crops, can increase N leaching. Roy and Fred changed their forage cropping policy for management reasons, but they also are increasingly aware of the impact of forage crops on N leaching. Roy learnt from his nutrient management consultant that some crops have high N leaching. On the consultant's advice Roy stopped planting maize, is reducing the area of summer turnips grown, and is considering stopping cropping. Fred noticed photosensitivity issues when his herd was grazing summer turnips ('*they're grumpy most of the time'*), decided to reduce turnips, then learnt from his nutrient management consultant that reducing turnips would reduce the farm's N leaching by 3 kgN/ha/yr. The Land Use Consent process contributed to Roy and Fred's knowledge about forage cropping and N leaching, and both Roy and Fred elected to reduce summer turnips as one of their Land Use Consent mitigation strategies.

Roy and Fred's decisions to change farm management practice were influenced by social interactions with their nutrient management consultants. This is an example of social learning.

Conclusion

Historical events shape current events, and understanding history is critically important to understanding farmers' current responses to water quality interventions. Notification of the POP signalled a change in Horizons' approach from non-regulatory advice to regulatory controls over farm management practices to improve water quality. Farmers and organisations representing farmers were surprised and concerned by Horizons' regulatory approach. Farmers strongly opposed both controls over their farm management practices, and Horizons' perceived environmental focus that paid little attention to the socio-economic impacts of the POP on the wider Tararua community. Community resistance to the POP ensued.

This research illustrated a range of individual and collective farmer responses to water quality interventions. In addition, the different farmers in this study responded differently to water quality interventions. All the farmers in this study made changes to their farm management practices that can impact on water quality (individual response). However, many of these changes were for practical management reasons, some were made in response to a water quality intervention, others for water quality reasons, and some for a combination of reasons. Where practice change was driven by practical management reasons, there was evidence that farmers understand the impact of farm management practices on water quality. There was no clear difference, however, between the farm practice changes made by farmers in targeted and non-targeted WMSZ. One farmer in a non-targeted WMSZ was more proactive and making more practice changes than some farmers in targeted WMSZ. There is evidence, however, that farmers in targeted WMSZ who have a Land Use Consent have a deeper understanding of their farm's nitrogen loss and how aspects of their farm management can impact on nitrogen loss and water quality than non-consented farmers. Other individual farmer responses were noted, such as negative emotions after the POP was introduced; attending a farmer meeting; and changing farm monitoring and recording practices (e.g. Fonterra's N recording pages).

As a collective of dairy farmers, there was evidence that farmers are changing their thinking about current farm practices, and their agreement on what farm practices are acceptable in relation to water quality (collective response). Social interactions through social networks enabled social learning to occur (collective response), and social learning contributed to a change in farmer awareness and understanding.

The TCEIS was a key player in shaping events during the POP process. The formation of this collective action group (collective response) widened the problem's focus from farming and water quality to community prosperity, and empowered the community to question, challenge and express their anger towards Horizons and resistance to the POP. During the implementation of the One Plan, DairyNZ, in collaboration with the TCEIS and other organisations (Horizons, Federated Farmers and Fonterra) were advising and supporting farmers to adopt the farm management practices required to farm under the One Plan.

The next results chapter explores the relationships farmers have with individuals and with organisations around farming and water quality. The nature of these relationships informed and influenced farmers' responses to water quality interventions and influenced farm practice change.

Chapter Eight
Relationships, relationships, relationships

Introduction

This second of two results chapters explores the relationships that shaped farmers' responses to water quality interventions. In essence, this chapter addresses the second research question: '*What role did social capital play in shaping farmers responses*?' This results chapter continues with 'asides'. These asides link the farmers' stories of response with conceptualisations of networks, trust and norms (the 'unwritten socio-cultural rules'), or, the theorised elements of social capital. In particular, examples of the factors that are theorised to influence trust (care, competency, commitment, predictability, longevity and external control) are identified.

This results chapter emphasises the farmer diversity identified in the previous results chapter. Farmers are different individuals with different backgrounds and farming experience, form relationships with different individuals, and as such, respond differently to water quality interventions. Pseudonyms, direct quotes and farmers' stories are used extensively in this chapter. This chapter commences by exploring farmer's values around water, and beliefs about water quality decline. Farmers connect and interact with a range of individuals through their social networks, and the diversity of farmers' networks is then described. The nature of farmer to farmer relationships is explored, and how these relationships informed and influenced farmers' beliefs and farm practice change is examined. The relationship dynamics that influence whether one farmer will discuss unaccepted farm practice with another farmer are also examined. This chapter concludes by exploring the nature of relationships farmers have with organisations and with individuals from groups and organisations in relation to water quality, and how these relationships informed and influenced farmers' beliefs and farm practice change. In particular, the relationship between farmers and a range of organisations (Horizons, DairyNZ and Fish and Game), groups (TCEIS), individuals (farm systems consultants, nutrient management consultants and fertiliser company representatives) and members of the general public are explored.

‘*I don’t want to wreck water’* - Farmers’ values and beliefs

The farmers in this study are different individuals with different backgrounds and farming experiences, and as such, have different values, beliefs, opinions and ways of interpreting the world. Although not specifically asked about their values, the farmers’ values around water were evident from the language they used. Some farmers described how they believe they are responsible for the environment and water quality for current and future generations. Jack firmly stated he does not want to ‘*wreck*’, Ian does not want to ‘*ruin*’ and Ken does not want to *‘pollute*’ land and water. Furthermore, Jack believes ‘*everyone’s’* values and interests around water are similar, and he continues: ‘*everyone wants to be able to swim in the river, everyone wants to be able to take their kids down to catch a trout and take it home to cook’.* Ken’s care for water is evident in his words: ‘*Being an old trout fisherman, I don’t like seeing rivers getting polluted*’. Steve’s values of stewardship and environmental care are influenced by his religious beliefs. Steve believes ‘*[God] called us to look after the planet’*, and his strong Christian faith shaped his moral obligation to look after the waterways and fish: ‘*you just don't want to kill the fish*’. Tom believes he is a ‘*caretaker*’ of the environment for current and future generations, and his values of environmental responsibility influenced his decisions around stock exclusion and effluent management:

> ‘*I know that the One Plan's here to protect the river and all that, but we're doing everything we can anyway to protect it. I don't want to fill it up with effluent; I wouldn't want to put my cows in there. This is our farm, but we're only caretakers of it really, because we're not here forever. With a bit of luck maybe the kids might carry it on, but we certainly don't want to leave them with a big mess*’.

Other farmers commented how polluted water can impact on them, their families, their businesses and downstream users (e.g. neighbours). Ian knows ‘*you don’t want to pollute their [neighbour’s] water for their stock’,* and Owen cautions: ‘*If we're not [good custodians], our farming, our production, everything will go down the drain*’. Owen firmly believes a good farmer is ‘*a person who protects the environment’,* and, in his opinion*, ‘if you haven't protected the environment, you haven't got an efficient or a profitable farm.*’

> *These stories reflect personal norms of stewardship. Personal norms are sometimes termed values in the literature.*

All farmers in this study except Paul, believe and accept that water quality has declined, and that dairy farming (among others) contributes to this decline. Owen takes personal responsibility for water quality decline:

> '*Our water, water quality in New Zealand has dropped away, is I think probably the biggest thing. Water's valuable, exceptionally valuable, and I'm not sure that we can actually fix everything that we've ruined*.'

Paul disagreed with the majority view. He firmly states that water quality is a '*perceived problem'*: '*I don't think it's as bad as what people are saying'*. He argues '*water is not degraded'* and believes water quality is improving because dairy farmers have changed management practice ('*for effluent they've gone from water-based discharge to land based discharge'*.) Even though Paul does not accept personal responsibility for water quality decline ('*I don't think I'm doing anything to degrade the water, so I don't think I need to go and improve anything')* he has fenced and riparian planted waterways. Paul's perception of the problem influenced his information seeking behaviour. He stated he does not need information about farming and water quality and has not discussed farming and water quality with the individuals he interacts with: other farmers, fellow church parishioners, his fertiliser rep, his farm consultant, or staff from DairyNZ, Horizons or Fonterra. The next section provides an overview of the relationships the farmers in this study have with others.

The diversity of farmers' social networks

The farmers in this study interact with others through their social networks. The relative size of each farmer's social network varies. Some farmers have a broad and extensive network, while others interact with a smaller number of individuals. Some farmers have a diverse farming network, others have a diverse off-farm network (e.g. church, sport), and some have both. The farmers in this study described how they used their networks to share knowledge (learn) and access information, resources, emotional support and friendship from the individuals they interact with. Specifically, they described how they used their existing networks to access information about farming and water quality.

> *Relationships between farmers and: family, friends, other farmers and the TCEIS leaders are examples of **bonding** social capital.*
> *Relationships between farmers and: DairyNZ, fertiliser reps, farm consultants, nutrient management consultants and Fish and Game are examples of **bridging** social capital.*
> *Relationships between farmers and: Horizons, Federated Farmers and Fonterra are examples of **linking** social capital.*

Although all farmers in this study interact with other farmers, the extent of farmer-to-farmer interactions varied. These farmers all farm with family members: a spouse, children, parents, an uncle, and in-laws. Three farmers are sharemilkers[104], another is in an equity partnership, and these farmers also interact with the farm's owner(s). Some farmers interact with more farmers than others. Retired farm owner Owen interacts with sheep and beef farmers in the Manawatu-Wanganui region, dairy farmers in Taranaki (previously farmed and still owns a dairy farm in this region), and with horticulturalists in the Hawkes Bay. Tom interacts more with the sheep and beef farmers in his community than the dairy farmers, because these are the friends he made through their children's school. Jim comments: '*I socialise basically with neighbours, with groups within the area*', and Ken, a third-generation farmer (on the same farm) from the same established farming community as Jim, describes the interactions between the farmers in their community: '*Because we live in a district here, that's a no end district, the cockies are often getting on their bikes having a pow-wow'*. Other farmers like Fred, who described himself as '*self-contained',* interacts mainly with the family he farms with and has less interaction with neighbouring or other farmers.

Many farmers in this study voluntarily support their local community. Ken manages the local hall, Max and Paul are on their local primary school's board of trustees, Owen and Steve are involved in their local church, Fred and his wife foster children, Tom coaches school sport, and Jack and Ian raise calves and donate to local community organisations (e.g. the fire brigade). While these actions are not directly related to farming and water quality, community involvement provided an opportunity for some farmers to discuss the impact of the One Plan, other farmer's practices, and staff from the organisations that work with farmers. Ian organises regional and national sports events, and he remembered a local event when farmers were discussing and judging Horizons' interactions with a local dairy farmer: '*We were saying about all this ridiculous stuff at [event]. One of the farmers had heard about this stupid stuff, and a couple of the other farmers had talked about it'*.

> *Volunteering, or 'doing good for others' in the community, is an example of a cultural norm of reciprocity.*

[104] Steve and Ian are 50:50 sharemilkers and Stu is lower order (33%).

The farmers in this study interact with staff from a wide range of organisations. Some interactions were for farm management, others for regulatory and water quality, and some for a combination of reasons. Water quality may be the focus of an interaction (e.g. an effluent inspection) or may be discussed in some way during the interaction. Some farmers interact with staff from a few organisations (e.g. Horizons, DairyNZ, Fonterra, their fertiliser rep) while other farmers have extensive contacts with a wide range of farming-based organisations including science providers. All farmers interact with regional staff (e.g. Fonterra Area Manager) and some farmers also interact with national level staff (e.g. DairyNZ head office staff). Some farmers in this study use a farm systems consultant for farm production reasons, while others do not.

Some farmers in this study are involved with farmer organisations. Some are current members of Federated Farmers (Feds), including Owen and Jack who previously held elected positions with Feds at provincial and national level. While other farmers are not current members, they use Feds' services (e.g. sharemilker contracts), advice, and support for both general farming and water quality issues. Ian remembered when he contacted regional Feds' staff for advice and felt supported during a historical issue with Horizons over effluent non-compliance.

Some farmers are or were involved in the regional Dairy Farmer of the Year competition. Jack and Jim are judges, and Steve was a competitor. The competitors discussed the One Plan, their farm practices, and impact on water quality with the judges. Steve remembers how his discussion with the judges made him reflect on his business and the potential impacts of effluent on water quality:

'*So because you have to present what you're doing for the environment and how you manage your pasture and your effluent to judges, it makes you look at your business and go what can we do better?*'

Electronic methods are part of the farmers' information and communication networks. Some farmers in this study use electronic communication extensively (e.g. email, some farmers tweet), and the internet is an integral part of their information network. Fred commented: '*Before I do anything, I do a lot of research [on the internet]',* and Roy shared how he regularly uses the internet for farm data, information about dairy production, and for information about farming and water quality: '*One of our streams is on Horizons [database] and you can google the water quality. I know you can google the flow at certain times of the year*'. As Roy said: '*Oh no, it's [google] fantastic, I use it for everything'.* Other farmers use a computer less, Ken doesn't use at all ('*I'm no good with computers, paperwork or anything like that'*), and less regular users rely on a family member to use a computer on their behalf. Some farmers access information and resources via the internet (e.g. DairyNZ's website), while others may ring the organisation and request a copy of the resource.

While some farmers have more extensive connections and networks, other farmers like Fred, have a less extensive social network. Fred described himself as '*self-contained'*, farms with his family, and admitted he has little interaction with other farmers, and non-farmer groups. Fred talks with his Fonterra Area Manager and farm consultant, is an avid internet user, and is more informed about farming and water quality, and has made more farm practice change, than other farmers with more extensive contacts and interactions.

Fred's story suggests that the relative size and range of a farmer's network does not influence their access to information and knowledge about farming and water quality.

Finding out information about farming and water quality

All farmers in this research, except Paul, used their existing networks to access information about farming and water quality. Paul was the exception. As discussed earlier, Paul stated he does not require information about farming and water quality, because he does not believe water quality is degraded or is his problem.

The types of information sources and the number of sources the farmers used for information about farming and water quality varied widely. As illustrated in Table Eleven, some farmers accessed information from a number of sources and other farmers from a few sources in their network. Some farmers used their personal connections with specific individuals, some used published resources, and others used both. Some farmers like Roy, Max and Fred who are avid 'googlers' would self-research and use online resources, while others like Jim, who doesn't use a computer, would read press releases and articles in farming journals. Some farmers, like sharemilkers Ian and Stu, would use their Fonterra Dairy Diary. All except Fred and Paul would talk with other farmers. Some like Owen, Max, Jim Fred and Roy would talk with their farm consultant. Others, like Fred, Owen, Steve and Ken would talk with their Fonterra Area Manager. Some, like Tom, Ian and Stu, would wait until the annual effluent inspection and talk with either the Horizons' inspector or the QCONZ inspector. Some farmers were clear about the sources they would not use or sources they would treat with some reservation. Ken and Max were clear: Ken said '*I don't use DairyNZ*', and Max would not approach Horizons ('*they are there for the legal black and white. I wouldn't use them for advice'*.) Stu might approach Horizons, but he would be '*suspicious*' about their information, because in his opinion, '*there's an adversarial feel between farmers and Horizons, they're on one side and we're on the other*'.

Table 11: The farmers' sources of information about farming and water quality.

	Jack	Fred	Max	Paul	Owen	Steve	Roy	Tom	Ian	Ken	Stu	Jim
One Plan classification[1]	T	T	T	T	T	T	T	NT	NT	NT	NT	NT
Self - own research		✓	✓				✓					
Other farmers	✓		✓		✓	✓	✓	✓	✓	✓	✓	✓
DairyNZ	✓		✓				✓*			X		✓
DairyNZ staff member		✓										
Fonterra						✓						✓
Fonterra Area Manager		✓			✓	✓				✓		
Fonterra's Dairy Diary									✓		✓	
QCONZ inspector								✓			✓	
Farm consultant		✓	✓		✓		✓					✓
Horizons		✓	X		✓	✓	✓					✓
Horizons effluent inspector									✓			
Farm journals												✓

X indicates would not use
*Roy would use DairyNZ's online resources rather than personal contact

The relationships that farmers form with farmers and other individuals shaped their responses to water quality interventions. The next section explores the nature of these relationships between farmers, and how farmer to farmer relationships shaped farmers' responses.

The nature of farmer to farmer relationships

Introduction

The farmers in this study are informed and influenced by their relationships with other farmers. The farmers accessed information, knowledge, resources and support from other farmers. In addition, these farmers talked directly with and observed other farmers' practices ('first hand'), and also heard from other farmers about what they heard or observed another farmer saying or doing ('third hand'). These conversations and observations shaped farmers' beliefs, emotions and behaviour, and influenced the relationships between farmers, and between farmers and staff from organisations. Stu, for example, obtained information (e.g. about the One Plan) and knowledge (e.g. about how to grow chicory on his farm) from other farmers. He also relies on the other farmers in his community for emotional support:

'*Well that's [other farmers] your support group. It's quite often there's only a handful of people in each farm, you tend to get isolated in your workload and feel that your problems are your own, yet everyone in the district's going through the same things. It helps to lighten the load by sharing*.'

Farmers talk to other farmers

The farmers in this study talk with their neighbours and with other farmers. A neighbour can be a farmer with a farm next door, or another farmer in close proximity. Ken often talks with his '*neighbour up the road',* and comments*: '[Farmer] will often just wander down here and find out what I'm doing up the paddock'*. Although Fred admitted he infrequently interacts with his neighbours, the other farmers in this study talked more often with their neighbours, have more interaction with their neighbours, and their neighbours' beliefs and opinions can influence or reinforce their own beliefs and opinions. Ken farms in a non-targeted WMSZ and learnt about the One Plan and Land Use Consents from his neighbour who farms in a targeted WMSZ. From these conversations, Ken believes Horizons is trying to control farmers' practices: '*they're [Horizons] clamping down on him [his neighbour] at the moment*'**.**

The farmers in this study talk with farmers at a range of venues and occasions. The farmers talk with other farmers at organised events (e.g. meetings, discussion groups), social occasions ('*down at the pub'* - Roy), sports events ('*on the sideline at rugby'* - Jim), school, church, farming events (e.g. field days), while on holiday, and informally (e.g. chat while passing on the road). The farmers are more likely to talk about farm production rather than hold specific conversations about farming and water quality, and Roy quips: ‘*farmers are a funny lot together, they are, they talk production, production, production*’. The farmers discussed the One Plan with other farmers, and how the One Plan will impact on their businesses, for example, changes in stocking rate, and potential impacts on farm value.

Stu talked about how information flows through farmer networks. He described how the information that flows directly from a source to a farmer (e.g. from Horizons to a farmer), is also shared between farmers (‘*spread the word’*). Stu likened the information flow between farmers as ‘*chinese whispers*’, and used this metaphor to describe how the meaning of the message can change as it is passed along the chain:

> ‘*Not everyone will go to all the Fonterra meetings or the Horizon meetings or the DairyNZ meetings but some do and the rest spread the word. So, everyone's getting the information, it just comes in a bit Chinese whispered sometimes*.’

Stu later raised his concerns about how heightened emotions can decrease the accuracy of information being ‘*spread*’ by farmers:

> ‘*Someone's whispered this at a discussion group and then everyone thinks the worst. We all talk, one person hears something and goes and tells someone else and generally speaks about things, possible embellishments*.’

Stu’s story illustrates how bonding social capital can distort information.

Some farmers learnt about other farmers’ opinions of the One Plan and observed other farmers’ behaviour towards Horizons’ staff at farmer meetings and discussion groups. Different farmers expressed different opinions and behaviour towards Horizons’ staff, and Stu and Tom described some of the negative behaviour they observed. Stu and Tom’s beliefs were not influenced by the behaviour of other farmers at the meetings. Stu remembered a discussion group meeting he went to, described other farmers’ reactions towards a Horizons’ staff member as ‘*ridiculous*’ and ‘*pretty idiotic’*, and felt these farmers were ‘*arguing and taking the piss’*. Tom attended a few meetings when he first moved to the district, and remembers how other farmers reacted negatively to the One Plan and to Horizons’ staff:

> ‘*I've been to a couple of public meetings, but they were just a big slinging shit fight really, I felt sorry for the poor pricks [from Horizons] that tried to host it, because they just got shut down*.’

Some farmers were unable to attend a One Plan meeting and relied on other farmers for information about the plan and the event. Stu was unable to attend a meeting (‘*the boss had to go, someone had to milk’*), yet his words (‘*we*’ and ‘*I know*’) described the event as if he had personally attended. Stu’s boss’s recollection of the meeting shaped Stu’s beliefs about the meeting. Stu described the strong farmer turnout (‘*it was a big meeting*’ and ‘*the whole region, everyone, there was a lot of farmers*’), and the purpose (‘*how we can tackle the issue’*). Stu’s boss’s recollection also shaped Stu’s beliefs about how the One Plan will impact on farmers. Stu described how other farmers felt, and their opinions about the One Plan: ‘*I know some farm owners felt of the opinion that they might as well sell the farm and piss off to the beach because they feel like there's no future in what we're doing*’. The farmers in this study talk with other farmers, and this next section explores how these conversations and observations of farmer practice influenced their responses to interventions.

Farmer to farmer influence

For some farmers in this study, farming family members influenced their decisions around the inputs and farm practices that can impact on water quality. Ken relies on his son (also a dairy farmer) to recommend a maintenance fertiliser programme and relies on his advice about farming under the One Plan. Ken reveals: ‘*I’ll ask him [son], and he's quite blunt and up front, and he'll just say you don't need to do that. He's up with the modern stuff, more than we are.’*

For other farmers, an employment relationship (boss-worker and farm owner-sharemilker) influenced a farmer’s beliefs and decision making. Stu’s belief that stream fencing is ‘*common-sense’* was influenced by a previous boss’s proactive attitude towards fencing: ‘*We’re fencing now, we can do the bare minimum or we can future proof, let's do it all now*’. Stu also remembered how he chose to work for another farmer because of this individual’s industry connections (‘*I didn’t have many contacts at the time’*) and his reputation (‘*he’s a rock star’*). Among other topics, Stu learnt about alternative forage systems (e.g. chicory), and the One Plan from this farm owner (‘*he was always coming back with more and more information about it [One Plan]*’).

Some farms in this study are sharemilker-owner businesses. These farm owners expect their sharemilkers’ farm management practices will not impact on water quality. Sharemilker Stu is responsible for the operational decisions about FDE application on the farm owned by Ken, and it is important to Ken that effluent is correctly applied (‘*not in the water system*’). Ken relies on Stu’s work ethic (‘*he’s quite conscientious’*), previous farming experience and understanding of what is accepted effluent practice; plus their personal relationship which in Ken’s opinion, is based on mutual respect and regular communication. Ken and Stu ‘*talk most days*’ about what’s happening on the farm. When Stu started working on Ken’s farm, they talked about what was accepted farm practice - as Ken put it, ‘*where the irrigator’s allowed to go’*. If Stu ‘*made a muck up with the effluent’*, Ken would not want Stu working on his farm because Ken is liable (Ken would be fined) and Stu’s actions would contradict Ken’s beliefs of accepted farming practice and his personal values of water care: ‘*I'd be very upset if some pollution came off my property. Being an old trout fisherman, I don't like seeing rivers getting polluted.’*

For some farmers, like Jim, their farmer-to-farmer conversations can reinforce their own beliefs about an individual or a situation. Jim remembered a conversation with his neighbour about a frustrating interaction he had with a Horizons’ effluent inspector about effluent ponding under the effluent irrigator. The neighbour’s incredulous reaction (‘*Oh for God's sake, what does she expect happens when we get 50mm of rain?’)* matched Jim’s opinion that the staff member had been over zealous.

For other farmers, like Tom and Jim who farm in a non-targeted WMSZ, their conversations with their targeted dairy farmer neighbours influenced their opinions about the potential impacts of the One Plan. After moving to the district, Tom was concerned when his targeted neighbour told him about the expected farm system changes under the One Plan (e.g. ‘*reduce stocking rate, no grazing on the hills and a million-dollar herd home*’), and Tom thought ‘*Oh shit, what have we walked into here*?’ Tom felt relieved after a Horizons’ staff member told him: ‘*you’re lucky you don't have to worry about it’*. Similarly, after talking with older targeted farmers, Jim’s relieved he can avoid the paperwork and change associated with farming in a targeted WMSZ. Jim’s heartfelt emotion is reflected in his words:

> ‘*Thank God, thank God I'm not going through this. Talking to some of the dairy farmers on the Toki, my age, they don’t want to go through it. When you get to our age, you don't want these headaches, you don't want these changes. Some of them have said, oh I'll sell the farm, they're of that age, like the first dairy farmer on the road, I'll sell the farm. But now he realises he can't sell it, nobody wants to buy it until he's done that bloody paperwork*’.

Other farmers in this study talked about the ‘good’ farmers who use ‘good’ farm management practices around water quality. Jack learnt about farming and water quality from farmers he described as ‘*proactive and progressive*’, who in his opinion, are the ‘*environmental leaders’*. In contrast, Jim talked about poor dairy farm practice around water quality. Jim went to a Dairylink field day about N leaching, and believes the focus farmer's nutrient management practices ('*brings in lots of supplements'*) and effluent infrastructure ('*unlined effluent pond'*) were behind best practice. This field day reinforced Jim's belief that his farm practice was best practice, and he reckons: '*I'm ahead of his [focus farmer's] game.*' Continuing with the theme of farmer to farmer influence, the next section explores how farmers respond to hearing about or observing farm practices they consider to be unacceptable.

'Best' practice, or expected and accepted farm management practice, is a practice norm.

Seeing and hearing about unacceptable farm practices – how do farmers respond?

The farmers in this study identified some of the commonly accepted and expected farm management practices around water quality. As discussed in Chapter Seven, the farmers described commonly accepted management practices around waterways (e.g. stream fencing, installing bridges and culverts), effluent (e.g. no ponding, no effluent in waterways), nutrients (e.g. reduce nitrogen application), livestock (e.g. reduce stocking rate) and crops (e.g. reduce forage crop area). The farmers also described how they may respond if they hear about or observe another farmer's practice they deem unacceptable (e.g. effluent in waterways). Jim used the phrase '*the unwritten code'.* In Jim's opinion, the unwritten code covers accepted farm practice, and how farmers may respond when another farmer breaches the code. Jack used the phrase '*peer pressure'.* He believes that if farmers and staff or representatives from farming organisations (e.g. Federated Farmers) talk with other farmers about their unacceptable farm practices, this can influence them to change.

The farmers in this study described how they may respond if they saw a farm practice they consider to be unacceptable. Some farmers may discuss directly with the farmer concerned. Jim rang his neighbour about his stream fencing, when the neighbour's cattle gained access to the stream on Jim's farm (Jim had fenced his waterways). Some farmers may discuss the offending farmer's behaviour with other farmers or other professionals. Ken would talk to his neighbours, and Max may ring a farming organisation such as the First Response Team[105]. Some farmers may

[105] The First Response Team includes a range of organisations (e.g. DairyNZ, MPI, Rural Women and the Rural Support Trust) that support farmers through environmental, animal, financial and farmer welfare issues.

choose to watch what the farmer is doing over time, before deciding what action to take. If Ken saw unacceptable practice, he would '*look each time he drove*' by to decide if it was '*one-off'* instance or an on-going practice. Others may not act and wait for another farmer or individual to take action. Ian speculated '*they don't want to rock the boat*'. For example, Tom and other farmers saw effluent flowing in a drain when on a farm discussion group walk but did not comment to the farmer involved.

*The farmers' stories illustrate examples of informal sanctions of practice norm violation*s.

The farmers in this study described a complex range of factors that can influence the actions they may take upon seeing an unacceptable farm practice. For some farmers, an existing relationship can influence the action taken. Ian's neighbour rang him once about an effluent spill that went into the creek and scolded '*that's not good enough'*. Similarly, Steve thinks '*if it was someone you know you feel like you could say something, but I wouldn't talk to someone if I didn't know their name'*. For other farmers, relative age and farming experience could influence their actions. Steve commented that he may talk with a younger farmer who may be less experienced and admits '*it's possible that he may not even know that he can't actually spread effluent by the road*'. Similarly, Tom believes a younger farmer discussing unaccepted practice with an older more experienced farmer would be disrespectful ('*it would have been frowned on'),* particularly if the farmer is a long standing respected community member ('*He's been here forever and he knows everything').*

Tom shared his experiences during a discussion group farm walk when he and the other farmers observed effluent going into a drain. One farmer commented to the others: '*shit, that's a bit marginal*'. None of the farmers present discussed the unaccepted practice with the farm's sharemilker or later with the farm owner. The nature of Tom's relationship with the older established farm owner was one of the factors that prevented Tom discussing the sharemilker's effluent practices that he considered were unaccepted:

> '*I don't know many people down here very well, and this guy's been here forever. Not the sort of guy you really try and tell what to do just because he's been there forever and he knows everything. He's been pretty good for us since we've been here, with advice. But I wasn't going to go and say to the guy look you shouldn't be doing that, because he's an older guy and he'd just tell me to piss off, he would have.*'

Some farmers in this study are concerned about preserving their relationship with other farmers. Steve is concerned how the other farmer may react if he discusses their farm practice: '*I don't want to offend him, he will just blow up at me*'. Other farmers are concerned about their reputation in the eyes of other local farmers. Ken does not want other farmers to think he is '*a stirrer',* and Max believes other farmers will think he is '*the stickler or the policeman or the goody good*' if he talked to another farmer about unaccepted practice. Max's desire to preserve his reputation and relationship with other local farmers would influence his behaviour if he observed a neighbouring farmer's unaccepted effluent practices. Max would be more likely to contact a professional (e.g. his DairyNZ Consulting Officer or member of the First Response Team), than discuss directly with the farmer involved, because he believes that contacting a professional will not affect his personal relationship with that farmer.

Many farmers in this study believe it is a farmer's right to make farm management decisions on their farm without external control or direction from others. These farmers would not tell another farmer what to do or criticise their farm management decisions, because they believe in another farmer's privacy and right of choice. As Roy emphasises: '*it's none of my business'*. Owen believes that not telling another farmer what to do is part of the New Zealand culture:

> '*New Zealanders are pretty funny people, we will not be told how to do things. In America you can tell a farmer to do something and oh do we have to do that, and he does it - they don't do it in New Zealand*'.

> *These stories reflect cultural norms of autonomy or the rights associated with private property ownership*.

Max feels strongly about effluent in waterways, and his reputation as a good dairy farmer. However, the actions Max would take if he saw another farmer's unaccepted farm practice is more strongly influenced by his belief in an individual's rights:

> '*The kiwi way, the farmer way, is you just shut your mouth and carry on, business as usual. That's their right to do that, but when it starts impacting on me by the fact that farmers get slammed in the paper, then it does affect me, but not enough for me to go and see him. It would impact me when - if I've got cow shit flowing down my creek, from my neighbour, I would probably go and say something to him*.'

'Dobbing in'

Many farmers in this study would not '*dob in'* another farmer, or contact the authorities about another farmer's unaccepted farm practice. These farmers described how '*dobbing in'*, or contacting the authorities (e.g. Horizons, SPCA or MPI[106]), is in itself not accepted behaviour. Dobbing in is a breach of the '*unwritten code*'. The farmers believe that 'dobbing in' leads to ramifications for the individual involved. Max believes that if a farmer dobs in another farmer, they will '*get ostracised'* by other farmers in the community. 'Dobbing in' also impacts on other farmers in the community. Jim believes that if a farmer rang Horizons about another farmer's practice, Horizons would come into the community to inspect and monitor all farmers, and as he reinforces: '*We don't want them [Horizons] up the road'*. In some cases, a negative historical relationship between farmers may influence whether a farmer dobs in another farmer. Max believes '*some people do it to get someone back'*, and from Stu's perspective '*Unless there was bad blood between neighbours I don't imagine anything would be said*'. Other farmers, like Fred, would contact the authorities. Fred firmly stated that if he heard about or saw a farmer putting effluent in the creek '*I'd be on the phone to Horizons'* He believes this farmer's action does not meet his personal standards of environmental care.

> *Dobbing in an example of a cultural norm violation. Dobbing in reduces trust between farmers. Those who dob in are informally sanctioned for violating this norm.*

'Tarred with the same brush'

Some farmers in this study described how they felt angry and disappointed when hearing about other farmers' actions. These farmers described how they believe other farmers are not being honest when reporting their farm data to organisations. Fred's Fonterra Area Manager told him '*there are farmers that haven't been putting in those nitrogen figures*', and Fred thinks '*well someone [a farmer] might use say two tonne of nitrogen, and not put it in there'.* Fred's '*pissed off'* with these farmers and their dishonesty, particularly when he records all farm inputs into Fonterra's N pages. Similarly, Jack talked about farmers dishonestly reporting their stream fencing information to Fonterra, and how MPI's published stream fencing report[107] found these discrepancies: '*MPI does a spot audit and hello, you were telling lies'*. Jack feels '*let down'* and

[106] MPI (Ministry for Primary Industries) and SPCA (Society for the Protection of Cruelty to Animals) are involved in animal welfare issues.
[107] An independent survey to measure stream fencing progress, found significantly lower levels of fencing than previously self-reported by farmers in the snapshot of progress reports (Sanson & Baxter, 2011).

'*disappointed*' and feels that the actions of a few farmers reflect poorly on all farmers: '*all farmers are bad because of it'*.

Other farmers believe only poor farming practice (e.g. effluent or stock in waterways) is reported in the media, and by association, all dairy farmers use poor practices. As Jack commented: '*there's always that 5 percent that let the team down, and they're the ones that make the media'*. Jim and Jack used the phrase '*tarred with the same brush*'. If Jim heard about or saw a neighbour putting effluent into a waterway he would confront that farmer, because he believes this farmers' poor practice violates the unwritten code and will also implicate Jim. Jim doesn't want to be '*guilty by association'*:

> *'It makes that tag of dirty dairy farming, we all suffer, it only takes one farmer to do it and we're all tagged with it, public perception'.*

After exploring the nature of farmer to farmer relationships, the next section explores how relationships between farmers and organisations and with individuals from groups and organisations, informs and influences farmer response to water quality interventions.

The nature of relationships between farmers and individuals from groups and organisations

Introduction

The farmers in this study are informed and influenced by their interactions with other individuals and with staff from organisations. Farmers access information, resources, and support, and exchange knowledge through these interactions. The first part of this section initially explores the historical (post POP) and current interactions between farmers and Horizons, and between some of the other actors and Horizons. The second part explores the interactions between farmers and: the TCEIS; DairyNZ; Fish and Game; farm systems consultants; nutrient management consultants; fertiliser company representatives; and with members of the public. Finally, the relationship between farmers and two key individuals are explored. The interactions between farmers and Fonterra around stream fencing were explored in the previous results chapter (Chapter Seven).

Interactions between farmers and Horizons and between Horizons and other actors

After the POP process – the state of relationships

Simon (Horizons) believed the relationship between Horizons and farmers was '*very broken'* after the POP process. He commented: *'there's no trust in there.*' The previous results chapter explored the factors that contributed to a deteriorating relationship between farmers in this study and Horizons. Some farmers believed Horizons did not consult with them about the POP. Others believed Horizons was taking control and telling farmers what to do on their farms. Some farmers described Horizons' approach as top-down and dictatorial (not listening to farmers). Other farmers believed Horizons were taking a singular environmental focus and disregarding the economic effect of the POP on farmers and the community. Some farmers described feeling upset, worried and frightened while others felt angry and victimised. These emotions and beliefs led to conflict between Horizons and the farmers in this study, and resistance to the POP.

This summary highlights how the farmers perceived Horizons had violated their cultural norms around autonomy, and fairness and equity. Violating cultural norms reduces trust. A perception of being told what to do (external control) also reduces trust. Disregarding the economic impact on the community indicates a lack of care. Trust was reduced.

The state of the relationship between farmers and Horizons after the POP process influenced if and how farmers in this study interacted with Horizons. Some farmers chose not to approach Horizons for advice, and others were sceptical and disbelieved the information provided by Horizons. Chris (Federated Farmers) believes the *'poor'* relationship between Horizons and farmers reduced Horizons' effectiveness in supporting and assisting farmers:

> '*But when you've [Horizons] just rucked them [farmers] over and rucked them over, and it was a whole lot of complicated personalities and those personalities are gone now but there's still scars there. For a long time, farmers used to say, "Bloody Horizons are not coming on my farm, I'll get them with the pitchfork, I'll run them over with my four-wheeler. Bloody bastards are not coming down here", you know. It's like how can the regional council do a good job of educating and advising and assisting farmers to move in the right direction, if farmers feel like that*?'

The relationship between Horizons and some of the other actors, including Federated Farmers, DairyNZ and Fonterra, deteriorated during the POP process. From a Federated Farmers perspective, Horizons' regulatory approach to the POP was unexpected, particularly after the on-going pre-notification discussions about a non-regulatory approach. Chris (Federated Farmers) believed Horizons disregarded their experience and knowledge, and asserts: '*The regional council just thought the Feds were just a pack of crazies; red-necked, didn't know what they were talking about'*. This same staff member talked about the '*tough*' and '*aggressive*' nature of the court process. Similarly, Mark (Horizons) described Horizons' relationship with Federated Farmers after the POP and court processes as '*damaged'.* From Fonterra's perspective, Pete (Fonterra) believed that the POP was not workable and would negatively impact on farm businesses and on milk supply to Fonterra: *'we could see that [Table 13] pushing a portion of farms completely out of business*'. Some staff from these organisations felt Horizons were not listening to their concerns about the POP. Doug (TCEIS) remembered how he felt Horizons were treating these organisations, and the influence of a community voice:

> *'Federated Farmers, DairyNZ and Fonterra all said to Horizons this is not workable. In some ways Horizons just about gave them the finger and said, "well this is what we're doing". It's not until you get the general community [involved] that there's a change, and that's the biggest thing that I've learnt'*.

> *The POP was unexpected. This indicates a lack of predictability. Trust reduced.*
> *Disregarding experience and knowledge, and not listening indicates a lack of care. The cultural norms around relationships were violated. Trust reduced.*

Building and re-building relationships

Horizons and the other actors

Horizons recognised they needed to build relationships and adopted an approach of '*working with*' staff from Federated Farmers, Fonterra, DairyNZ, and the TCEIS. Mark (Horizons) described the current open and friendly communication between Horizons and Federated Farmers ('*I call into the Fed's office and say Hi'*), and Chris (Federated Farmers) believes mutual respect has developed ('[*Name - Horizons] is very good, very nice person, he really wanted to find solutions*'). Mark (Horizons) believes the current relationship between Horizons and Federated Farmers is '*stronger*' than before the POP process.

The relationship between Horizons and Fonterra has also changed. Simon (Horizons) believes '*[Fonterra] have consciously re-engaged with regional councils',* and also believes *'Industry is far more willing to be involved in trying to find solutions*'. At farm level, some Fonterra and Horizons' staff work together to advise farmers on implementation of the One Plan (e.g. shared farmer meetings). This relationship between Fonterra and Horizons is influenced by the calibre of the individuals involved, and Pete (Fonterra) reckons '*at our [farm] level it's great because you've got people like [Horizons staff member], they go out of their way to help farmers'.*

> *'Wanted to find solutions' indicates care. 'Helping farmers' indicates care. Trust was built.*

A new working relationship was built between Horizons and DairyNZ. Several DairyNZ head office and regional staff work closely with Horizons' staff, and Simon (Horizons) commented on the regular and open communication: '*we'll pick up the phone and talk to each other*'. Simon (Horizons) trusts DairyNZ will support Horizons ('*stand alongside us'*), and claims:

'*One of the real values for us [Horizons] in that is we can walk out of a meeting and say okay we've done our bit, had that discussion and DairyNZ and farmers can continue that discussion without us there. I trust them to do that without throwing us under the bus*.'

> *This new relationship indicates predictability. Trust was built.*

A new relationship was built between Horizons and the TCEIS after the TCEIS-organised May meeting. Horizons' staff and the TCEIS had little contact before this meeting, and Doug (TCEIS) remembered a pre-meeting conversation he had with the Horizons' chairman who accused him of 's*caremongering people'*. Doug (TCEIS) reckons Horizons and the TCEIS are '*allies now rather than enemies.*' After the meeting, Simon (Horizons) and the TCEIS farmer leaders developed a relationship based on regular and honest communication: '*they [Horizons] would keep us in their loop all the time and we [TCEIS] would keep them in a loop*' (Doug, TCEIS). Simon (Horizons) feels he can contact the TCEIS farmer leaders and ask for advice and support: '*I phone people up and go how do we deal with this situation, or I'm worried about this situation, do you have a view of it*?'. Additionally, Simon (Horizons) acknowledged the TCEIS's role and contribution: '*We [Horizons] recognise that they [TCEIS] bought legitimate concerns to the table about the future of the Tararua'.* Doug (TCEIS) respects Horizons' change in approach towards farmers: '*they're [Horizons] less confrontational, they're more helping'*.

> *These stories highlight how trust was built between the TCEIS leaders and Horizons. 'Keeping in the loop' is an example of predictability, and 'I'm worried about a situation' and 'helping farmers' are examples of care. 'Recognising' the TCEIS's role reinforces respect and norms around relationships.*

Re-building the 'broken' relationship between Horizons and farmers

Many farmers in this study believe their relationship with Horizons has changed since the POP process. Some farmers described a change in Horizons' approach and manner (a '*change in culture*' – Roy) from autocratic, confrontational, arrogant, and telling farmers what to do, to one where farmers feel Horizons' staff are '*working with',* supporting and listening to them. From Paul's perspective: '*They've [Horizons] gone from not having an understanding of basically what they were saying, to be fully informed, working on our behalf*'. Other farmers believe the One Plan's rules have '*softened*' ('*not having a hard and fast rule'* – Jack), and the rules are more flexible and realistic ('*timeframe and that sort of thing have certainly been relaxed a little bit'* – Paul). As a result, the farmers feel there is less conflict between farmers and Horizons. Pete (Fonterra) has '*total respect for most Horizons' people now because they've been able to take on farmer views and listen and change, and that takes quite a lot to do.'* Roy shares the changes he's noticed in Horizons' approach and manner with farmers:

> *'At one stage they [Horizons] were running around like enforcers, I think they're working alongside us more. I think there's a little bit more, their attitude has changed a little bit, that little bit more less tone. Like you said they've got to work with us, there can't be good guy bad guy sort of stuff'*.

Doug (TCEIS) shares his experiences and increased respect of Horizons:

> '*They're [Horizons] less confrontational, they're more helping you implement smart things on your farm and helping you get your process into place*. *Every farmer I've talked to recently says "hell they've been nice to deal with". You talk to the council in Dannevirke, "they've been nice to deal with". You talk to other people who aren't farmers, the regional council have been great to deal with, and that is just so commendable to them'.*

> *Supporting and listening to farmers indicates care. Trust was built.*
> *'Not running around like enforcers' and 'more relaxed rules' indicates less external control. Trust was built.*

Many farmers and staff interviewed in this study associated Horizons' change in approach with changes in Horizons' staff (staff and executive level) and councillors. Some farmers believe a few Horizons' staff were setting the One Plan's direction ('*two or three people making the policy I think, they decided that was the way their policy was going to be implemented'* – Paul) and believe Horizons supported their approach ('*Once they gathered up a bit of steam, others within Horizons stepped in behind them'* – Owen). Other farmers believe these staff had an environmental approach (‘*they were coming from a real green environmental standpoint’* – Jack), had little understanding of farming (‘*their suggestions just weren't practical on farm*’ – Jack), and didn’t consider the impact of the POP on farmers (‘*They certainly frightened us, these couple at Horizons, they were going to shut the farming industry down’* – Ken). One of these Horizons’ staff members previously worked for an environmental organisation before working for Horizons, and some farmers believe his previous employment influenced how he worked with and understood farmers: ‘*He was the one dealing with farmers, and he burnt a lot of bridges. He still had his [organisation] hat on.*’ (Jack). Other farmers believe the departure of these staff signalled a change in approach from autocratic to collaborative. Max comments:

‘*Well I think they've sacked a couple of the key people that were being arseholes, and then they've just started collaborating a lot more with farmers, there's been a huge attitude change*’.

‘Not practical on farm’ indicates a lack of competency. ‘Shut the industry down’ indicates a lack of care. Trust declined.

Some farmers attributed the culture change at Horizons (in part) to a new executive staff member. Jack commented on his empathy with farmers (‘*he’s prepared to listen to the practical implications of the rules’)*, and Chris (Federated Farmers) commented on his manner (‘*he’s totally non-aggressive and not confrontational*’) and his approach (‘*he wants to do the right thing, wants to understand community direction overall, he actually just wants to see something positive happen’*).

‘He’s prepared to listen’ indicates care. Trust was built.

Other farmers attributed the culture change at Horizons (in part) to councillor changes. During the 2010 Horizons Regional Council elections, the sitting representative in the Tararua Constituency (and current chairman of Horizons) was voted off and dairy farmer John Barrow was voted in by the Tararua community. For some farmers, voting for John Barrow signalled farmer resistance to the POP (‘*we all voted for him, because he was against the One Plan Act’* – Ken) and for others, voting for John Barrow restored farmer support and power (‘*we [farmers] have a voice at the top table*’ - Jim). Roy believes councillor changes contributed to a change in Horizons’ approach with farmers:

'In the last 2 or 3 years since John Barrow's been elected it really stirred the hell out of them [Horizons], I think their [Horizons] whole attitude has changed towards dairy farmers.'

> *John Barrow has practical dairy farm experience (competency). Trust was built.*

After investigating farmers' historical relationships with Horizons, the next section explores farmers' current relationship and the Horizons' staff farmers interact with.

Farmers and Horizons – their current relationship

The farmers in this study described their current relationship with Horizons from '*good*' or '*fine*' to '*poor*' or '*distant*'. The farmers' current relationship is influenced by their previous interactions with Horizons or with Horizons' staff. For some farmers, their '*good*' relationship was influenced by the outcome of an effluent inspection ('*I've got a good relationship with Horizons, as long as they don't fine me'* - Max), and for others, receiving a fencing subsidy ('*They [Horizons] helped subsidise fencing off the waterways* - Fred), or obtaining a Land Use Consent. For other farmers, like Ian, his *'poor*' relationship with Horizons was influenced by historical effluent non-compliance issues. The '*distant'* relationship between Jim and Horizons was influenced by historical interactions with effluent staff he described as autocratic ('*you weren't working with them, you were working underneath them'*), and the autocratic way Horizons introduced the POP ('*it [POP] was totally inflexible, there was no discussion, no feedback, no engagement*').

> *'Working underneath them' indicates external control. Trust declined.*

The farmers in this study mainly interact with Horizons' staff for regulatory purposes: annual effluent inspection, obtaining a consent, and compliance with resource consents. The farmers may interact with different effluent inspectors and compliance officers, for example, due to staff changes or farming in a different area in the region. For some farmers, a Horizons' effluent inspector is the only Horizons' staff member they interact with.

In terms of consent compliance, the farmers know that effluent non-compliance results in a fine and increased contact with Horizons. Tom comments: '*I tick a few boxes and they leave me alone. Perfect!'*. Some farmers now proactively contact Horizons to report effluent issues and believe being proactive reduces the likelihood of fines and creates an opportunity to discuss issues and obtain advice. Steve thinks if he communicates with Horizons he '*won't get in trouble'* and rang Horizons before acting: '*I rang them up and said look we've got a blockage in the effluent line, I need to actually cause ponding, I need to blow effluent out of the hydrants'*. Ian rang to report a problem after being previously fined by Horizons for not reporting problems: *'It was 5 in the morning and I rang Horizons and said, "I've got a breakdown with the irrigator"*. Stu relates the open and honest way he works with his effluent inspector during the effluent inspection:

> '*I look for what I know that I've got right and wrong, and if I've got some problems that I think I've got, then I'll take them [effluent inspector] to those [problems] and show them look this is what I think I've got wrong and there's this problem. Try and be as open with them as possible, the moment you start hiding shit they're not silly*. *If I've got anything wrong, and I know I've done it, then I either need to get it sorted straight away, or I need to be straight up about it'.*

Other farmers, like Tom, described their dissatisfaction with Horizons' enforcement of effluent management practice. Tom and family moved from the Waikato and bought a farm in the district about six years ago. Tom was horrified at the previous farm owner's poor effluent practice, and frustrated that Horizons were either not aware or not acting to enforce effluent practices he deemed unacceptable. He exclaims: '*We come down here it was like man - this place should have been shut down*!' Tom's ideas about accepted farming practice were informed and influenced by Environment Waikato's rules and regulations, and he believes Horizons and Manawatu dairy farmers are '*10 years behind us [Waikato farmers]'*. Tom continues:

> '*Environment Waikato are very strict, have always been pretty strict on the effluent compliance and everything, with the storage and your disposal of it. Well there was nothing like that going on here. When we got here a lot of it was just going straight into the river, and he just had a little pod in a paddock which he'd hook up I think when they got checked. All they did was just flood a little area. So, we put a new line straight down to the bottom underground with a travelling irrigator, we just did it properly. Being up in the Waikato as well, they were on you a bit more, the rules - everyone just farmed a lot differently up there in the way I was taught to farm.*'

Some farmers in this study interact with staff other than their effluent inspector. Paul and Owen sought technical advice and reassurance from Horizons' staff before undertaking major on-farm changes related to water quality (e.g. installing a new effluent system and realigning a drain). Paul was '*frustrated*' Horizons would not provide advice, and recalls: '*I know they don't like giving advice because they change their minds later on and say, "well we didn't actually tell you that",* Owen felt '*more frustrated than before I went in'* with a staff member's attitude and disinterest, and felt '*they weren't really interested in that* [*my farm plan*]'. Tom interacts with monitoring staff, and was annoyed by the staff's lack of care ('*they [staff] ran over a pipe, like the effluent pipe, and then they went through a reel and broke it*') and consideration ('*They'd [staff] just come out whenever they wanted, and just go down the farm, and it used to annoy the shit out of us*'). Tom was also concerned the monitoring staff may '*snoop around',* and if they saw something, may report back to the Horizons' office.

> *Tom's story indicates a perceived lack of care, predictability and commitment ('snooping around'). The cultural norms around private property ownership were violated. Trust declined.*

Some farmers in this study discussed Horizons' staff's understanding of dairy farming. Some farmers spoke about specific staff (e.g. their effluent inspector) while others discussed Horizons' staff in general. Some farmers, like Tom, believe Horizons' staff have '*no understanding'* of farming, while others, like Max, believe effluent inspectors have a good understanding of dairy farming. A range of factors shaped the farmers' beliefs. Some farmers commented on the age of Horizons' staff, and on their education ('*they're young, they're recent graduates they've got biology, ecological degrees, whatever they are*' - Jim). Other farmers talked about the staff's lack of practical experience ('*they've never done it [dairy farming], and they don't actually know what it's like*' – Tom), and their urban rather than rural background ('*you get someone out of a town and you tell them anything, they'll believe it*' - Ian). Horizons have employed some staff with an agricultural background, and Sam (Horizons) who is from a family farm, comments: '*Because you understand, and especially when you're dealing with effluent and compliance and things like that, it's not in the forefront of farmer's minds, and you've got to understand that'*.

> *These stories indicate a perceived lack of competency (farm knowledge). Trust declined.*

The impact of historical interactions on the current relationship between farmers and Horizons

Some farmers' historical interactions with Horizons have influenced their current relationship. Jack remembered a Horizons' stream fencing awareness programme some years earlier[108], and how a Horizons' staff member talked with sheep/beef and dairy farmers in their catchment about

[108] This subsidy programme operated around 2006 and was earlier than the Tararua Stream Fencing Campaign (2010-2012) and the Manawatu River Clean-up Fund (2012-2014) the other farmers in this research refer to.

the impact of stock on water quality. Jack admits '*we'd never seen it as an issue before*'. Jack described this staff member in a positive way, in terms of his knowledge ('*he knows his trees*'), his calibre ('*good to work with'*), and his empathy with farmers ('*he actually thinks about the impact on farm, not just because it's a rule*'). Jack admitted he would not have fenced waterways at that time without input from the staff member and subsidy, and his story illustrates how he worked with the Horizons' staff member to fence and plant waterways:

'*So, then he [staff member] started moving down country and came to us, and said you're a bit of a fish bowl, you've got all this road frontage, would you work with me? If we can get people seeing the trees and fencings looks good and can be done, it might create momentum. I said yeah, sweet, because he said he was going to subsidise the fencing.*'

'Knows his trees' indicates competency. 'Thinks about the impact on farm' indicates care. Jack trusted this staff member. He believed the information provided, and as a result, Jack changed farm management practice.

Ian recalled several historical interactions with Horizons' staff over effluent non-compliance and described how these interactions shaped his beliefs about Horizons. He believes Horizons do not treat farmers equally, and believes he was being treated unfairly ('*picked on*') by Horizons because he was not conforming with effluent best practice. He also believes: Horizons think he is a 'poor farmer' because he '*does not contact them*' and '*does not work with them'*; and Horizons only contact 'good farmers' about fencing subsidies ('*They [Horizons] probably work out, right, we've got $50,000, we'll just hang on and maybe give it to the good farmers that contact us. Then they get it all, and then everyone else misses out*'.) Ian discussed his experiences with other farmers and Federated Farmers' staff, and these conversations confirmed Ian's belief that he was being treated unfairly: '*people have said you're getting picked on'*.

Ian perceived his cultural norms around fairness and equity were violated. Feeling 'picked on' indicates a lack of commitment. Trust declined between Ian and Horizons.

Jim acknowledges Horizons are now taking a different approach towards farmers – they're '*trying to engage with farmers'*. However, Jim's previous experiences with effluent inspectors ('*that snotty one that came and dealt to us')* shaped his attitude towards current inspectors ('*I'm wary of their attitude*'), his opinion of their manner ('*arrogance*'), and belief that inspectors feel they have control over farmers (‘*They know full well they've got all the regulations behind them, to do anything they want. They could shut you down at a moment's notice*’). Jim’s current distant relationship with Horizons also stemmed from notification of the POP. Jim believed Horizons were trying to take control (‘*you were going to jump through hoops and meet it*’), felt excluded (‘*there was no discussion, no feedback, no engagement*’), and these beliefs influenced his decision not to apply for a fencing subsidy:

> ‘*When the One Plan came in, it got farmer's backs up, big time, the way it was worded and the way it was going to be implemented. Basically, farmers shut the door on Horizons, and said we're not even going to cooperate. That cooperation extended to even seeking their advice, talking with them, talking to them, dealing with them, you just tolerated them. They came on, did the inspections, and went, and it was just one-way dialogue. The subsidy was made available during those times, and really, that state of feeling, was during those times. So, if you had a waterway that was 100 metres long, sort of thing, it just wasn't worth it. The paperwork and dealing with people you didn't want to deal with - it wasn't going to happen.*’

> *Jim felt Horizons were trying to take control. He perceived Horizons violated the cultural norms around autonomy. Trust declined. Jim chose not to accept a subsidy from Horizons. This is an example of Jim sanctioning Horizons for the violation of cultural norms.*

Fred remembered a historical negative interaction with a Horizons’ effluent inspector, yet described a ‘good’ current relationship with Horizons. Fred’s effluent system had previously passed several previous annual effluent inspections, but when an effluent inspector visited on a wet spring day and observed effluent ponding, he told Fred he needed to fix the problem. Fred described the inspector in a negative way (‘*he wasn’t a nice man*’), objected to his manner (‘*He was goading us to challenge it, so he could take us to court*’), and felt he was trying to take control (‘*He [inspector] said he used to be a cop, but he liked this job more because he had more power over people*’). Fred’s response to this negative interaction was to research and install a new effluent system[109], and as a result, Fred is proud the farm now receives an excellence pass (‘*the top grade*’) for their annual effluent inspection. Fred’s not sure if the inspector still works at Horizons.

> *Fred felt this effluent inspector was trying to take control. Trust declined.*

[109] Fred installed ‘a roughly $200,000 effluent system’: a pond with a bridge and stirrers, a spitfire irrigator, and buried about 3km of effluent pipe and hydrants to increase application area by 10ha.

Farmers and the TCEIS

Some farmers in this study talked about the community group, and some went to a TCEIS organised meeting. These farmers believe that the TCEIS understood the issues farmers and the community were facing and felt the TCEIS were supporting and working on behalf of the community. Fred recalled: '*they [TCEIS] were saying the projected drop [in cow numbers] that they [Horizons] wanted us to have, would hurt those rural communities'.* The commitment of group leaders, and the role and actions of the TCEIS, was discussed in the first results chapter.

Doug (TCEIS) believes the TCEIS have established a relationship with farmers and with staff from DairyNZ, Fonterra and Horizons. He believes the TCEIS supports farmers: '*If something's going wrong, if you feel threatened, if you're having a mental stress for you, make sure you come and talk to us'.* He also believes the TCEIS advocates for farmers and the community: '*they [the community] know that if there's anything - if it brews to a point that's unacceptable or needs some discussion, we'll be back there discussing it with them [Horizons]*'.

> *Fred's and Doug's words indicate care of farmers and the rural community. Trust was built.*

Some farmers sought the TCEIS's support during the Land Use Consent process. Pete's (Fonterra) heard some TCEIS farmer members '*get rung by distraught farmers still who are struggling with a consent'*, and Henry (DairyNZ) remembered a farmer who was refusing to apply for a Land Use Consent. This farmer purchased a recently converted dairy farm about four years prior, and was angry with DairyNZ staff and the nutrient management consultant because he believed they were restricting his '*high expectations*' of future farm production[110]. This farmer felt the TCEIS was his only supporter, and Henry shares his memories:

> '*He was threatening to do this and do that and take us to this TCEIS group to rake us over the coals because we were just…Yeah, this is the farmer talking to our team, "you can't do this" and, you know, so you've got to make sure that TCEIS are kind of on board, we're in the same position, that we're not too far at odds around this sort of stuff as well. I think [TCEIS member] has spent quite some time on the phone with this chap, talking through the issues*.'

[110] The farm's Overseer file was for production of about 65,000 - 70,000 kgMS/yr, and the farmer believed he should be able to do 110,000 kgMS/yr. Henry (DairyNZ) commented the farmer '*hadn't got anywhere near*' the higher production in four years of farm ownership.

Farmers and DairyNZ

The interactions between the farmers in this study and DairyNZ varied. Max has regular ongoing contact with DairyNZ; Fred, Jack and Roy were involved with DairyNZ during the Land Use Consent pilot programme; Ken and Ian have little or no contact with DairyNZ (Ken said '*I don't use DairyNZ');* and the others have intermittent contact (e.g. may attend a field day, may use a DairyNZ resource, may attend a discussion group meeting). Fred was one of the three farmers working with DairyNZ during the consent process but has no ongoing contact with DairyNZ (doesn't attend discussion groups). Ken and Stu interact with one of the DairyNZ Directors, who also has a farm in their community.

Some of the intermittent DairyNZ users described their frustrations with the organisation. Farmers pay a levy to DairyNZ[111], yet these farmers believe they have little input into how DairyNZ use the levy, and believe they receive little in return from DairyNZ. Stu remembered how he and other farmers felt after DairyNZ's recent referendum:

> '*Last year there was a referendum on should we continue paying DairyNZ how much we're paying them or should we pay them more? Every dairy farmer I spoke to not a single person said anything positive about it, yet the day after the vote the email came out that it was overwhelmingly received, and yet you can't find a single person who voted for it [levy].*'

DairyNZ usually interacts with farmers through extension methods: regional discussion groups[112] run by a consulting officer (CO), field days, workshops, and information. The majority of farmers in this study do not attend DairyNZ discussion groups. Max attends regularly (and interacts with his local CO), and sharemilkers Steve and Stu attend irregularly *('I've only been once or twice'* – Steve). Stu found he's attending discussion groups less often in the past 12 months. He remembered hearing about the POP at a discussion group meeting when he was a farm manager. Stu thinks DairyNZ's information is inconsistent over time, differs from his own beliefs, and declares: '*We feel like they're just going whichever way the wind blows them and they're not actually coming up with stuff with any conviction or we feel like they flip-flop quite a bit*'. Tom's stopped attending discussion groups. He used to attend discussion groups in the Waikato (as a sharemilker), went to discussion groups when he moved to the district because he thought he could meet farmers and learn about local farming, but found the information repetitive: '*it's just the same thing every year*'. Paul does not attend discussion groups or interact with his local CO,

[111] DairyNZ's levy system is described in Chapter Six.
[112] Regional DairyNZ discussion groups are run several times a year and discuss seasonal farm management issues.

but he does go to field days. He likes the way DairyNZ present research in a way farmers can understand. He remembered one field day about effluent management. A few farmers have used a DairyNZ resource (on-line or ring for a printed copy).

Stu's 'flip flop' indicates a lack of predictability. Trust declined.

Jack used to attend a strategic planning and governance discussion group, which differed from the farm systems discussion groups the other farmers discussed. Jack's group was facilitated by the DairyNZ regional manager, rather than a consulting officer. Jack described the group generally *('it was really cool')*, the format ('*we got guest speakers in four or five times a year*') and how it made him feel ('*it was just an invitation only, we thought we were elite'*). Jack later described farmers who attend discussion groups as '*proactive*', '*progressive*', '*more likely to change*' and '*leaders in the environmental space'.*

In terms of research and development, Max talked about the Pasture 21 Programme[113], and other DairyNZ research with farmers, research farms and universities (Massey and Lincoln) around reducing N leaching. He believes Pasture 21 was set up because of declining water quality, pressure from the public, and a recognition that '*we need to keep our right to farm'*.

The farmers described DairyNZ's involvement with the One Plan. After the POP was notified some farmers described how DairyNZ staff worked with Federated Farmers and Fonterra, and others felt DairyNZ supported farmers ('*they started doing some investigating and started adding their voice'* – Jim*).* Some farmers commented how DairyNZ attended and organised farmer meetings, and Max described how DairyNZ conducted research: '*DairyNZ's economics team were investigating the costs of the One Plan on the Tararua'*.

'Doing some investigating' indicates care. Trust was built.

Fred attended a POP farmer meeting and felt '*disgusted*' with DairyNZ and Fonterra. Fred believes these organisations were supporting Horizons and telling farmers what to do ('*you've got DairyNZ and Fonterra up there, happily telling people you might have to winter all your cows out, or drop*

[113] Pasture 21 is described in Chapter Six.

10% or 20% of your cow numbers') rather than supporting farmers and telling Horizons what to do ('*I think they could be been more trying to change the One Plan, and Horizons' thinking of it*').

Fred thought DairyNZ were telling farmers what to do (external control). Trust declined.

Roy, Jack and Fred farm in a targeted WMSZ, and worked with a DairyNZ head office staff member during the Land Use Consent pilot programme. Roy spoke positively about the way DairyNZ worked with farmers ('*I thought DairyNZ put a lot of time and effort into us'*), and Jack about the cost savings ('*we're lucky there because it's $5,000 to $7,000 if we'd paid for it ourselves'*). Roy also spoke highly of the staff member involved, described him generally ('*very nice', 'very good to work with'*), and his manner ('*great people skills'*, '*very approachable'*). The farmers in this study from non-targeted WMSZ have not worked with DairyNZ staff around the One Plan and water quality. John (DairyNZ) intends to work more with the non-targeted farmers in the future '*around nutrient management and in an educational sense more than anything*'. Some regional DairyNZ staff are involved in the One Plan farmer meetings, and these meetings were described in the first results chapter (Chapter Seven).

Farmers and Fish and Game

Some farmers and key informants in this study discussed their interactions with and beliefs about Fish and Game. Passionate trout fisherman Ken and duck hunter Max are angry and feel victimised by Fish and Game's comments in the media. They believe Fish and Game blame dairy farmers for water quality decline, yet they cited several examples of the faecal contamination and sedimentation they have noticed from ducks and swans in the region's waterways. Jim thinks Fish and Game's 'Dirty Dairying' campaign[114] negatively influenced the public's perception about dairy farmers. Jim recalled how trout fishermen approach him to access the river through his property, and he shares his response:

'*And I said, "Do you support Fish & Game?" "Oh yeah." "Well bugger off, you're not coming through here, you won't get any access down here*."

Some farmers and key informants alike think Fish and Game have a non-collaborative manner. Ken explains: '*Just a few flash people in high places that think they know everything and they like*

[114] The 'Dirty Dairying' campaign was discussed in Chapter Five.

to pick on farmers'. Chris (Federated Farmers) believes Fish and Game do not want to be part of the water quality solution because they believe they have not contributed to declining water quality. Similarly, Doug (TCEIS) described how Fish and Game were not involved in the TCEIS collaborative process, and asserts:

'"*My view was they [Fish and Game] seem to be very much anti dairy farmers, and everything they said was it was dirty dairying that was causing all of the problem. These people get extreme in the way they say something, you know, you're all of the problem and nobody else is. It's just not right'*.

'Blaming farmers' is a perceived violation of the cultural norms around equity and fairness. Trust declined.

Farmers and farm systems consultants

Some farmers in this study use a farm systems consultant, while the others do not. A farm systems consultant was commonly termed a '*cows and grass'* consultant. Although focused on farm systems advice, the farm consultant is also a source of information and knowledge about farming and water quality for some of these farmers. Roy's nutrient management consultant suggested sensible farm practice changes to reduce the farm's N loss, and based on the mutually respectful relationship that developed, Roy retained this individual as their farm systems consultant. Owen was unable to attend a Land Use Consent information meeting, asked his farm consultant to attend on his behalf, and as a result, the farm consultant is advising Owen on mitigation practices to obtain a Land Use Consent. Fred learnt from his farm consultant (among other topics) about other farmers' mitigation strategies and N loss, and Land Use Consents. Additionally, the consultant's beliefs about water quality in the Manawatu River, shaped Fred's beliefs:

'*I think, no I know, it is like he [consultant] told me, the rivers, the Manawatu River is physically cleaner than it was back in the 70s, because of the improvements*.'

Farm knowledge indicates competency. Trust was built. Longevity of relationship builds trust. These farmers believed their consultant's information and advice about farming and water quality.

Some farm consultant-farmer relationships are based on longevity. Jim has a 33-year relationship with his farm consultant (‘*he replaced me when I left the Dairy Board’*), and Max has an intergenerational relationship with his farm consultant (‘*he was my Dad’s local consulting officer when I was in nappies*’). Jim and Max would discuss farming and water quality with their farm consultant. Jim talked about the dairy farm his farm consultant owns, and how this farm recently won an environmental award in recognition of the mitigation strategies they adopted to improve water quality. Jim went to the farm field day, and explains how impressed he felt:

> ‘*So, they were going above and beyond what the industry was being asked to do, and they had got involved with the local iwi, amongst others, and were doing mitigation things that were quite - were out of this world*.’

> *Winning an award indicates competency. Trust was built.*

Farmers and nutrient management consultants

Roy, Fred and Jack were part of the Land Use Consent pilot programme, and worked with a nutrient management consultant[115] and others during this process. Roy and Fred described contrasting experiences with the consent process, and their experiences were influenced by their relationship with their nutrient management consultant, Horizons and DairyNZ staff.

Roy found the consent process ‘*stress free’*. He positively described Horizons’ and DairyNZ’s approach towards farmers (‘*I haven't felt like they've been forcing it, they've been working with you’*), and the head office DairyNZ staff member he worked with. Roy felt reassured and supported by his nutrient management consultant: ‘*He gave us good advice and I felt he was working for us actually, working for the farmer*’. Roy felt he had a freedom to choose the mitigation strategies that would work for his farm system. On the advice of his nutrient management consultant, Roy increased the FDE application area, reduced herd size, stopped maize cropping, and reduced the area in summer turnips. These system changes reduced the farm’s annual N leaching and will improve water quality. Roy positively described his nutrient management consultant generally (‘*a really nice guy’*), his practical farm experience (‘*he’s milked cows and he's done the hard graft and put cups on’*), his communication skills (‘*he knows the*

[115] Nutrient management consultants are regional dairy farm consultants with a formal certification in nutrient management.

farming talk') and his farm knowledge ('*he just knows the finer things really about the feed budgets and all that'*). As a result of the positive relationship that developed between Roy, Roy's farm business partner (a family member) and the nutrient management consultant during the consent process, Roy and his farm partner retained the nutrient management consultant as their '*cows and grass'* consultant. These farmers had not previously used a 'cows and grass' consultant. Roy feels their relationship with him is '*excellent*' and feel their consultant in return respects their farming knowledge: '*He's really praised [name] and I, he seems to think that we're pretty good guys to deal with and know our stuff*.'

> *Roy's story indicates perceived competency (farm knowledge) and care '(working for us'). Mutual trust and respect were built. Roy changed farm practice based on the advice from his consultant.*

In contrast, Fred was '*aggravated*' by his nutrient management consultant, and how Overseer was used to dictate farm system changes. Fred repeatedly stated he does not like being told what to do: '*I hate being told that I couldn't drop 40 cows to 260 on my terms'*. Fred is proud of the system changes he made for environmental benefit[116] ('*we've now become an excellence farm for our annual consent*'), and was annoyed that Overseer (and the nutrient management consultant) did not consider these previous mitigation strategies when modelling the farm's N loss. Fred's aggravation and frustration at being told what to do and the nutrient management consultant's (and Overseer's) disregard of his farm knowledge, are evident in his words:

> '*He [nutrient management consultant] said, he couldn't change it. It [Overseer] stated - I'm not sure how the program works it out, but it said our feed needs that those cows need to produce this. So, they took out half my supplement, which would have been all my brewers grain, and tried to tell me that we will still do 400 a cow, which I know we won't do 400 a cow, because we were only doing 330 a cow, feeding twice as much brewers grain and the maize anyway. So that was one issue. The second issue was the program [Overseer] was telling them, and me, that we were growing 14 tonne of grass on the hills. Now I can guarantee we're not growing 14 tonne, and they wouldn't change it, they would not change it.*'

Fred negatively described his nutrient management consultant. Fred described him generally ('*wasn't very helpful'*), his manner ('*arrogant*'), and felt the consultant was disregarding his farm

[116] Fred's system changes include: installing a bridge, a new effluent system, increased effluent application area, fencing waterways, a new feed pad, and no break-feeding of winter crops.

knowledge (‘*he won't change figures that you know are wrong*’) and previous environmental actions that Fred was proud of (‘*he told me putting the bridge in, well that was a waste of time…it's not dropping your N anything, it's only stopping faecal matter getting in there*’). Fred could not understand how the nutrient management consultant’s suggested ‘*radical*’ system changes would only reduce N loss by 1 kg/N/ha/yr.

> *Fred’s story indicates a perception of external control and a perceived violation of his cultural norms around relationships (a disrespect of his farm knowledge). Trust declined.*

Fred used other information sources to learn about the factors that could contribute to the farm’s N leaching: the internet, the head office DairyNZ staff member he worked with previously, and his Fonterra Area Manager. Fred learnt the farm’s higher N loss is related to their supplementary feed[117], however his internet research and information from his farm consultant[118] about protein type contradicts the N loss modelled by Overseer. Although Fred was frustrated by the nutrient management consultant and Overseer’s ‘*rigid*’ modelling of his farm system, he is happy with a 20-year consent; particularly when he learnt at a farmer meeting their farm has the longest consent compared with other farms in the pilot programme.

Farmers and fertiliser company representatives

Many farmers in this study soil test, and their fertiliser company representative (rep) commonly uses this information to recommend a maintenance fertiliser programme. Many farmers in this study interact with Ravensdown staff[119] for product (e.g. urea[120] or maintenance fertiliser) and/or advice (e.g. fertiliser recommendation), and some farmers use Ravensdown to prepare their annual nutrient budget. Tom, Jack, and Paul use alternative fertiliser companies for their maintenance fertiliser (Kiwifertiliser, Probitas and Terracare). Jack does not use Ravensdown, while Tom and Paul obtain urea from Ravensdown. The farmers’ nutrient management policies are detailed in the first results chapter (Chapter Seven). This chapter explores the range of

[117] Fred uses brewers grain, which has a higher protein content and is believed to increases cow urinary N.
[118] Fred read American research articles and his farm consultant told him that brewers grain is bypass protein and the protein either goes into milk production, or weight gain rather than urine.
[119] Ravensdown is a farmer owned fertiliser co-operative.
[120] Urea is a manufactured organic compound. Ravensdown fertiliser company states on their website that urea has the highest quick release N content of any fertiliser in New Zealand.

relationships that informed and influenced a farmer's beliefs and decision making about maintenance and nitrogen fertiliser.

The relationship between the farmers and their fertiliser rep varied. Some farmers using Ravensdown commented that their usual rep was on maternity leave, were unsure who their rep was, or did not have a specific rep. Ken uses '*whoever is there*', and Fred explains *'if we want anything now, we just ring Ravensdown and get it ordered'*. Ian's farm owner, also a family member has been a *'loyal'* customer of Ravensdown for *'over 50 years'*, yet Ian does not have a Ravensdown rep. Other farmers, like Jim, have regular contact with their Ravensdown rep ('*2 or 3 times a year'*), and Steve knew the name of his Ravensdown rep.

The nature of the relationship between Jack, Tom and their respective fertiliser rep is in marked contrast to the other farmers in this study. As described earlier, Jack and Tom use other fertiliser companies ('*not mainstream'*) for their maintenance fertiliser, and chose these companies because they believe the products are more '*natural*' and for their concerns about phosphorous. Jack and Tom described having a personal as well as professional relationship with their fertiliser rep. Jack explains '*he's almost a bit more than a fertiliser guy now, he's like a friend*', and Tom believes '*he looks after us'*. When Tom's rep changed fertiliser companies, Tom also changed company to maintain their relationship. Tom's relationship with his rep provides friendship, family support, and a contact within the community - a community that Tom and family felt excluded from as district newcomers:

> '*Yeah, well he's an older guy, he's 70 now, but he's a mad keen trout fisherman, he's a local trout fisher guru, and he takes the kids for trout fishing, when we're busy in November and all that, when they have the fishing carnival, he'll take the kids out fishing. He's a local fire arms officer, he's got his hands in a lot of pies, and he's just a nice guy, just a good old guy. He treats the kids like his own little grandkids really, doesn't he? We talk mainly about fishing (laughs), and what's going on around the district. Because he knows everyone, we don't do a lot in the district. Because we didn't know anyone when we came down here, I suppose we found it reasonably hard to break into the little groups that are around here*.'

> *Jack's and Tom's stories indicate the different nature of their relationship with their reps, based on friendship and support (care). Trust was built.*

Relationships that influence farmer decisions around nitrogen use

As outlined in the previous results chapter, almost all farmers in this study changed their nitrogen policy in some way. These changes were for both management and water quality reasons. Using sharemilker Steve's story as an example, this section illustrates how a diverse range of relationships can inform and influence a farmer's beliefs and decisions around nitrogen use. Steve was influenced by his relationship with a farm systems consultant, other farmers, the farm's owner, friends, and a fertiliser rep.

The amount of urea applied on the farm owned by Owen is jointly decided by Steve (50:50 sharemilker) and Owen, with each contributing one half of the urea cost. Steve wants to apply less urea, but feels '*strongly influenced'* by their farm consultant's opinions that '*urea is a cheap form of supplement'* compared with palm kernel and maize. Steve described their farm consultant (also a vet) as a '*very good consultant*' and '*an expert in cow condition*'; found the information he provides '*very useful'*; and used the consultant's knowledge around pasture plant leaf stages as a '*major tool'* in his pasture management.

Steve talked with other farmers. They told him '*urea wasn't really working'* for them, and these farmers found the same pasture growth results on their farms, over time, with or without urea. Steve discussed urea with a close family friend and lifestyle farmer, and he told Steve about the different fertiliser ideas he is trialling. This conversation raised Steve's interest and encouraged him to contact the alternative fertiliser rep his friend uses. Steve believes this fertiliser rep is a soil scientist and his ideas are based on science ('*it's not some made up thing from whatever*'). After talking with the rep, Steve believes urea can negatively impact on worms ('*he reckons that a lot of the urea actually kills the worms'*), and the rep's comments confirmed Steve's belief that urea is a drug: '*he's saying the plant actually almost becomes addicted to it, and they actually become reliant on it'.*

Steve described the dilemma he faces. He would like to implement the fertiliser rep's ideas (using humus granules) which will reduce urea use, and thinks reducing urea will be beneficial for him ('*make more money'*, '*more time for family')*, and for water quality ('*lower nitrogen leaching')*. But, the farm consultant is encouraging urea use because of the economic benefits for the farm. Steve's trying to be proactive because he thinks farmers may be prevented from applying urea in the future, and if he reduces urea, then he believes he will have options ('*alternative strategy for grass growth*') with less impact on his business. Steve's hoping to use the new rep in the future and slowly change urea policy, but he's aware that his farm consultant's and new fertiliser rep's '*views may conflict'*. Steve has not discussed his new ideas with Owen, the farm's owner.

Steve used his bonding (other farmers, farm owner) and bridging (fert rep, farm consultant) social capital to obtain information about urea. Steve trusts the individuals he interacted with, through a perception of competency (knowledge) and care (interested in him and his farm). However, Steve received conflicting information from two of his trusted advisors. Steve is yet to talk about an alternative urea use policy with the farm owner and farm consultant, whose opinions about urea use differ from his own.

Farmers and members of the public

The farmers in this study believe the members of the public do not trust dairy farmers to look after water quality. These farmers believe the public's lack of trust in dairy farmers is influenced by their understanding of dairy farming, their beliefs about dairy farmers, and the media's negative portrayal of dairy farming and dairy farmers in relation to their impact on water quality.

These stories suggest a perceived lack of social trust in dairy farmers.

Some farmers believe the public has a poor or limited understanding of dairy farming and of dairy farm practices. Tom and family interact with many non-farmers through motocross, and he shares his experiences:

> *'From the people that we know, they don't have any idea. People can't work out how come you have to shoot back home to milk, why can't you just milk them tomorrow? Or, why don't you just have a weekend off and milk them when you get back? They don't understand that you've got to milk twice a day, or morning and night or whatever it is, they don't understand that it's got to be done, you can't just not do it'.*

Other farmers described how they believe dairy farmers are perceived by the public. These farmers believe the public think dairy farmers are '*rich*', '*greedy*' ('*they think we'll do anything to make money'* – Jack*),* and they are '*polluters*'. Max believes the public think farmers complain ('*Oh those bloody farmers*'), and Jack explains that when farmers raised their concerns about the POP, '*the general public think the farmers are bitching again, this is just the farmers, blinkers on'.* Paul shares his beliefs about the public's perception of dairy farmers:

> '*All people think that dairy farmers are greedy, they're just out to make money out of every scrap of land they can, and put cows on it and milk cows, pollute the environment, grab all the money for themselves*'.

The farmers in this study believe the public learn about dairy farming and about dairy farming's impact on water quality through the media. There was unanimous agreement that the media only portray negative stories about dairy farming and water quality, and Steve thinks these stories can be highly emotive and sensationalised: '*bad news sells fast doesn't it?)*. Some farmers recalled the negative stories they had seen, read or heard about via television ('*Once a week you turn on the TV and it's all about dirty dairy farmers*' – Jack), radio, magazine articles, newspapers and social media. Ken remembered Mike Joy[121] blaming dairy farmers for poor water quality: ('*[Mike Joy] was on TV the other night, it shows you all these cows, thousands of them walking down raceways and pooping everywhere'*), and Roy remembered John Campbell's[122] television article on '*dirty farmers'*. Fred recalled the negative comments he's read about dairy farmers on social media:

> 'Y*ou read online all the time there's an article done about someone, it was about the payout being down, and how hard it's going to be. Then there's all the comments below it, from all the city people, badmouthing farmers, like well the environment and that, and everything else'*.

Some farmers are frustrated that the media only reports poor farm practice. Tom thinks '*the media only seems to write and report on the negatives'* and he thinks the media should write about *'how 98 per cent of Fonterra farmers are good, and everything with stock around their waterways'*. Stu is concerned the public believe all dairy farmers use poor practice, and he claims:

> *'Everyone's only got the media's impression of things. I don't think it's accurate. Any information is presented out of context*'.

Other farmers believe the public form opinions about dairy farming from what they see. Jack is concerned about what the public may see from the road, and as a Federated Farmers' representative, he stopped and talked with a farmer about his effluent application practice in a roadside paddock: '*just making people have it in the forefront of their mind that this is going to be a bad look if I cock up'.* Jim has roadside frontage, and is concerned about the '*bloody dangerous'* public perception, and the public's lack of knowledge and understanding about dairy farming:

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[121] Mike Joy is a freshwater ecologist and a Massey University senior lecturer. He is publicly outspoken about the impact of intensive dairying on water quality.

[122] John Campbell is a well-recognised TV and radio journalist and presenter, supported by the public (a public outcry and 80,000 signature petition after his TV programme was cancelled), and the recipient of several journalistic awards for investigative current affairs.

'*The public drive down a road, and they think they understand farming, and they think they have a right to comment, and they think they have a right to have input into what happens on a farm. No, they don't understand at all*.'

Individuals who '*talk the talk'*

Some farmers and key informants in this study spoke about a DairyNZ head office staff member and a Fonterra Area Manager, and described their relationships with farmers. These individuals facilitated the flow of information, knowledge, advice, support and resources around dairy farming and water quality. In addition, their actions positively influenced the relationships between farmers and other organisations and groups.

Some farmers and key informants spoke highly of a DairyNZ head office staff member. Among other roles, this individual advised and supported the TCEIS, presented water quality information, informed farmers about water quality at farmer meetings, and worked with Horizons' staff to help them understand the community's and farmers' issues and concerns. The first results chapter (Chapter Seven) described the ways this individual worked with the TCEIS, Horizons' staff and others during the POP and implementation stage of the One Plan. Some farmers and staff interviewed described his calibre in a general way ('*really, really neat guy',* '*exceptional*'), and farmers described his empathy and farm knowledge ('*he's a farmer' 'the practical implications and how it [One Plan] will work on farm*'), his communication ('*he spoke in single syllables',* '*simple language for farmers'*) and his honesty. Jim heard this individual speak at a meeting, learnt how long it takes for the impact of mitigation strategies on water quality to be seen, and he shares his impressions:

'*He was actually exceptional…He spoke from the heart, he spoke in single syllables, no bullshit, no hidden agenda, he spoke how it was. He wasn't kowtowing to - he wasn't selling a lie, he said how it was, and what he said was backed by science, and backed by fact, not opinion*.'

Pete (Fonterra) shared his experiences, and describes the way that this individual builds relationships with farmers:

He's excellent because he adds value, he comes to meetings when he can, he talks the talk and it makes sense and farmers get confidence and he's very knowledgeable.'

These stories indicate competency around dairy farming ('he's a farmer') and water quality ('backed by science'), and care ('how it will work'). Trust was built.

One of the Fonterra Area Managers works with farmers from targeted WMZ. He is a farmer supporter and source of One Plan information and knowledge for the targeted farmers in this study. Among other roles, this Area Manager supported farmers in the POP meetings, supported the TCEIS, and attends (and organises some of) the farmer One Plan information meetings. Among others, this individual interacts with head office and regional DairyNZ staff, Horizons' staff and councillors, the TCEIS leaders, Fonterra staff, nutrient management consultants, fertiliser reps and talks with the elected Federated Farmers' representatives in his area.

This individual works with farmers. He personally contacts farmers and makes them feel included: '*I get emails to say there are meetings on, come along*' (Fred) and '*He said, "I'm doing some things on it [One Plan], I'll put you in the mix now and come and see you'* (Owen). The farmers who interacted with this Area Manager described him generally (*'a brilliant guy'* - Max), Fred thinks he's '*very helpful'* and *'always very friendly',* and Roy thinks he's not self-centred - *'he doesn't talk about himself, that's always important'.* He is knowledgeable about the One Plan ('*he's very involved with it'* – Owen, and, *'he knows his stuff'* – Roy), and the farmers feel he supports them - '*He'll ring you up and ask you how you're going'* (Steve). He is available and contactable: '*I left a message and he rang me back last night*' (Owen), and '*he rings you, he answers his phone, if I left a message on his phone he answered it back no worries'* (Roy). Owen also thinks '*he's easy for me to relate to',* and he does not disrespect Owen's ideas ('*he doesn't think I'm a nutter*'). Steve likes the way '*He'll find out stuff for you'.*

> *These stories indicate competency (dairy farming and One Plan knowledge), care (support), commitment (treating farmers fairly) and predictability ('returns calls'). Trust was built.*

This Fonterra Area Manager is a key source of information about farming and water quality for Steve, Owen and Fred. If Steve wanted to find out about farming and water quality, he would ring this individual. When Owen wanted to know more about Land Use Consents, he talked to this individual. Fred contacted this individual during the One Plan Consent process, because he could not understand how the radical changes to his farm system suggested by the nutrient management consultant would not significantly drop the farm's modelled annual N loss. Fred's story highlights the nature of his relationship with this individual and how this relationship informed and influenced Fred's decisions:

'*Personally, I like [Area Manager], I've been in contact with him during the One Plan consent, and he was very helpful. He was instrumental in pushing to find out why - to help answer some of my questions of why we were so high [N loss] and everything*.'

Conclusion

Farmers are different individuals with different values and beliefs about water and water quality. The farmers in this study believe they have a responsibility of environmental care for current and future generations. Even though farmers are different, all farmers except one in this research agreed that water quality has declined, and that dairy farming has contributed to the decline.

Farmers also have different social networks, form relationships with different individuals, and interact with a wide range of individuals through their social networks. These social interactions provided access to information and resources, emotional support, and a way for farmers to exchange knowledge (social learning) and share their experiences with others. The farmers in this research interacted at organised farmer events (e.g. meetings, field days) and at informal occasions (e.g. at sports events, social events).

In this research, all farmers interacted with other farmers, and their decision making and responses to interventions were shaped by these interactions. Another farmer's beliefs and experiences shaped their own beliefs about new mitigation strategies (practices around farming and water quality) and the impact of the One Plan on their farm businesses. Through social interactions, the farmers also shared knowledge about what are considered the accepted practices around farming and water quality ('best' practice). The farmers agreed on what are accepted practices (e.g. stream fencing, no effluent in waterways), and that 'good farmers' use these accepted practices. The farmers in this research felt angry and disappointed when another farmer's actions challenged their reputation as 'good farmers' who care for water. If a farmer saw a practice they considered unaccepted ('poor' practice), they might take direct action and talk to the farmer, talk to others about the farmers' actions, or take no action. Farmers would be very unlikely to 'dob in' another farmer, or ring and report their actions to the authorities. The nature of a farmer's relationship with other farmers in their community influenced the actions a farmer may take.

The farmers also gained information from and exchanged knowledge with the staff or advisers they trust, for example, a farm consultant, Fonterra Area Manager, DairyNZ head office staff member, and fertiliser representative. However, not all social interactions between farmers and others were based on trust and respect. The POP process reduced trust between Horizons and farmers, and this reduced trust influenced whether farmers used and believed information from Horizons. The current relationship between farmers and Horizons has improved, based on a perceived change in approach towards farmers by Horizons. Through this range of social interactions, farmers learnt about the character of individuals (their personal qualities) and the trustworthiness (whether they are worthy of trust) of individuals and organisations.

This chapter concludes the results from this research and illustrates how dairy farmers' responses to water quality interventions were shaped by their relationships with others. In the next chapter, the key findings from the two results chapters are considered in relation to the research questions and the literature.

Chapter Nine
Discussion

Introduction

This chapter returns to the research questions: *How and why have New Zealand dairy farmers responded to water quality interventions?,* and, '*What role did social capital play in shaping dairy farmers' responses?* This chapter discusses dairy farmers' responses to water quality interventions, and the socio-cultural dynamics that shaped these responses.

A single-case study research strategy was used to explore dairy farmers' responses to water quality interventions in the Manawatu-Wanganui Region of New Zealand. The specifics of this case are initially presented, and these characteristics provide context from which the research findings can be compared with other empirical research. Transition theory is drawn on at this point in the discussion, to capture the shift in the New Zealand public's expectations about agriculture's impact on the environment; a shift that contributed to the introduction of water quality interventions. The dairy farmers in this case responded as individuals and collectively to water quality interventions. The next section presents the multi-dimensional nature of dairy farmers' responses to interventions, before exploring dairy farmers' collective responses and the socio-cultural dynamics that shaped this collective response in more detail. The final section in this chapter explores dairy farmers' individual responses, and the diversity evident among the different dairy farmers in this case. The chapter concludes by examining how networks, trust and norms influenced individual dairy farmer's responses to water quality interventions.

The specifics of the case

The specifics of this case provide a context from which dairy farmers' responses can be interpreted and compared with other studies. This case is an example of farmers' responses to a suite of environmental policy mechanisms, or the voluntary, economic, regulatory and educational water quality interventions successively introduced by government and the dairy industry. These policy mechanisms were introduced at a time when the New Zealand public's expectations of the impact of agriculture on the environment were changing. As such, dairy farmers' responses to interventions were responses not only to these specific interventions, but to the broader shift that was occurring in agriculture. A gradual shift in the public's expectations in this case is consistent with aspects of Rotmans and Loorbach's (2010) definition of a transition.

This case is also an example of dairy farmers' responses to a change in approach by a regional council to water management in New Zealand. Horizons was the first regional council to introduce regulation to control land use practices for water management purposes in a non-lake environment (One Plan operative 2014). Regulation over farm practices is a relatively new phenomenon for water quality management in New Zealand. Chapters Seven and Eight described the farmers' unfamiliarity with, and subsequent focus on the regulatory intervention (the One Plan). Although the other interventions also influenced farmers' responses, the regulatory intervention dominated their narratives in relation to water quality. In contrast, European farmers in some areas have farmed under regulatory controls over land use for water quality purposes for over 25 years (since 1991).

The interventions in this case focus on water quality, or more specifically, mitigating non-point source discharges from agricultural sources to freshwater. The interventions in this case use a non-prescriptive output-based approach (predictive modelling of outputs), which differs from the prescriptive inputs-based approach used in the EU (e.g. Nitrates Directive). In contrast to other farmer response studies, a suite of interventions were applied in this case to enforce and encourage farmer behaviour change, namely, regulatory, voluntary, economic and educational interventions. The regulatory intervention in this case (the One Plan) takes a targeted approach to water management, which is similar to the European Nitrate Vulnerable Zone (NVZ) regulations that take a targeted regulatory approach to water quality issues (Osborn & Cook, 1997). The voluntary intervention in this case is industry-led, which differs from the government instigated voluntary schemes in other countries (e.g. Landcare, AES). The interventions in this case were targeted at individual farmers rather than using a farmer group-based approach, which differs from the voluntary Australian Landcare Programme and European collective AES.

An important contextual difference between this case and other countries, is that New Zealand farmers (including dairy farmers) do not receive production subsidies and have not done so since 1984. The economic intervention in this case was a regional government subsidy to part-cover the cost of waterway fencing materials and was not a production subsidy. In contrast, European AES offer de-coupled payments to encourage farmers to adopt practices with positive environmental outcomes (European Commission, 2017). In some cases, these agri-environment payments constitute a considerable component of some European farmers' total farm business income (Winter et al., 2016).

This research extends our understanding of how and why New Zealand dairy farmers responded to environmental policy interventions and the implementation of these interventions. This case study explores a historical and contemporary perspective of the issue. It takes both a snapshot (a picture of what is now) and a retrospective view (what happened in the past) of farmers' responses, and reports farmers' recollections of how they remember change over time. Other than Hall and Pretty (2008), who took a retrospective view of a change in relationship between government and farmers, the majority of empirical research reports on farmers' responses at one point in time ('a snapshot') and does not explore the history leading to the current situation. This research uses social capital theory (networks, trust and norms) to explore the socio-cultural dynamics that shaped farmers' responses. Other farmer social capital studies have tended to investigate how one or two of these theoretical elements influence farmer response (e.g. Compton & Beeton, 2012; Fisher, 2013), but little work has investigated the three components of social capital. The historical socio-cultural context of this case will be presented in the following section.

Historical socio-cultural context of the case

Dairy farmers' responses to interventions in this case were significantly shaped by the historical socio-cultural context, as outlined in Chapter Five, within which these water quality interventions were introduced. Dairy farmers' responses to water quality interventions were responses not only to the interventions, but to the broader shift (transition) that was occurring in agriculture. Transition theory is useful in this research to help capture and illustrate the long-term gradual change in the New Zealand public's expectations about agriculture's impact on the environment. Drawing on transition theory, a transition is a gradual shift or a transformative change from a current system (or regime) to another more sustainable system (Rotmans & Loorbach, 2010; Van der Brugge et al., 2005).

A shift or re-negotiation in relationship between some actors and dairy farmers was evident from the farmers and key informants' narratives. Multiple actors with different values and expectations are involved in transitions, and Chapter Six identified these actors and their respective roles around dairy farming and water quality. A shift in relationship between multiple actors is another key aspect of transitions (Van der Brugge et al., 2005). A change in relationship between farmers, and who they termed 'the public', was evident from the farmers' opinions that social trust in farmers to manage water quality for the benefit of others has declined. This gradual shift in social trust and in the New Zealand public's expectations, this research argues, is changing the nature of relationships between farmers, regional councils, government and industry organisations in the management of water. As described in Chapters Five and Six, farmers had historically interacted with regional government around voluntary schemes and environmental grants for on-farm work (e.g. soil conservation), but not around the regulation of on-farm practices. Consistent with Rotmans and Loorbach's (2010) definition of a transition, the gradual shift in the public's expectations identified in this research contributed to a change in structure (e.g. rules and regulations), dairy farm practices (behaviour) and social norms, and more specifically, to a change in practice norms. Social norms were identified as reflective of the culture of the farmers interviewed and their broader group. The farmers in this case responded not only to each successive intervention (a change in structure), but also to a change in social norms as a consequence of a shift in the public's expectations around agriculture's impact on the environment, and a change in the relationship between farmers and other actors, including regional councils.

After presenting the specifics of this case, the next section introduces the multi-dimensional nature of dairy farmers' responses to the suite of water quality interventions that were applied in this case. This section describes the multi-dimensional nature of response, presents the forms of social capital that shaped dairy farmers' responses, and introduces the socio-cultural dynamics including the social norms identified in this case.

The multi-dimensional nature of dairy farmers' responses to water quality interventions

This research emphasises the *multi-dimensional* nature of farmers' responses to water quality interventions, and, to changes in farmers' responses over time. 'Response' is not considered in this research to be uni-dimensional (a change in individual farmer behaviour), but a *multi-dimensional* phenomenon that encapsulates farmers' individual and collective responses. As illustrated in Chapters Seven and Eight, the farmers in this case responded to water quality interventions as individuals and collectively. The farmers in this case responded as individuals to a single intervention (e.g. regulatory One Plan, voluntary industry accord), to the other interventions linked to that single intervention (e.g. economic fencing subsidies, education), and to the broader shift in the New Zealand public's expectations around the impact of dairy farming on water quality. In addition, farmers' individual responses were linked and interwoven with the collective response of farmers, whereby farmers' individual responses influenced a collective response (and vice versa). Farmers' collective responses were evidenced by a general shift over time in the farming community's acceptance of interventions and farm practice change. Evidence of the inter-woven links between individual and collective response in this case, supports Blackstock et al.'s (2010) contention that an individual farmer's behaviour is shaped by the social and cultural context within which their decisions and actions are made; a point also argued by Burton (2004a). Burton's (2004b) empirical research linked the variable uptake of European agri-environment schemes (individual behaviour) with farmers' social construction of what was considered to be a 'good farmer'. The farmers in this research described what it meant to be a 'good farmer' in relation to water quality and the practice norms associated with this. The social conceptualisation of a 'good farmer' in this research, similarly to Burton's (2004b) research with English farmers, was found to influence an individual farmer's responses.

The forms of social capital

Social capital was shown to play an important role in shaping farmers' individual and collective responses to the water quality interventions in this case. Returning to social capital theory, bonding social capital is created between individuals with a shared social identity (Putnam, 2000). As highlighted in Chapter Eight, bonding social capital was evident through farmers' relationships with other farmers, family, friends, and the TCEIS farmer leaders. Bridging social capital is created through the weaker relationships between individuals from different social identities, networks or groups (Putnam, 2000). In this case, bridging social capital was evident between farmers and staff from organisations (e.g. DairyNZ) and other individuals (e.g. consultants, company representatives, accountants). Linking social capital is created though interactions occurring across a power or authority gradient (Szreter & Woolcock, 2004), and in this case, linking social capital was evident between farmers and staff from Fonterra, Federated Farmers and Horizons. Farmers' interactions with Fonterra can be described as linking due to the level of authority farmers believe the milk company has over their decisions around farming and water quality. Farmers' interactions with Federated Farmers can also be described as linking, because this organisation represents farmer interests in policy decision making. In unpublished research, Fisher (2012) similarly identified UK farmers' interactions with the National Farmers Union (membership organisation representing farmers) as linking. Based on this three-way theoretical conceptualisation of social capital, the social interactions between farmers and others in this case will be defined as bonding, bridging or linking. To provide context for later discussion, the socio-cultural dynamics, and in particular the unwritten socio-cultural 'rules' (social norms) that shaped farmers' responses, will now be introduced.

Socio-cultural dynamics

The socio-cultural dynamics that shaped dairy farmers' individual and collective responses to water quality interventions were identified in Chapters Seven and Eight. As identified in these chapters, farmers' responses to water quality interventions were influenced by: their past and current social interactions through social networks; the level of trust in these interactions; the 'unwritten' socio-cultural 'rules' that shaped individual and collective farmer behaviour; and the social conceptualisation of being a 'good farmer'. The unwritten socio-cultural rules in this case are similar to what Minato et al. (2010) identified as social norms. Networks, trust and norms are the theorised elements of Putnam's (1995, 2000) social capital theory. These three elements, and the connections between, are explored in detail in this research. Other than Hall and Pretty (2008) and Sobel et al's (2001) research, relatively few studies have explored the influence of the three elements of social capital, and the connections between them, on farmers' response to interventions. While Fisher (2013) and Compton and Beeton (2012) considered networks and trust with little attention to social norms, Minato et al. (2010) investigated social norms, paid less attention to networks, and gave little consideration to trust in relation to farmers' response to interventions. In addition, with the exception of Minato et al. (2010) and Hall and Pretty (2008), farmer response studies have not fully explored the role of social norms in particular farming contexts, and, how social norms influence farmers' responses to environmental policy interventions.

Through social interactions built on trust, the farmers in this case discussed farm practices and shared farm specific knowledge about the 'good dairy farm management practices' that are carried out by 'good farmers'. What constitutes a 'good farmer' identity is one component of what Burton (2004a, p.360) described as the 'cultural turn', or a focus on understanding 'language, meaning, representation, identity, and difference'. Understanding what is considered to be 'best' or 'good' practice (practice norms), was found to be central to understanding how the socio-cultural dynamics influence farmers' responses to interventions; a point also raised by Blackstock et al. (2010).

Social norms – the unwritten socio-cultural rules

Some of the cultural, personal, and practice norms that can influence farmers' responses to interventions were evident from the farmers' narratives in Chapters Seven and Eight. These social norms created a collective expectation about how individuals will behave, and these behavioural expectations, or what Eggertsson (2001) described as reflections of society's beliefs about behaviour, influenced individual and collective farmer responses. Minato et al. (2010) also identified cultural (e.g. around relationships and 'being a good neighbour'), personal (e.g. the 'look' of the land) and practice norms (e.g. weed control) in their study of the social norms that operated within an Australian rural community. As with this research, Minato et al. (2010) identified a collective expectation of behaviour that acted to influence individual and collective farmer behaviour. Although the norms identified in Minato et al.'s (2010) research were centred upon a voluntary intervention (Landcare group), the results from this research suggest that irrespective of the intervention type, the social norms that are fostered through social networks influence individual and collective farmer behaviour.

As illustrated through the farmers' narratives, cultural norms as to the rights associated with private property ownership, being a good neighbour, social responsibility, relationships, and an individual's right to fairness and equity were identified. The cultural norms in this research were identified as reflecting the farming culture of the farmers interviewed and the broader group to which they belong. These cultural norms emerged as important in shaping farmers' individual and collective responses to water quality interventions. The cultural norms associated with private property ownership in this case embody the right of farmers to be autonomous, and to make farm management decisions on their farm without interference and control from others ('mind your own business'). The farmers' narratives reflect a social meaning of private land ownership, and the farmers in this research generally did not question another farmer's individual rights and farm management decision making. Furthermore, the farmers in this research resisted regulation that they considered challenged their individual rights and their cultural norms associated with private property ownership. Cultural norms associated with private property and individual rights, a reluctance to question others' decisions, and a resentment of the legislation that challenges this norm were similarly identified by Minato (2011) in her unpublished research. The cultural norms associated with private property ownership identified in this research and by Minato (2011), reflect what Burton (2004a) referred to as a social meaning of private property ownership, and a part of what he also referred to as farming culture.

The cultural norms identified in this research that are associated with being a good neighbour and social responsibility, such as volunteering, are consistent with what Putnam (2000) identified to be a norm of reciprocity. While volunteering was identified as a norm of reciprocity in this case and in Minato's (2011) unpublished research, Sobel et al.'s (2001) study identified the norms of reciprocity as the expectations that group members would work together on land management projects for the benefit of others. The norms of reciprocity, or 'doing good for others' (Putnam, 2000) did not directly influence land management practices in this case, but were pivotal to building respect and trust, and in encouraging community cohesion and cooperation.

The broader cultural norms identified in this case, over-arched and influenced practice and personal norms. Practice norms were identified by the farmers in Chapters Seven and Eight as the accepted and expected farm management practices around farming and water quality. Personal (or internalised) norms around the stewardship of land and water were also identified in this case. Internalised norms are sometimes termed values in the literature (Hechter & Opp, 2001), and the farmers described their personal values and responsibility around taking care of water for current and future generations in Chapter Eight. These personal norms reflect a sense of responsibility for what is in their care, which suggests a belief that taking care of water is the 'right' thing to do. In addition, the farmers described 'good farmers' as those who demonstrate stewardship for land and water. Similar personal norms that reflect a personal ethic of care and responsibility were identified by Minato (2011) in her unpublished research.

After introducing the multi-dimensional nature of farmers' responses, and the socio-cultural dynamics that shaped farmers' responses, the next section explores farmers' collective responses in more depth. This section also explores how social interactions through social networks, trust, norms, and farmer identity influenced the collective responses of farmers to water quality interventions.

Dairy farmers' collective responses to water quality interventions

This research identified a myriad of dairy farmers' collective responses to water quality interventions, and importantly, a change in collective response over time. In addition, this research highlighted how farmers' collective responses were shaped by the socio-cultural dynamics identified in this case: social interactions through social networks, the dynamics of trust, socio-cultural rules, and farmer identity (being a 'good farmer'). This research interprets 'collective' to be how dairy farmers collectively responded to water quality interventions. This interpretation differs from other farmer response studies that tend to interpret collective to be collective action, whereby interventions are driven though a farmer group process, for example, collective AES (Emery & Franks, 2012; Mills et al., 2011) and Landcare groups (Cary & Webb, 2000; Sobels et al., 2001). In addition, this research explored responses to interventions that targeted individual farmers, and the collective responses that resulted from this individual focus; something not previously reported in the literature in relation to farmers' responses to water quality interventions.

This research identified a broader collective change in what farmers consider to be the accepted farm management practices around farming and water quality, and a change in what constitutes 'good' dairy farming in relation to water quality. These broader changes influenced farmers' individual and collective responses to the notification of the regulatory intervention (POP), and several stages of collective response were evident over time. An initial and general farmer resistance to the POP contributed to the formation of a farmer-led collective action group. The actions of this group contributed to the re-negotiation of relationships between the regulator and farmers, and farmer acceptance of controls over land use activities (by almost all dairy farmers interviewed in this case). This research identified a change in the social norms that reflect the farming culture of the farmers interviewed and their broader group. The research also identified how social capital among the dairy farming community contributed to this process of collective change. Farmer networks facilitated information exchange and social learning, and ultimately, a change in the social norms that govern both the behaviour of farmers and the individuals, such as regional council staff, who interact with farmers in rural communities.

Importantly, this research identified how both historical (the past) and current interactions between farmers and others, shaped farmers' individual and collective responses to interventions. The farmers' narratives highlighted a loss of trust and respect between themselves, the regional council as an entity and with some regional council staff, which in turn, influenced whether in some instances these farmers sought advice on farming and water quality, and in other instances, whether they applied for a fencing material subsidy (economic intervention). Hall and Pretty (2008) also identified increasing mutual distrust and professional disrespect between UK farmers and government over time (past 40 or 50 years) and described these changes as 'significant'. Their work similarly identified how the changing relationships between farmers and government at times influenced where farmers sought advice and information, and they also identified an adverse effect on farmers' transition to more sustainable land management practices. The increasing social distance identified by Hall and Pretty (2008) between UK farmers and government was also evident in this research between some farmers and regional council staff. However, farmer 'buy-out', or the farmers 'deeply internalised hostility to the government's governance of agricultural and rural policies' identified by Hall and Pretty (2008, p.409) was not evident in this research. The evidence from this research suggests that a change in the level of trust and respect between government and farmers over time can have more influence over farmers' responses than the specific type of policy intervention introduced.

Resistance was identified in this research as a collective response of farmers to the introduction of a regulatory intervention. In addition, this phenomenon of a collective farmer resistance influenced how farmers responded collectively and as individual farmers. In contrast, other empirical research identifies resistance as the response of an individual farmer to a single policy intervention (e.g. Barnes et al., 2011; Bartel & Barclay, 2011; Macgregor & Warren, 2006; Mendham et al., 2007; C. Morris & Potter, 1995). These studies pay no attention to the phenomenon of collective resistance, or the influence of a collective of farmers over an individual's resistance to an intervention. Burton and colleagues (e.g. Burton et al., 2008; Burton & Paragahawewa, 2011) explored farmers' cultural resistance to voluntary AES. They contended that farmers may resist interventions they believe do not allow them to demonstrate what is considered to be conventional 'good farming' practice, or, a loss of their conventional 'good farmer' identity. Burton and colleagues' (Burton et al., 2008; Burton & Paragahawewa, 2011) phenomenon of cultural resistance is similar to the collective resistance identified in this research. This research extends our understanding of farmer resistance to be a collective rather than an individual phenomenon, that collective resistance can influence farmers individual and collective responses to policy interventions, and that regardless of the intervention type (e.g. voluntary, regulatory, economic), farmers' aversion to external intervention in farming contributed to their resistance to environmental policy interventions.

After introducing farmers' collective responses, the broader collective change in what farmers consider to be the accepted farm management practices around farming and water quality will be examined in more detail. In addition, the influence of social interactions through social networks, trust, and social norms on this broader collective change will be explored.

A collective farmer agreement on accepted practice

This research highlighted a change in what farmers collectively consider to be the accepted and expected farm management practices around farming and water quality (a change in practice norms). Over time, a gradual change in what farmers consider to be 'best' or 'good' dairy farming was also identified. These changes in practice norms (accepted farm management practices) contributed to individual farmers considering water quality in their farm management decision making, and on-farm practice change. This research argues that changes in practice norms, and changes in farmers' collective agreement of what they consider to be 'best' or 'good' dairy farming, were influenced by the suite of water quality interventions and by the broader shift in the New Zealand public's expectations about farming's impact on the environment. Minato et al. (2010) also identified changing practice norms and highlighted how the social networks that operate within voluntary Landcare groups contributed to existing norms being reinforced and new norms being encouraged to form. However, their research, and other farmer response studies, have not identified a broader shift in the public's expectations about farming's impact on the environment as a contributor to practice norm change.

Trust and social interactions through social networks – social learning

Social interactions through the bonding, bridging and linking social networks identified in this case, enabled farmer access to information, resources and support, and encouraged the exchange of knowledge. Social interactions between individuals in social networks was argued by Reed et al. (2010) to be an example of how social learning occurs. A wide variety of formal (e.g. field days, farmer meetings) and informal social interactions (e.g. dialogue between farmers, between farmers and others) were illustrated in the farmers narratives (Chapters Seven and Eight), and these interactions enabled social learning to occur. The social learning that occurred through farmers' bonding, bridging and linking relationships was strongly linked to the level of trust that existed in these relationships. The level of trust in these relationships was related to the factors identified by Kasperson et al. (1992) that can cultivate trust: care (e.g. for farmers), competency (e.g. practical farm knowledge), commitment (e.g. farmers being treated fairly) and predictability. The level of trust was also influenced by longevity, and the perceived level of external control. The factors that influenced the level of trust are illustrated in Figure Nine. The farmers in this case preferred to access information and exchange knowledge with those they trust and respect: other farmers, family, trusted advisors, and trusted staff from organisations. Trust was described by Fisher (2013, p.13) as the 'essential catalyst' that enabled knowledge transfer between UK farmers and their advisors. The catalytic and enabling role of trust identified by Fisher (2013) was also evident in this research. This research extends Fisher's (2013) work, emphasises the importance of understanding the trust-norm dynamic (e.g. norm violations can reduce trust), and how the trust-norm dynamic can influence knowledge transfer between farmers and those they interact with. The farmers' narratives illustrated how interactions between themselves and trusted individuals contributed to a change in individual farmer awareness and understanding of how farm practices can impact on water quality, and to a broader collective change in what is considered accepted and expected farmer behaviour around farming and water quality. In contrast, relationships based on distrust resulted in disbelief of, and at times, a challenge of the information provided.

This key relationship between trust, social learning and an individual's change in farm management practice is illustrated in Figure Nine. As this figure illustrates, interactions with trusted individuals through social networks enabled social learning to occur, and social learning contributed to a change in individual understanding and a change in farm management practice. Social interactions also enabled farmers and others to challenge and criticise current practice, and these discussions contributed to a broader collective change in what is considered accepted practice, fostered the adoption of 'good' practices, and enabled the sanctioning of practice norm violations. Sanctions in turn reinforced what is considered 'good' management practice, which also contributed to a change in farm management practice (as will be illustrated in Figure Ten). Figures Nine and Ten illustrate the social dynamics of farm management practice change, whereby, practice change is identified as a social process of exchanging information and knowledge, questioning, challenging current practice and reinforcing what is considered accepted practice around farming and water quality.

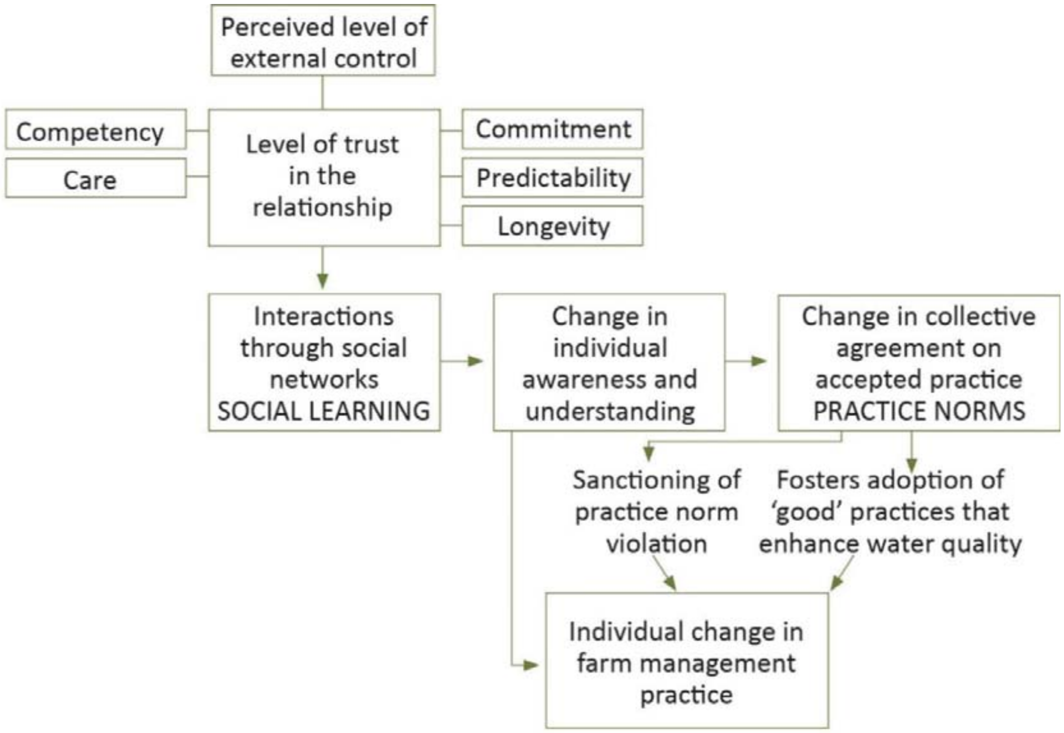

Figure 9: The relationship between trust, social interactions, a change in collective agreement and individual change in farm management practice.

A change in farmer awareness and understanding of nitrogen (N) leaching, and the management practices that affect this, was identified in this research. Social learning through social networks contributed to a change in farmer awareness and recall of information about N loss, and, a change in farmers' deep understanding about the impact of N loss on water quality. The farmers could describe N loss through leaching, for example, factors contributing to N loss, the range of water quality interventions, and how they operated. In addition, over time the farmers developed varying degrees of understanding of the technical details of nutrient leaching, for example, the impact of specific farm practices on increased N loss, and could link the impact of these farm practices and increased N loss on water quality. The specific requirements of a water quality intervention (e.g. record keeping for Fonterra's Dairy Diary), and the associated social interactions that occurred (e.g. discussing the Dairy Diary with the QCONZ farm inspector, Fonterra Area Manager, other farmers) enabled social learning to occur. These findings illustrate that over time, collective social learning was central to individual farmers' increased awareness and deep understanding of N loss. A study by Mills et al. (2011), also found social learning among the farmer members of a collective AES group contributed to individual farmer understanding about the sustainable management of their land.

Of particular interest in this case, is the influence of targeted regulation on farmer understanding and farmer decision making about N loss. The social learning that occurred during the Land Use Consent process contributed to targeted farmers' understanding of N loss. The targeted farmers who have been through the Land Use Consent process had a more in-depth understanding of N loss, than those without a Land Use Consent. These targeted farmers understood how their current farm practices contributed to their farm's N loss, and could quantify (kgN/ha/yr) how a specific farm management decision could increase or decrease N loss and impact on water quality. When choosing the combination of mitigation strategies for their Land Use Consent, these farmers made a pragmatic farm management decision based on the potential impact of changing practice on their current farm system and impact on water quality. Although many of the other farmers could describe the factors influencing N loss from their farms, they could not describe the impact of specific farm practices on water quality in the same level of detail. Any other differences in understanding between targeted and non-targeted farmers appear to be individual-specific. Although the non-targeted farmers generally had a lower level of understanding of the impact of farm practices on water quality, one non-targeted farmer in this case had a better understanding of N loss and farm practices than some farmers targeted by regulation. Other studies investigating farmers' responses to targeted regulation for water quality purposes (European NVZ regulations) do not compare differences in understanding and behaviour between farmers who are targeted and not targeted by regulation (Barnes et al., 2009; Macgregor & Warren, 2006, 2016). While Macgregor and Warren (2016) did find that targeted regulation had influenced some farmers' attitudes towards regulation, this research demonstrated how targeted regulation can influence farmer understanding through the social learning that occurred with trusted individuals as a consequence of the consent process, and how this change in understanding can contribute to a change in behaviour.

It can also be argued that the broader change in this case is related to farmers having a freedom to choose the mitigation strategies that suit their current farm system, and as such, being able to demonstrate their knowledge and consideration of water quality. The non-prescriptive nature of the water quality interventions in this case contributed to a change in practice norms. These findings in part support Burton et al.'s (2008) argument for farmers' cultural resistance to policy interventions. They argued that European farmers resisted prescriptive agri-environment schemes because these schemes limited their opportunities to demonstrate their conventional farming skills. However, this research contends that farmers resisted a regulatory intervention that challenged their personal stewardship or care for water and land.

The farmers' narratives highlighted examples of a collective change in what farmers consider to be accepted N loss ('best' farm practice). Some farmers (both with and without a consent), key informants and other individuals who work in the agricultural sector, assigned value to N loss levels (high or low, 'good' or 'bad'). Some of these farmers also used N loss levels to compare individual farm systems ('good' or 'bad') and to question and criticise current farm practices. Discussion and agreement about what constitutes accepted N loss, increased farmer confidence to question and criticise current practice, and, contributed to new practice norms being adopted. This finding suggests a collective farmer influence over individual farmer practice change; an influence identified in other studies (Cotching et al., 2009; Mills et al., 2011; Minato et al., 2010). Although the context of these studies (group based voluntary interventions) differed from this case, the identified group characteristics in these studies that contributed to the success of farmer social learning (e.g. existing trust and norms of reciprocity), were also evident and contributed to farmer social learning in this research. Social interactions between group members in these studies, and between farmers and others in this research, contributed to new information being circulated, a sharing of knowledge, and increased farmer confidence to consider, question and at times criticise current farm practice. A collective understanding and questioning of current practice by the farmers in this research contributed to new practice norms being adopted.

A collective farmer agreement - the influence of social norms

This research clearly highlighted the pivotal role of bonding social capital in informally sanctioning practice norm violations, and thereby, reinforcing what is considered accepted farm management practice. In this case, a farmer's right to discuss or criticise another farmers' behaviour was not questioned, and actions taken to enforce norms, using Minato et al.'s (2010) words, were 'not considered to be improper'. The farmers' narratives also illustrated examples of the informal enforcement mechanisms used to sanction norm violations; sanctions that in this research are based on a collective social agreement of what is considered accepted behaviour. This research, as with that of Minato et al. (2010), provides an illustration of social norms and norm sanctioning in rural communities.

A range of farmer responses to practice norm violation were evident from the farmers' narratives in Chapters Seven and Eight and illustrated in Figure Ten. The farmers in this case used their social networks to respond in a number of ways, including: discussions with the farmer involved; discussing the farmer's actions with peers (e.g. gossip); observing over time; contacting a farming organisation or the authorities; a combination of these responses; or taking no action. Although Minato et al. (2010) identified a range of farmer responses to practice norm violation, including direct action (weed control on another landholder's property), direct communication, judgemental gossip and ostracism, their research did not identify farmers who chose not to take action as was evident in this case. Although ostracism was not identified in this case, one farmer was aware ostracism could be a potential consequence of violating the cultural norms associated with autonomy, and reporting practice norm violation to an authority ('dobbing in').

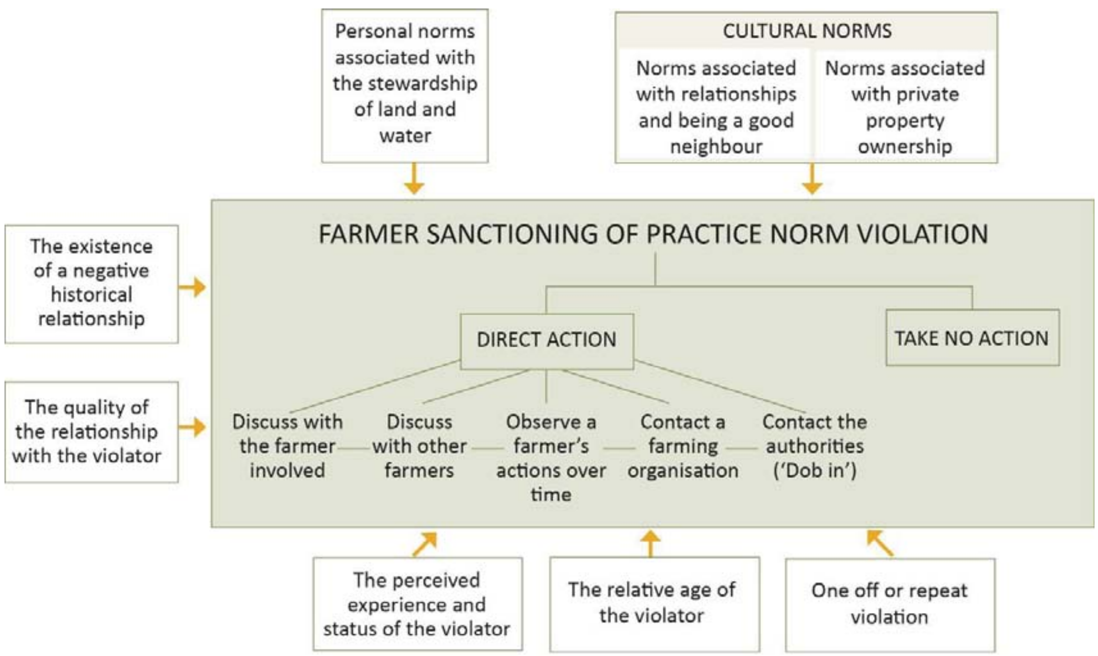

Figure 10: Dairy farmers' responses to practice norm violation and the factors influencing their responses.

Whether a farmer in this case would sanction practice norm violation, and the actions they may take, was influenced by a range of factors. These included: the context or the specifics of the circumstance, including whether it was a one-off or a repeat violation; the quality of the relationship with the person violating the norm; the existence of a historical negative relationship; and the relative age, perceived experience and status of the violator. Farmer action was also influenced in part by other social norms, including: the cultural norms identified in this case associated with being a good neighbour; cultural norms associated with private property ownership; and personal norms associated with the stewardship of land and water. In some instances, a farmer may challenge another farmer about a practice norm violation if they believed it was unlikely to undermine a valued and trusted relationship, or compromise the cultural norms held by farmers (e.g. norms of reciprocity and being a good neighbour). In other instances, concerns about what other farmers might think, and the potential consequences of breaking farmer to farmer trust, could over-ride a farmer's personal values and objections to unaccepted farm practice and prevent farmers talking to another farmer about violations of practice norms. The farmers in this case are aware of how 'poor' farm practices are perceived by those external to the farm and are aware that the actions of some farmers can impact on all farmers. These concerns were not sufficient in some cases to over-ride a farmer's personal objections to norm violation and to enable farmer sanctioning of practice norm violation. This research has highlighted, however, that over time as the practices that constitute 'good farming' change, farmers were more willing to challenge what they perceive as 'poor' farming practice. These findings suggest linkages between social norms, a point also made by Hechter and Opp (2001).

This research provides new evidence of how cultural and personal norms work in concert to influence individual and collective behaviour in response to practice norm violations. Evidence from this case suggests that in any given situation, a norm that is more prominent (more salient) could have more influence over an individual's behaviour; a distinction also made by Cialdini et al. (1990). In addition, the risk of violating a cultural or personal norm may override a farmer's desire to sanction practice norm violation. These findings are similar to those identified by Minato et al. (2010). Their empirical research reported that older more established norms (the cultural and personal norms in this case) were associated with a greater sense of obligation to sanction norm violation, compared with the newer practice norms which may carry less obligation.

Contacting the authorities ('dobbing in') was strongly emphasised as an unacceptable farmer response to practice norm violations by almost all farmers in this case. 'Dobbing in' was perceived by the farmers in this case as a violation of the cultural norms associated with being a good neighbour, and those norms around private property ownership (respect of another farmer's autonomy and independence, or 'minding your own business'). 'Dobbing in' can reduce trust between farmers. The threat of being sanctioned by other farmers for dobbing in (e.g. criticism, ostracism, a loss of personal reputation), generally prevented individual farmers in this case from contacting the authorities. Returning to the literature, 'dobbing in' is an example of how norm prominence (saliency) can influence farmer behaviour (Cialdini et al., 1990). The findings from this case clearly highlight a collective socio-cultural influence over individual farmer behaviour, and importantly, present a key finding of the prominence of relational norms among farmers over the sanctioning of practice norm violations. After exploring the changes in collective farmer agreement on accepted practice, and the influence of networks, trust and norms, the following sections examine farmers' collective responses to the notification of the regulatory intervention (POP): resistance and collective action.

Resistance to the POP - challenges to farmer autonomy, identity and knowledge

A general and strong resistance to the introduction of rules and regulations over land use activities was the initial response from farmers and some farming organisations to the POP in this case. The farmers were not resisting farm practice change to improve water quality per se, but responding to: what they perceived as a threat to their autonomy as farmers ('being told what to do') and the lack of respect shown by regional government towards farmers and their community; a challenge to their identity as 'good farmers' ('stewards of the land'); and a disregard for their local knowledge. Farmer autonomy, an independence or freedom to farm without interference, is often cited as a core value in farming and a reason why farmers choose a farming lifestyle (e.g. Niska, Vesala, & Vesala, 2012; Stock & Forney, 2014). Many farmers in this case resisted the regulation that was perceived to reduce farmer control over farm management decisions, to challenge this core value of farmer autonomy, and to violate their cultural norms associated with private property ownership. Other empirical research identified similar factors that contributed to an individual farmer's resistance to an environmental policy intervention: increased long-term uncertainty, and a belief that their individual autonomy would be restricted (Curry & Winter, 2000; C. Morris & Potter, 1995; J. Morris et al., 2000). Importantly, this research identified resistance as a collective response, and identified how the violation of cultural and personal norms contributed to this collective resistance to water quality interventions. The farmers in this case felt that Horizons were being disrespectful and challenging their farm practices, which violated the relationship norms associated with expectations of how individuals will mutually behave.

The farmers in this case were also resisting a challenge to what they perceived as their stewardship rather than their production-led 'good farmer' identity. Farmer identity is a component of what Burton (2004a) refers to as farming culture, and identity is also a component of the socio-cultural dynamics in this case that shaped farmers' responses to interventions. There was general recognition among the farmers in this case that a good farmer has a stewardship role, and has a responsibility to care for land and water for current and future generations. By introducing rules and regulations to control land use practices, the farmers perceived that Horizons violated their personal norms around stewardship and challenged their 'steward of the land' good farmer identity. Burton and colleagues (Burton et al., 2008; Burton & Paragahawewa, 2011) similarly found farmers' responses to interventions were linked to farmer identity, or what farmers believe constitutes good farming. Furthermore, irrespective of the intervention type, farmers resisted change when they believed their 'good farmer' identity, or what they construe to be 'good farming' practice, was challenged.

These findings from this research suggest that environmental farm practices are becoming accepted as part of 'good dairy farm' practice. These findings differ from the assertions made by Burton and colleagues (Burton et al., 2008; Burton & Paragahawewa, 2011) that environmental policy interventions (AES) have failed to change the farming culture to one that also considers the environment. Burton et al. (2008) found little change in farming culture from a production-led to an 'environmentally friendly farming culture' (p.30), and claimed farmers had limited opportunity to demonstrate their productive skills, or their 'good farming skills' (p.26), through conservation practices to other farmers. Furthermore, Burton and Paragahawewa (2011) claimed that environmental farming practices are not becoming accepted as part of 'good farming' practice, are not being established in farming culture, and are not resulting in a change in social norms. However, the differences in findings between this research and that conducted by Burton and colleagues, could be attributable to differences in context and intervention type. Their research explored farmers' responses to payment-based prescriptive European agri-environment schemes, and environmental policy interventions of this type do not operate in New Zealand. Interestingly, MacGregor and Warren's (2016) research on Scottish farmers' responses to prescriptive NVZ regulations, found a positive change in farmers attitudes toward the environment compared with earlier research (Macgregor & Warren, 2006); a change they attributed to NVZ regulations.

The farmers in this case were also responding to a perceived disregard of their local knowledge by regional government. Duncan (2016) used the phrase 'ways of knowing' to describe the divergence in farmers and policy makers' framing of a water quality problem in New Zealand. Using Duncan's (2016) differentiation of different 'ways of knowing', the farmers in this case felt more emphasis was being placed on science-policy ways of knowing (e.g. based on monitoring data and a modelling tool, Overseer, being used to predict nutrient outputs) rather than farmers' ways of knowing (i.e. based on practical experience, intuition, and direct observations). For several farmers in this case, their way of knowing was based on inter-generational knowledge handed down through families, and these farmers have theirs and family members' recollections of the past; a finding also highlighted by Duncan (2016). Some farmers in this case, responded to Overseer's theoretical interpretation of the nutrient output from their farms, which differed from their own practical way of knowing and visualising outputs from their farm. In addition, Overseer's interpretation is based on a modelling tool that farmers believe from their own and other farmer's experiences to be inconsistent and inaccurate, and a tool based on science that is regularly upgraded (different versions produce different outputs from the same farm inputs). Using Kasperson et al.'s (1992) trust framework, the farmers' perceptions of inconsistency (lack of predictability) and inaccuracy (lack of commitment) suggested a lack of trust in this modelling tool. Furthermore, farmer awareness of Overseer and understanding of how it operates varied, from those with little awareness to those with a good knowledge of the relationship between farm inputs and N loss. These factors contributed to the farmers' perception that nutrient management goals were changing, or, 'moving goal posts'. Returning to Kasperson et al. (1992), a perception of 'moving goal posts' indicates a lack of predictability. The farmers in this case were questioning, sceptical and disbelieving of science data that differed from their own observations, experiences and farm knowledge; a point also noted by Duncan (2016). These findings reiterate the issues identified by Fisher (2013) in her discussion of the government's disregard of farmers' local knowledge in favour of scientific evidence in relation to bovine tuberculosis, and as she further explained, farmers were sceptical of the reliability of government information. Trust, social norms and social interactions through social networks were found to contribute to farmers' resistance to regulation, and these will now be explored in more detail.

Declining trust and perceived violations of social norms – contributions to resistance

The farmers perceived Horizons had violated their cultural and personal norms, and the associated decline in trust between farmers and Horizons contributed to the collective resistance of farmers. Trust was identified in this case as a key influencer of farmers' responses to interventions, and it is useful to consider the factors that influenced farmers' individual and organisational trust. The behaviour and actions of Horizons during the POP reduced trust in the four key areas set out by Kasperson et al. (1992) in their social trust framework: competency, care, commitment and predictability. The farmers in this case believed that: Horizons did not have the practical farm experience and knowledge to dictate farm practice change (lack of competency); Horizons were not concerned about or interested in farmers and farming (lack of care); farmers were not being treated equally and fairly (lack of commitment); and farmers' expectations were not being met (lack of predictability). In addition, the farmers felt Horizons were trying to control their farm practices through regulation, and this also reduced farmer's organisational trust in Horizons. Fisher (2013) also used Kasperson et al.'s (1992) trust framework to explore that factors that reduced trust between UK farmers and government officials. She found reduced trust was due to: a perceived lack of government action to control bovine tuberculosis (commitment); a perception that government officials did not care about farmers (lack of care); a perceived lack of farming knowledge (competency); and a change in direction by policy makers (lack of predictability). Fisher (2013) did not identify increasing government control as a factor influencing organisational trust.

The social interactions between farmers and Horizons in this case that were based on distrust and disrespect, were found to contribute to farmers challenging and disbelieving information provided by Horizons and resisting the regulatory intervention. Empirical research from the UK reported similar findings of reduced trust between farmers and government, and also how reduced trust contributed to a disrespect for government policies (Hall & Pretty, 2008), and a disbelief in and disuse of government information and advice (Fisher, 2013). Evidence from this research and from other empirical studies suggests that regardless of the intervention type (e.g. regulation, voluntary, educational), the nature of trust between farmers and government is crucial to farmers believing in and using information provided by government, and ultimately, in influencing farmer behaviour change.

This research also identified the key role of social norms in shaping farmers' collective resistance to the regulatory intervention. In addition, this research clearly identified how perceived violations of social norms reduced individual and organisational trust. By introducing rules and regulations for land use activities, the farmers felt that Horizons violated their personal norms around stewardship (responsibility of care for land and water), and the cultural norms associated with private property ownership (i.e. autonomy). In addition, the farmers felt unfairly targeted and blamed for water quality decline (cultural norms associated with an individual's right to fairness and equality), when they believed others also contributed. The perceived violation of farmers' cultural and personal norms, contributed to reduced trust between farmers and Horizons. The dynamic or relationship between perceived violations of social norms and a reduction in trust, is not widely reported in the literature. Although also using Putnam's (2000) social capital theory to frame her research, Fisher (2013) did not investigate the role of social norms, or discuss how violations of social norms reduced trust: a dynamic that was clearly evident in this research. In other research, Emtage and Herbohn (2012) reported reduced trust between Australian farmers and government, but did not identify these concepts in relation to the violation of social norms. The farmers in Emtage and Herbohn's (2012) study, felt blamed and criticised by government for water quality decline, and felt the government was challenging their 'honour' as responsible citizens. The government's perceived challenge to farmers' honour and criticism of farm practices in Emtage and Herbohn's (2012) research, is similar to the violation of cultural norms in this case; the farmers in this case feeling that regional government was showing them little respect and was challenging their good farm practices.

Social interactions through social networks - contributions to resistance

This research clearly highlighted how farmers' individual and organisational trust fundamentally altered their relative use of bonding, bridging and linking social capital for support, resources, information and knowledge. This effect was particularly noticeable during farmers' resistance to the POP. The farmers' narratives illustrated how they tended to rely on their close bonding relationships (e.g. family, other farmers) for emotional support and information about the POP. Many farmers also used their bridging relationships with trusted individuals for information and advice (e.g. farm consultant, accountant, fertiliser representative). The farmers in this case were more likely to use their linking social capital with Fonterra staff (e.g. Fonterra Area Manager), rather than their linking social capital with the staff of the organisation (Horizons) that introduced, monitors, and enforces this regulation. Fisher (2013) similarly found farmers were more likely to use and believe information and knowledge from their trusted veterinarians and other farmers about control of bovine tuberculosis, rather than information from Defra, the government department responsible for controlling this disease in the United Kingdom, because of reduced organisational trust.

There was evidence that the social interactions between farmers at times modified, distorted and embellished certain information flowing through farmer networks. As a result, the message became increasingly inaccurate, sensationalised and emotive, focused on the potential negative impacts of the POP on individuals, and contributed to farmer resistance to the POP. Emotive and sensationalised media reports about the POP also contributed to the 'distorted truth' effect. This finding suggests a feedback loop, whereby 'distorted truth' embellishes fact, which contributes to an extreme view of change, which in turn exacerbates emotional resistance. Figure Eleven illustrates this feedback loop.

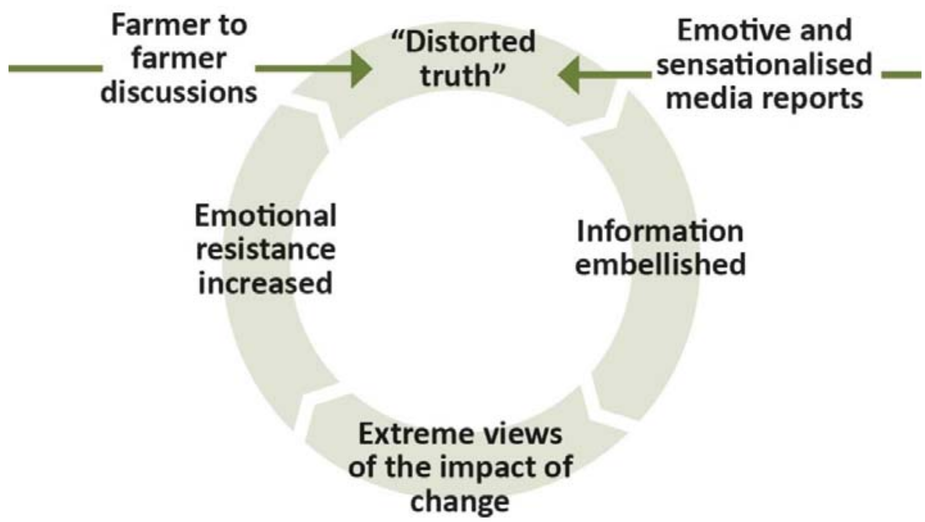

Figure 11: The effect of 'distorted truth' on information flows through dairy farmer networks.

Although the literature tends to emphasise the positive outcomes of social capital, Putnam (2000) identified the potential for bonding social capital to create inward-looking and exclusive networks. Putnam (2000) labelled these negative outcomes as the 'dark side' of social capital. Portes (1998) argued that strong bonding ties can exclude outsiders, but this negative phenomenon of strong bonding social capital that creates 'distorted truth' has not previously been reported in the social capital literature in relation to farming. After exploring farmer resistance to the POP, and the factors that contributed to this resistance, the next section examines how the formation of a farmer-led collective action group enabled the community to respond as a collective rather than as individuals to the POP.

A community approach – formation of a farmer-led collective action group

The formation of a farmer-led collective action group (TCEIS) enabled a rural community to respond as a collective, rather than as individuals, to the issues they faced. Chapters Seven and Eight highlighted how and why the TCEIS formed to represent the wider Tararua community's issues, including the perceived challenges to farmers' autonomy, identity and knowledge, and the community's future socio-economic prosperity. The 'community' in this case was self-defined by the individuals and organisations affected. As Warburton (1997) proposed from her participatory action literature review, a community is best defined by the people affected by the issue under debate. Several stages of collective action were identified. General farmer resistance to the POP contributed to the community's issues being identified, an economic impact analysis being undertaken, and these actions resulted in the formation of a collective action group (TCEIS). The group accessed existing and built new social networks. The social learning that occurred through these social networks involved, informed and empowered the community to question and challenge Horizons at a public protest meeting. A pro-active period of relationship re-building between farmers and Horizons, and a shift by Horizons to a collaborative rather than an approach that was perceived by farmers to be autocratic, has contributed to farmer acceptance of rules and regulations for land use practices.

This research extends our understanding of a collective farmer response, and in particular, the formation and actions of a farmer collective action group. Farmer collective action is variously interpreted in the literature, for example, farmers working together as part of a formal group such as a collective AES (Emery & Franks, 2012; Mills et al., 2011) or a Landcare group (Sobels et al., 2001). However, some key contextual differences were noted between these studies of farmer collective action and this research. While Landcare groups and collective AES are formed through the actions of an organisation or government, and commonly as the result of a voluntary intervention, collective action in this research was a farmer-led response to the perceived impact of a regulatory intervention.

This research adds new insights into the pivotal role of social capital in enabling a successful 'community' response to a regulatory intervention. In this case, collective action accessed existing social capital within the community and built new social capital through creating new networks, building trust and reinforcing the existing norms of reciprocity and norms around relationships and respect. The TCEIS farmer leaders used their bonding networks to access resources (e.g. other farmers helping on the leaders' farms, so they could undertake TCEIS work) and the leaders extended their bonding, bridging and linking networks to bring in expertise to help with the group process. The level of linking social capital between farmers and Horizons, and bridging social capital between some organisations and Horizons, was limited after the POP process. This collective action strengthened the bonding, bridging and linking social capital within the community, built bridging social capital with organisations external to the community, and ultimately, built linking social capital between farmers and the regulator (Horizons). These findings are not commonly reported in the context of a farmer-led collective action process. The majority of social capital studies investigate how social capital shaped the responses of individual farmers (e.g. Fisher, 2013; Hall & Pretty, 2008). This research provides a detailed illustration of how social capital enabled a collective community action in response to a proposed intervention. While some studies identified low levels of linking social capital between farmers and government (Fisher, 2013; Hall & Pretty, 2008), this research provides evidence of how collective action among farmers and their local community built linking social capital to enable resolution of the issues the community faced. This collective action ultimately contributed to the collective response of farmers over time to the intervention, but it did not occur in isolation. Social interactions through social networks, trust and respect for social norms were found to contribute to the success of the collective action group, and these will now be explored in more detail.

Social interactions through social networks – encouraging a community approach

Social interactions through bonding, bridging and linking networks contributed to farmers accessing support, resources and information, and fostered the exchange of knowledge. The bridging and linking relationships in particular, provided access to new information and resources; a point also highlighted by Fisher (2013) in her research with UK farmers. As earlier identified, social interactions through social networks was argued by Reed et al. (2010) to be an example of social learning. The collaborative approach used by the TCEIS ('individuals felt included') built trust, reinforced social norms of reciprocity, and encouraged involvement and social learning. Through social learning, members of the community increased their understanding of the issues (e.g. negative socio-economic impacts of the POP) and gained confidence to question and challenge information from the regulator. As a result, the community felt empowered to take control and to develop their own solutions. Similar outcomes of understanding, confidence and empowerment were noted by Sobels et al. (2001) and Compton and Beeton (2012) from social learning through Landcare group activities. Both studies emphasised how empowerment increased community control over 'conditions that make actions possible' (Sobels et al., 2001, p.274), and gave people 'an opportunity to control their own destiny and influence the decisions that affect their lives' (Compton & Beeton, 2012, p.153). Although these studies similarly found increased confidence and empowerment among group members, the context of these studies (groups that formed in response to a voluntary intervention) differed to this case (group formed in response to a perceived community threat).

Trust and social norms – enabling a collective response

This research illustrated the key role of trust in enabling a collective farmer response to interventions; a collective action that occurred in response to farmer distrust of the regulator. While the factors that reduced trust between farmers and Horizons have already been discussed, it is useful to consider the factors that allowed trust in the TCEIS to develop. The behaviours and actions of the TCEIS leaders built trust in the four key areas set out by Kasperson et al. (1992) in their social trust framework: competency, predictability, commitment and care. The TCEIS leaders were respected locals with farm and business-based experience and knowledge (competency), were contactable and available (predictability), and were believed to be supporting and working on behalf of farmers and the community (care). The TCEIS leaders used local trusted professionals' numeracy skills to verify data (competency), and as a result, the community believed the economic impact analysis prepared by the TCEIS was accurate (commitment). Increased trust in the TCEIS leaders resulted in a belief in the information provided (e.g. economic impact analysis) and a willingness for individuals to become involved in collective action (e.g. attend meetings, challenge the regulator).

This research also identified the key role of social norms in shaping individual and collective behaviour, and in ensuring the success of a collective farmer response. These cultural norms included norms of reciprocity and relationship norms. A collective response reinforced existing norms of reciprocity (working together for mutual benefit) and built social capital. The TCEIS leaders volunteered their time and personal resources to support the community, and in turn, other members of the community provided time, resources, information and expertise to the TCEIS. Putnam (2000) identified that volunteering, or in his words 'doing good for others', reinforces norms of reciprocity. Empirical studies of Australian Landcare groups found individuals were willing to invest time and energy in group projects, and also found the norms of reciprocity that existed within groups, encouraged farmers to work together because they expected others to do the same (Cary & Webb, 2000; Sobels et al., 2001). Although similar norms of reciprocity were identified in these studies and in this case, the context of these landcare group studies (voluntary intervention, a formal group) differed from this case (regulatory intervention, a group that formed in response to a perceived community threat). The evidence from this research, and from these empirical Landcare group studies, highlights the key role of norms of reciprocity in both encouraging and sustaining collective group action.

The collective response evidenced in this case also enabled the community to sanction the perceived violation of cultural norms. The farmers felt that by introducing controls over land use (POP), Horizons violated farmers' cultural norms associated with private property ownership and an individual's rights to fairness and equity. From the farmers' perspective, being treated with disrespect violated relationship norms. Chapter Seven described the catalytic public meeting, whereby members of the community sanctioned Horizons by holding a vote of no confidence in their chairman. While some studies identified how norms of reciprocity within existing groups encourage collective action (Cary & Webb, 2000; Sobels et al., 2001), these group studies do not investigate how sanctioning of cultural norm violations can influence the current and future behaviour of group members. Furthermore, this collective response encouraged Horizons to change their behaviour towards farmers ('new way of working'), which ensured relationship norms were not violated and resulted in increased trust and respect. The increased trust and respect between farmers and Horizons contributed to reduced resistance to regulation, a willingness to work together, and a change in farmer behaviour (e.g. seeking information and attending Land Use Consent meetings). These new and important findings are not commonly reported in the literature. These findings provide further evidence of how a collective farmer response, or group formation, sanctioning and subsequent changes in behaviour to ensure norms are not violated, influenced individual and collective behaviour. After exploring farmers' collective responses, the final section in this chapter presents farmers' individual responses to water quality interventions. The diversity of farmers' individual responses is explored in more detail, and the factors that contributed to an individual's response are examined.

Dairy farmers' individual responses to water quality interventions

This research identified response to be a *multi-dimensional* phenomenon, whereby the multiplicity of farmers' individual responses were linked and interwoven with a myriad of farmers' collective responses. The multiplicity of farmers' individual responses to water quality interventions was clearly evident from the farmers' narratives and the summary tables (Chapters Seven and Eight), and contrasts with the simplistic nature by which other empirical research presents farmers' responses to interventions. Other empirical research commonly presents response as a *uni-dimensional* phenomenon, whereby farmers' responses are often described as a singular behaviour change of individual farmers, and often, an individual response as a change in farm management practice (Barnes et al., 2013; Bewsell et al., 2007; Greiner & Gregg, 2011;

Macgregor & Warren, 2006, 2016). In contrast to these studies, this research identified changes in farmer behaviour, characteristics (emotion) and knowledge (awareness and understanding). In addition, a number of behavioural responses were identified. This section explores the behavioural responses in more detail. Emotional responses were found to be linked to behavioural responses. Changes in farmer awareness and understanding were previously discussed in the collective farmer response section.

A change in farmers' emotions in this research was found to be linked to a change in individual and collective behaviour. Almost all farmers in this study described their initial negative emotions (e.g. shock, anger, fear, worry) after the POP was notified, and these negative emotions influenced individual farmer behaviour, the level of trust between farmers and Horizons, and contributed to the collective farmer resistance identified in this case. In contrast, one farmer in this study described initial positive emotions to regulation, from a realisation that practice changes would not be required for their farm to meet the specified nutrient leaching targets. Other academics (e.g. Barnes et al., 2013; Botha et al., 2013; Emtage & Herbohn, 2012; J. Morris et al., 2000) also linked a change in farmer characteristics (e.g. emotion, attitudes, motivations) with a change in behaviour, however, these studies commonly focused on attitude rather than emotion as an influencer of behaviour. Botha et al. (2013) investigated New Zealand farmers' emotional responses to imminent change from a regulatory intervention, and found farmers' initial negative emotions to be similar to those described by the farmers in this case. However, they did not identify farmers with a positive emotional response to the introduction of regulation as reported in this study. While not investigating an emotional response per se, some studies reported farmers' negative emotions, including suspicion of a government intervention (Mendham et al., 2007), and frustration and anger with government staff (Fisher, 2013; Hall & Pretty, 2008). This research and these empirical studies identified how the farmers' negative emotions contributed to a loss of trust between the farmer and government. Farmers' behavioural responses to water quality interventions will now be explored in more detail.

Behavioural responses

The farmers' narratives highlighted five main behavioural responses to water quality interventions. Both a change in practice and other behavioural responses that contributed to practice change were identified. These responses included: 1) a change in practice, that could be further separated into a change in recording practice and a change in farm management practice; 2) uptake of economic incentives; 3) a change in information seeking behaviour; 4) a change in the way farmers engaged with the regional council; and 5) a change in a farm business decision that was directly linked to an intervention. While some studies also described farm management practice change in response to water quality interventions (e.g. Botha et al., 2013; Duncan, 2013; Macgregor & Warren, 2006, 2016), seeking information (e.g. Lankester et al., 2009), and the uptake of economic incentives (e.g. Mendham et al., 2007), the other behavioural changes noted in this research are not commonly described in the literature. Some studies identified other behaviours not described by the farmers in this research, such as joining a Landcare group (Compton & Beeton, 2012; Sobels et al., 2001), trialling a practice (Cotching et al., 2009), and monitoring changes after a practice was introduced (Lankester et al., 2009). The following sections will describe these five behavioural responses in more detail.

Practice changes

The farmers in this case changed their monitoring and record keeping practice as a requirement for both industry and regional government water quality interventions. Other studies also reported an increase in record keeping as a requirement for prescriptive NVZ regulations to improve water quality (e.g. Barnes et al., 2009; Macgregor & Warren, 2016), and the farmers in these studies expressed some frustration with increased paperwork. While some farmers in this research also expressed frustration with increased paperwork (e.g. as required for the annual Farm Dairy and Environmental Assessment described in Chapter Six), their frustrations were tempered by a realisation that increased paperwork was part of current dairy farm practice. An important finding from this study, was how industry record keeping also acted as an educational intervention and contributed to an increased farmer understanding of the impact of specific farm practices on water quality. For example, one farmer in this study used his farm's Fonterra prepared Nitrogen Report to compare the N leaching from his farm to other farms, and to indicate whether his farm leaching was reducing. This response has not been mentioned in other studies where farmers are required to keep records.

A change in farm management practice was the second practice change identified in this research. All farmers in this case have changed their farm management practices that can impact on water quality. These practice changes were in response to a specific intervention (e.g. regulation), and in response to the broader shift, or transition, in the New Zealand public's expectations about agriculture's impact on water quality. Although many farmers may have changed practice for practical farm management and economic reasons, a consideration of water quality has become part of the farm management decision making for these farmers. Changes were made to: farm dairy effluent management, nutrient management, livestock and forage crop management and the management of waterways. The farmers' narratives and tables in Chapter Seven illustrated the diversity of farm management practice changes. The type and extent of practice change was individual farmer and context specific and no clear patterns could be identified. For example, all farmers in this study fenced waterways. Almost all farmers changed their nitrogen fertiliser policy in some way, for example, applying less urea to not applying urea, changing the product used, and changing the timing and rate of application. Most farmers changed their management of effluent (e.g. changes to effluent application method, application area, timing of application), and some farmers changed their forage cropping (e.g. area and crop grown). Further examples of this diversity include a farmer who did not believe there was a water quality problem yet still fenced his waterways, and another farmer who was near retirement, and as such, did not want to spend capital on upgrading his effluent system. While many studies describe an aggregate of farm management practice change in response to regulatory, voluntary, economic and education interventions (e.g. Bewsell et al., 2007; Botha et al., 2013; Duncan, 2013; Lankester et al., 2009; Macgregor & Warren, 2016), the detail and diversity of individual farm practice change evidenced in this study is not commonly captured by the empirical literature.

With some exceptions, the farm practice changes noted in this research were similarly made by both targeted and non-targeted farmers. In this case, targeted and non-targeted farmers made similar practice changes in some management areas: all farmers fenced waterways and all farmers made changes to meet the terms of their Dairy Effluent Discharge Consent, for example, installing effluent storage if their consent was due for renewal. While a few differences were noted in some instances (e.g. only targeted farmers stopped applying nitrogen fertiliser for management and water quality reasons), little difference was noted in other management areas (e.g. both targeted and non-targeted farmers reduced fodder crop area for water quality reasons). In addition, a few targeted and non-targeted farmers changed practice before a specific intervention was introduced. For example, a farmer installed effluent storage before the farm's existing effluent consent was due for renewal, because this farmer believed that storing effluent to reduce N leaching from wet soils is accepted practice. As discussed earlier, the targeted farmers with a Land Use Consent generally had a deep understanding of the impacts of farm practices on water quality and made practice changes for water quality reasons. However, one non-targeted farmer in this case proactively changed practice to reduce N leaching and purchased a run-off block, even though non-targeted farmers are not required to change practice. This farmer believed all farms would be targeted in the future and would require a Land Use Consent. These findings highlight how differences in farm practice change are specific to individual farmers and to farm context. These findings also illustrate the willingness of the dairy farmers in this study to respond to industry signals, and to accept that farm practice change was required. An earlier study by Bewsell et al. (2007) also found New Zealand dairy farmers responded to dairy industry signals to reduce their environmental impact. While the majority of farmers in their study fenced streams for practical management reasons, some fenced to comply with the dairy industry's Dairying and Clean Streams Accord, and some chose not to fence.

Acceptance of the need for farm management practice change was evident among the farmers in this research. Almost all farmers in this case accept there is a water quality problem and accept some responsibility for this problem. Duncan (2013) similarly found a general acceptance among the New Zealand farmers in her study that water quality was an important issue, and similarly found farmers were changing practice. One farmer in this study did not believe water quality is declining (he believed it was improving because farmers had changed practice), denied personal responsibility for the decline in water quality, yet this farmer still made some practice change: he fenced waterways and undertook riparian planting. The general findings from this case differ from other international studies about farmers' responses to water quality interventions. Research undertaken with Scottish farmers targeted by prescriptive NVZ regulations (Barnes et al., 2009; Macgregor & Warren, 2006), found these farmers generally denied personal responsibility for water quality decline, and in Macgregor and Warren's (2006) study, the farmers used this denial to justify their reluctance to change practice. A denial of responsibility was not reported in a later study with the same targeted farmers (Macgregor & Warren, 2016). The findings from this case support Blackstock et al.'s (2010) assertion, that gaining agreement on the causes of water quality decline is crucial to achieving farm practice change.

The findings from this study, in which all targeted and non-targeted farmers made some practice change, can be compared with studies of targeted Scottish farmers' responses to NVZ regulations. Earlier studies of farmers' responses to NVZ regulations indicated that targeted farmers were aware of the regulations, yet limited farm practice change occurred (Barnes et al., 2009; Macgregor & Warren, 2006). Over time, the number of farmers making practice change gradually increased (Barnes et al., 2011; Macgregor & Warren, 2016). Although farmers in the Scottish studies did eventually change practice, the differences noted between the Scottish studies, this case and the findings from Bewsell et al.'s (2007) New Zealand research, could be attributed to the differences between NVZ regulations and water quality interventions in New Zealand. In this case and in Bewsell et al.'s (2007) research, practice change was initially signalled by industry through an industry accords, rather than signalled by government through NVZ regulations. The interventions in this case adopt a non-prescriptive approach, which enables farmer choice over mitigation practices that can improve water quality. In contrast, NVZ regulations are prescriptive, state the farm management practices farmers must adopt, and remove farmer choice. In addition, studies of farmers' responses to NVZ regulations did not explore the practice changes made by farmers not targeted by regulation.

Uptake of economic incentives

A few farmers in this case contacted the regulator, Horizons, and accepted a fencing material subsidy to support waterway fencing. This economic intervention was not a driver for behaviour change because farmers were already fencing, but assisted farmers to complete waterway fencing. The farmers who chose not to uptake a subsidy had individual or farm specific reasons for their decision, including small areas left to fence, avoiding paperwork, not wanting to interact with the regulator and wanting to retain autonomy over their decision making. The majority of empirical research investigates farmers' responses to payments (e.g. AES offer payments for the provision of environmental services) rather than responses to a materials subsidy. Cocklin et al. (2007) investigated Australian landholders' opinions about a range of government sponsored economic instruments, including incentives, subsidies and fixed payments. Although these landholders expressed support in principle for incentives and payments, some concerns were raised about bureaucracy, (e.g. paperwork), a perception of fairness, and the possible erosion of land rights. The concerns of farmers in Cocklin et al.'s (2007) study appear similar to the farmers in this research expressing their concerns about the violation of cultural norms around fairness and equity and around private property ownership (e.g. retaining autonomy over land management decision making). The nature of their previous interactions, and the level of trust between a farmer and regional government staff was identified as a reason for accepting or not accepting an economic incentive in this research, but not in the work by Cocklin et al. (2007).

Changes in information seeking behaviour

The farmers in this case sought information about the interventions and the farm management practice changes required to reduce their impact on water quality. In this case, seeking information was both a response to an intervention, and an influencer of other responses, such as practice change. The information seeking behaviour of the farmers in this study was individual farmer and context specific and no clear patterns could be identified. While some farmers were proactive and actively sought information (e.g. used the internet, used their existing or extended their social networks), others were reactive and waited for information (e.g. waited until their Land Use Consent was due). One non-targeted farmer, however, was more proactive than some targeted farmers because he believed he would eventually need to change practice. The farmers also used a wide range of information sources, including social interactions (e.g. meetings, field days, industry competitions, workshops, discussion groups), print (e.g. newspaper, farm journals, fact sheets) and electronic means (e.g. email, internet, social media). While some farmers used a few information sources, others used multiple sources, and some compared and checked the validity of information from a number of sources. While some farmers used their existing contacts and networks for information, others extended their networks to access new ideas and information. Although the findings from this research are similar to other empirical studies that describe farmers seeking information about required farm management practice changes, and social learning through social interactions (e.g. Lankester et al., 2009; Mendham et al., 2007; Sobels et al., 2001), these studies tend to aggregate responses and do not encapsulate the detail and farmer diversity evident in this research.

Changes in farmer interactions with the regional council

Some farmers in this case changed to be more proactive in their interactions with the regional council to achieve mutually beneficial farm business and water quality outcomes. These changes in behaviour were individual farmer and farm context specific. The farmers who were applying for a Land Use Consent adopted a risk minimisation strategy, and strategically negotiated the terms of their consent with the regional council in order to minimise the impact of regulation on their farm business. For example, a farmer was buying a neighbouring farm that was in the process of obtaining a Land Use Consent, and he negotiated with the regional council that they would continue with the consent application after the sale was completed. This action ensured the new farm could be run with the same farm system as the existing farm. Other farmers adopted a risk management strategy in terms of effluent management, and proactively reported effluent management issues to the council to reduce or avoid formal sanctions or fines. While risk minimisation and risk management strategies are not commonly reported as farmer responses to policy interventions, Botha et al. (2013) did describe how some New Zealand farmers in their study bargained with the regional council after regulatory policy changes were made. They did not describe what was meant by 'bargaining' or what they were bargaining over.

Changes in farm business decisions about the sale or purchase of land

Some farmers' farm business decisions about the sale or purchase of land were directly linked to the introduction of regulation. One farmer in this case made a proactive decision to buy more land (a run-off block to reduce N leaching on the home farm), and this decision enabled the farmer to manage any future implications of this intervention. A second farmer chose not to purchase more land in order to avoid the implication of the intervention: if this non-targeted farmer purchased more land from the neighbour, the farm would be classified as targeted and a Land Use Consent would be required. Regulation was the catalyst for a third farmer to sell their farm earlier than planned, and this farmer's decision to sell was mainly due to issues within the dairy industry. The influence of regulation on farm business decision making in relation to the sale or purchase of land as identified in these examples is a new finding and does not appear to be previously reported in the empirical literature. Although Macgregor and Warren (2016) identified some farmers in their study had exited dairying since their earlier research (Macgregor & Warren, 2006), these changes were for industry reasons (milk price, profit) and not attributable to NVZ regulations. This final section describes the diverse range of factors that shaped an individual farmer's responses to interventions, and then explores the influence of social networks, trust and norms.

Factors influencing the diversity of individual farmer responses

As evidenced from the farmers' narratives, the Manawatu-Wanganui Region includes a diverse mix of dairy farmers. The dairy farmers in this study are different individuals who operate different farm systems on farms with different attributes, resources, business structures and farm sizes. As such, different farmers responded differently to different interventions. In addition, each farmer's responses to interventions in this study were shaped by a diverse range of factors, including: the stage of their farming life cycle; the bio-physical characteristics of their farm; the ownership structure of their business; financial considerations; their personal values; their acceptance of a water quality problem; and the socio-cultural dynamics that shaped behaviour within this community (social interactions with others, trust, norms and what is considered to be a 'good farmer'). This range of factors combined to influence farmers' responses, and as these combinations were individual farmer and context specific, no clear patterns could be identified. These findings suggest that the multiplicity of farmer's responses cannot be captured by classifying farmers into simple singular categories based on one farmer characteristic, such as attitude, as is common in some studies investigating farmer response (e.g. Barnes et al., 2011; Bartel & Barclay, 2011; C. Morris & Potter, 1995). In addition, scant attention is paid by many scholars to the socio-cultural dynamics that influence individual farmer's responses; a point stressed by Burton (2004a).

The influence of social networks on an individual farmer's responses

As previously discussed, the farmers in this case exchanged knowledge, and accessed information, resources and support through their diverse networks of bonding, bridging and linking relationships. The diversity of an individual farmer's social networks was highlighted in Chapter Eight, and no discernible pattern in farmer networks was evident. While some farmers' networks were relatively large and diverse, others were smaller and less diverse. Diversity within the three network forms was also evident, and again, no clear pattern was evident. While some farmers' bonding networks were small (e.g. one farmer only interacted with family and minimally with other farmers) and others were geographically focused (e.g. one farmer mainly interacted with other farmers in his community), some were larger and more diverse (e.g. one farmer interacted with farmers from several regions and with fellow church members). Farmers' bridging networks also varied, from a farmer who interacted with a few regionally based individuals (e.g. a fertiliser representative, a livestock consultant) to a farmer with extensive national and international networks (e.g. including staff from research institutions, universities, agricultural service companies and DairyNZ). Farmers' linking networks also varied, and these interactions were individual farmer and context specific. For example, while all farmers interacted with Fonterra staff (e.g. the tanker driver, Fonterra Area Manager), interactions with Fonterra staff about farming and water quality tended to be context specific (e.g. one farmer interacted with a Sustainable Dairying Advisor about effluent issues).

The findings from this research extend our understanding about how social networks influence knowledge transfer. The farmers' narratives illustrated how farmers with relatively small networks were making farm practice changes and were as informed about farming and water quality, compared with those famers with relatively large networks. These findings suggest that the size (i.e. number of people) and range (i.e. the range of relationships) of an individual's social networks did not influence their access to information and knowledge about farming and water quality. The evidence from this research does not support Reagans et al.'s (2003) finding that network range can improve information transfer from a source to a recipient, but does support their finding that the strength of the connection between individuals affects how easily knowledge is transferred. This research also extends their work on tie strength. The new findings from this research suggest that the nature of the relationship that a farmer has with other individuals within their networks (the degree of trust and respect for social norms), and the nature of the individuals they have in their network (their degree of expertise and knowledge or the competency of the individual in the relevant domain), can influence an individual's access to information and the quality of that information.

Another feature of farmers' networks in this case, was the farmers' relative use of the internet as a tool to access information and resources about water quality, interventions and mitigation strategies. While the internet was an integral part of some farmers' networks (e.g. one farmer extensively researched mitigation strategies on the internet and shared this information with others to extend his and their knowledge), it was less so for other farmers (e.g. one older farmer did not use the computer and relied on his spouse). In a few instances, information from internet research shaped farmers' responses to interventions. For example, one farmer read American research articles on the internet about supplementary feed and its impact on N leaching, and these results contradicted the N loss modelled by Overseer and the nutrient management consultant's interpretation of this modelled data. The farmer responded by discussing this information with the trusted advisors in his linking (Fonterra Area Manager) and bridging networks (DairyNZ staff member, farm consultant) before deciding on the mitigation strategies for his Land Use Consent application. The evidence from this research supports the findings of a literature review by Neves (2013), who suggested that the internet appears to build bonding and bridging social capital by providing users with increased access to information and resources, and the ability for individuals to use their social connections to share this information.

The influence of trust on an individual farmer's responses

As previously discussed, the farmers in this case preferred to access information and exchange knowledge with those they trust and respect. The farmers in this case obtained information from their bonding relationships with family and other farmers; their bridging relationships with their trusted advisors (e.g. farm consultant) and trusted staff from organisations (e.g. fertiliser representative, DairyNZ); and from their linking relationships with trusted staff from Federated Farmers and Fonterra (e.g. Fonterra Area Manager). The behaviour and actions of these individuals built trust in the four key areas set out by Kasperson et al. (1992): competency, predictability, care and commitment. The farmers in this case believed these individuals had dairy farm knowledge and experience (competency) and believed the information they provided was accurate (commitment). These individuals were contactable and consistent (predictability), and the farmers felt supported, respected and treated fairly by these individuals (care and commitment). While longevity of relationship was suggested in other studies as a factor that can build individual trust (e.g. Fisher, 2013; Sutherland et al., 2013), this factor was not a consistent finding in this research. While some farmers had a long-term trusted relationship with an individual (one farmer has an intergenerational relationship with his farm consultant), another farmer had a two year relationship with his farm consultant at the time of interview, yet he also described the key elements of trust in this relationship.

One of the Fonterra Area Managers and a DairyNZ staff member were trusted and respected by the farmers in this case who interacted with them. Not all farmers in this study interacted with these two individuals, because there were two area managers who worked with the farmers in this WMZ. The four elements of Kasperson et al.'s (1992) trust framework (competency, predictability, care and commitment) were evident in the farmers' narratives that described their relationships with these individuals. Importantly, these individuals provided support and contributed to the flow of information, knowledge and resources between farmers and between farmers and other actors. For example, the DairyNZ staff member presented information about farming and water quality at farmer meetings, supported the farmer leaders of the collective action group, and enabled access to information and resources. One of the Fonterra Area Managers supported farmers through the POP process, and provided information to farmers about the One Plan, Land Use Consent process, and possible mitigation strategies. The information and support from these trusted individuals contributed to a change in practice norms. The evidence from this research emphasises the importance of contact with a trusted and respected individual for achieving farmer behaviour change; a finding also reiterated by Blackstock et al. (2010) in their literature review of factors influencing farmer behaviour change to improve water quality.

The influence of social norms on an individual farmer's responses

The socio-cultural dynamics section of this chapter identified the cultural, personal and practice norms in this case that influenced farmers' responses to interventions. In addition, the collective farmer response section emphasised how a collective change in what is considered accepted practice contributed to an individual farmer changing their farm management practices (a change in practice norms), and individual farmers being willing to challenge current practice and sanction practice norm violations. This section summarises and highlights some of these previously discussed findings and relates the influence of collective social norms to an individual farmer's responses.

This research extends our understanding of how socially constructed collective agreements on what is considered accepted behaviour (social norms), can influence an individual farmer's responses to environmental policy interventions. As previously discussed and illustrated in Figure Ten**,** the extent of an individual farmer's response to norm violation was influenced by the saliency, or relative prominence of cultural and personal norms, and the nature of the relationship between the individuals involved. Other factors, such as the relative age of the violator, the perceived status and experience of the violator involved, and the context of the violation (one-off or repeat) can also influence sanctioning of practice norm violations. Some individual farmer differences in the sanctioning of practice norm violation were noted, and these differences were related to the relative influence of cultural and personal norms. There was a collective understanding and acceptance that farmers do not comment on or criticise another farmer's farm management practices (cultural norms associated with private property ownership), or, contact the authorities about practice norm violations (cultural norms associated with being a good neighbour). One farmer in this research would contact the regulator, or 'dob in' another farmer, if he observed practice norm violation. This behaviour is contrary to almost all farmers in this study, and the farmer would take this action because he believes the violator's actions would violate his personal norms around the stewardship of water. Another farmer may contact the industry group that supports farmers rather than discussing directly with the farmer involved, because he was concerned that other farmers may ostracise him if he sanctioned a practice norm violation. Other farmers believed that if a relationship between individuals was influenced by past negative interactions or events, an individual farmer may anonymously contact the authorities about suspected or observed practice norm violations. As previously discussed, violations of cultural, personal and practice norms reduced trust between the individuals involved, and the level of trust and respect that is inherent in the relationship between individuals, played a key role in shaping individual farmer's responses to environmental policy interventions.

Conclusions

This research identified a transition or shift over time in the New Zealand public's expectations about the impact of agriculture on the environment. This research found the dairy farmers in this case responded to a single intervention, to the other interventions linked to that single intervention, and to a change in social norms as a consequence of the broader shift in the New Zealand public's expectations about the impact of dairy farming on water quality.

The multi-dimensional nature of farmers' responses to water quality interventions was evident in this study. The farmers in this case responded to water quality interventions as individuals and collectively, and these responses were linked and interwoven. In addition, a multitude of individual and collective responses were identified. As individual farmers, changes in awareness and understanding, emotion and behaviour were evident. Furthermore, individual behaviour changes were noted, including changes in farm management practice, seeking information, acceptance of economic incentives, interactions with the regional council and business decisions around the sale or purchase of land. This research identified the diversity of individual farmers and their farm systems, that farmers respond differently to different interventions in different contexts and the diversity of factors that influenced their individual responses. These factors included on-farm circumstances, personal factors, the implications of change on their farm businesses, and the socio-cultural dynamics that shaped behaviour within this rural community.

The socio-cultural dynamics that shaped dairy farmers' individual and collective responses were identified in this research. Dairy farmers' responses were shaped by their past and current social interactions with others, trust, the unwritten socio-cultural 'rules' that shape individual and collective behaviour, and the influence of identity, or being a 'good farmer'. A range of cultural, personal and practice norms were identified in this research, and the saliency, or relative influence of one norm type over another, shaped farmers' responses to interventions. This research also highlighted the importance that farmers place on relationships, and influence of relational norms over behaviour within relationships.

Social interactions were identified as contributing to a change in understanding and agreement about what is considered accepted farm practice, a confidence to challenge and criticise current farm practice, and enabled the sanctioning of social norm violations. This collective farmer understanding and questioning contributed to a change in what is considered to be 'good dairy farming', a consideration of water quality in farm management decision making, and a change in farm practice. Importantly, it was found that farm practice change occurred in response to water quality interventions and in response to the broader change in public expectations about the impact of agriculture on the environment. This research suggests that when an intervention is supported by broader changes in public opinion, farmer behaviour change does occur.

Rules and regulations to enforce farm practice change were not common in New Zealand, and an initial strong farmer resistance to regulation was evident. This research highlighted that farmers were not resisting practice change to improve water quality, but resisting a perceived challenge to their autonomy, their identity as 'good farmers', a disregard for their local knowledge, and the lack of respect shown to them by regional government. This research highlights that when an intervention is associated with challenges to accepted relationship norms, or a lack of respect, and to what constitutes 'good farming', there is likely to be a collective response of resistance from farmers. When farmers felt challenged and disrespected, they tended to turn to their trusted close networks with other farmers and family for support and information. However, at times, the social interactions between farmers contributed to the twisting and filtering of information, embellishment, heightened emotion, and further resistance.

The existing social capital within this rural community contributed to a strong collective response from farmers and the formation of a collective action group. This collective response accessed not only existing farmer networks, but networks within the local community, those external to the community and created new networks. A collective response resulted in the renegotiation of the relationship between farmers and the regulator, and a willingness of farmers and staff from organisations to rebuild relationships and build channels of communication. In many cases, mutual trust and respect have been built. This collective response indicates the presence of social capital within the rural community.

The next and final chapter concludes this thesis. The insights gained from exploring Manawatu-Wanganui dairy farmers' responses to water quality interventions are presented, and the contributions of this research to the design and implementation of environmental policy interventions are highlighted.

Chapter Ten
Conclusions

Introduction

Dairy farming is one contributor to freshwater quality decline in New Zealand, and dairy farmers are expected to change their farm management practices to reduce the impact of dairy farming on water quality. In response to water quality decline, government and the dairy industry progressively introduced a suite of water quality interventions to encourage and enforce dairy farm management practice change. Dairy farmers' responses to water quality interventions was the phenomenon of interest in this research, and was explored using a single-case study research design in the Manawatu-Wanganui Region of New Zealand. This region is a recognised dairying region, has recognised water quality issues, and regulatory, voluntary, economic and educational water quality interventions operate in this region. A social capital framework was used in this thesis to investigate two research questions: *How and why have New Zealand dairy farmers responded to water quality interventions?,* and, *What role did social capital play in shaping dairy farmers' responses?*

This chapter presents the insights gained from investigating Manawatu-Wanganui dairy farmers' responses to water quality interventions, and highlights the study's contributions to the literature. This research was undertaken with practical applications in mind. As such, the implications of the findings for environmental policy design and implementation with respect to farm practices and environmental impacts are provided. Finally, an evaluation of the methodology used, and possible future research directions are presented.

Research conclusions and contribution

This doctoral research argues that understanding the historical socio-cultural context within which farmers operate, is important for understanding how and why the dairy farmers in this study responded to industry and government interventions. Exploring farmers' responses identified a shift in the relationship between the New Zealand public and dairy farmers over time, in-line with the New Zealand public's shifting expectations about farm management practices and environmental impacts. This research identified a change in farm practice (behaviour) as a result, in part, of a change in structure (rules and regulations). The change in practice suggested there had been a change in the farming culture, or a change in the norms of the farmers interviewed and their broader group. These changes in practice and norms are in response to both a shift in the public's expectations about the impact of agriculture on the environment, and the introduction of multiple environmental policy interventions.

A key contribution from this study, is the finding that farmers can change their farm management practices for environmental benefit without receiving direct payments to do so. The findings from this study provide a useful contrast to those reported in Europe in relation to farmers' responses to environmental policy interventions. This difference can be attributed in part to context and intervention type. European farmers are paid directly (de-coupled agri-environment payments) to protect and enhance the environment on their farms, and in some cases, AES payments constitute a significant proportion of some farmers' farm business incomes. In contrast, New Zealand farmers have not received production subsidies since the deregulation of the economy in 1984. Generally, European farmers have not been exposed to non-payment based environmental improvement interventions. In addition, New Zealand's non-prescriptive outputs-based approach to environmental policy design and implementation encourages conditions supportive of change without financial incentives. New Zealand farmers have the freedom to choose the mitigation strategies for their particular farm system, rather than mitigation strategies being prescribed, and industry is encouraged to work with farmers and regional government. The industry's contribution to a broad acceptance and understanding among farmers about the need for farm practice change as identified in this study, is rarely reported in the empirical literature.

Identifying farmers' responses to be a *multi-dimensional* rather than a uni-dimensional phenomenon is an important and new contribution from this research. The farmers in this case responded collectively and as individuals to water quality interventions. Furthermore, individual responses were linked and interwoven with collective responses, whereby individual responses influenced the collective response and vice versa. Most studies interpret farmer response to be uni-dimensional, that is behavioural in nature, and focus on the individual farmer. These studies do not consider the collective response of farmers and the interactions between collective and individual response; a key finding from this research. Importantly, this research contributes to Blackstock et al.'s (2010) identified research gap and provides a deeper understanding of 'the socio-cultural aspects of how stakeholders interpret, translate and respond to measures designed to mitigate diffuse pollution' (p. 5632). Furthermore, evidence of the inter-woven links between individual and collective response in this case, supports Blackstock et al.'s (2010) contention that an individual farmer's behaviour is shaped by the socio-cultural context within which their decisions and actions are made.

This research significantly expands and enriches our understanding of the socio-cultural dynamics that influence dairy farmers' individual and collective responses to environmental policy interventions. Social interactions through social networks, trust, social norms and being a 'good' farmer that uses 'best' farm practice (farmer identity) were identified as key influencers of Manawatu-Wanganui dairy farmers' individual and collective responses to water quality interventions. This research's contribution is to identify the socio-cultural dynamics that operated within this rural community; to identify how these socio-cultural dynamics operated and interacted; and to identify how these socio-cultural dynamics influenced both individual and collective farmer responses to environmental policy interventions designed to mitigate diffuse pollution. These findings provide strong support for Burton's (2004a) criticism of research that focuses on individual farmer characteristics, such as attitude, as determinants of behaviour, and studies that do not consider the socio-cultural factors such as self-identity and the influence of others over collective and individual farmer behaviour.

This research significantly expands our understanding of how dairy farmers collectively respond to environmental policy interventions. The term 'collective' in this research is interpreted as how farmers collectively responded to water quality interventions, which differs markedly from the literature that commonly interprets the term 'collective' as collective action driven through a government-initiated farmer group process (e.g. landcare groups). A number of collective responses to interventions were identified; many of which present collective in a different way or in a different context. Firstly, a broader collective change in what farmers consider to be 'good farm practice', or the accepted farm management practices around farming and water quality was evident. This interpretation of collective differs from other empirical research. Other studies commonly present a change in what is considered accepted practice as a response of an individual farmer, rather than recognising the socio-cultural influence of other farmers over individual behaviour as evident in this research. A key difference between this research and other studies, is how the broader need for farm practice change was initially signalled to farmers. The need for change was signalled by the dairy industry in this case through the voluntary accords, but in other studies it was signalled by government policy or programmes (e.g. Landcare, AES, NVZ regulations). Importantly, this research identified the key role of industry rather than government in signalling broader change practice change to farmers, and the importance of industry's contribution to the broad acceptance of and change in understanding among dairy farmers.

An initial and general farmer resistance to regulation was strongly evident and can be viewed as a second type of collective response. This study found farmers were not collectively resisting the need for practice change to improve water quality, but were collectively resisting an intervention that was perceived to challenge their social norms, their identity as 'good farmers' and to disregard their local knowledge. The collective resistance of farmers identified in this research contrasts with the majority of farmer response studies that focus on resistance as a characteristic of individuals, such as individual resistance to practice change or resistance to external interventions in farming (e.g.Barnes et al., 2011; C. Morris & Potter, 1995). Burton and colleagues (Burton et al., 2008; Burton & Paragahawewa, 2011) coined the term 'cultural resistance'. They argued that farmers resist prescriptive environmental interventions that do not generate cultural capital, or, resist environmental actions that do not allow them to demonstrate what is considered to be 'good farming' practice. Burton and colleagues 'cultural resistance' and the collective resistance identified in this research both identified how environmental policy interventions can challenge the culture of farmers and their broader group, and in addition, challenge their 'good farmer' identity. This research identified a challenge to farmers' personal or environmental stewardship norms which suggests a challenge to farmers' environmental 'good farmer' identity; a finding that suggests environmental farm practices are becoming accepted as part of 'good farming' practice. In contrast, Burton et al. (2008) identified a challenge to what they termed farmers' 'conventional good farmer identity', and argue that AES encourage little change towards what they termed an 'environmentally friendly farming culture' (p.30).

The formation of a farmer-led collective action group was a third type of collective response, and a response to the perceived impact of regulation on individual farmers and their communities. The collective action in this research is a different type of collective action and differs from that reported in other studies of farmers' responses to environmental policy interventions. This collective action was initiated by farmers in response to regulation, and differs from studies of the collective action of groups of farmers that are formed through the actions of an organisation or government, and often as the result of a voluntary intervention.

A multitude of individual farmer responses were evident, such as a change in knowledge and understanding, emotion and behaviour. This research argues that individual farmer response is considerably more complex than the published literature suggests. Empirical studies commonly describe response as the behaviour change of an individual farmer, such as the uptake of farm management practices, participation in a programme, uptake of an economic subsidy, and/or or a change in the characteristics of an individual farmer (e.g. attitude). Although some studies explored emotion as an individual farmer's response (e.g. Botha et al., 2013), this research adds to our understanding of emotion as both an individual response and an influencer of individual and collective responses, whereby negative emotion contributed to resistance to the POP. Other new individual responses to interventions were identified, such as an individual being more proactive in their interactions with the regional council to both manage and minimise risk, and an individual farmer changing their farm business decisions around the sale or purchase of land. A defining difference between this research and other farmer response studies, is how this research reports the detail and diversity of individual farmer responses, rather than reporting response as aggregated concepts, such as practice change or farmer participation in a programme. New insights were gained by investigating the types of practice change over a number of management areas. It allowed the identification of the drivers for specific practice change and some of the factors that influenced the decision to make that practice change, including the stage of their farming life cycle, the structure of their business, the nature of their farm system, and the identified socio-cultural dynamics. In addition, this research identified that different farmers responded differently to different interventions.

This research highlighted the complexity and combination of factors that influenced an individual farmer's responses to interventions. In addition, these factors were dependent on farmer, family and farm system characteristics, as well as their networks, the levels of trust within those networks and the prevailing social norms within the farming community. Furthermore, individual farmers' networks were highly diverse in terms of size and range, and the farmers utilised their networks in a myriad of ways to access information, support and resources and to exchange knowledge about farming and water quality. No discernible patterns in farmers' individual responses, the factors that influenced their responses and the size or range of their social networks were evident. However, this research suggests that the nature of the relationship that a farmer has with other individuals within their networks (the degree of trust and respect for social norms), and the nature of the individuals they have in their network (their degree of expertise and knowledge or the competency of the individual in the relevant domain), can influence an individual's access to information and the quality of that information. What was clearly evident from all farmers, however, was the catalytic and enabling role of trust and the trust norm dynamic in shaping farmers' individual responses to interventions. This doctoral research argues that understanding farmers' responses to interventions is reliant on embracing the diversity of farmers and farming, and an in-depth understanding of the socio-cultural dynamics that shape individual and collective farmer behaviour.

Identifying how the socially constructed collective agreements on what is considered accepted behaviour can influence farmers' individual and collective responses to environmental policy interventions, was a key finding from this research. The social norms identified in this research were found to be reflective of the farming culture of the farmers interviewed and the broader group to which they belong; a relationship not clearly identified in other studies of social norms in rural communities. More specifically, this research identified some of the cultural, personal and practice norms that operated in this rural community; the linkages between these norms; how sanctioning of norm violation occurred; and how norms influenced not only farmers' responses to interventions, but the relationships farmers have with each other and with staff from regional government. Importantly, Informal farmer sanctioning of practice norm violation was found to be a key part of the process by which farm practices that had a negative effect on water quality were criticised and challenged, and new practice norms were fostered. In addition, norm saliency was found to be dependent on a farmer's older more established cultural and personal norms, and the particular situation or context. Similar findings were reported by Minato et al. (2010). As such, contacting the authorities, or 'dobbing in', was strongly emphasised as an unacceptable farmer response to practice norm violations by almost all farmers. Extending the work of Minato et al. (2010), this study identified some of the contextual factors that influenced whether a farmer would sanction practice norm violation by another farmer, and the actions they may take. These contextual factors included: whether it was a repeat violation or a one off; the quality and closeness of the relationship with the person violating the norm; and the relative age, perceived experience and status of the individuals involved.

Trust was consistently emphasised in this research as crucial to farmers' accessing information, resources and support and exchanging knowledge through their social networks. Although trust is discussed in other farmer response studies, this study identified an important dynamic or relationship between norms and trust. Adherence to norms, or conversely norm violation, influenced the level of trust and the quality of the relationship between the different actors in this study. Importantly, the level of trust in a relationship influenced not only the flow of information through networks, but whether an individual believed and used the information provided by other actors and the use of this information to bring about practice change. A key finding from this study was the role that organisational trust, or in this case distrust, played in galvanising farmers' resistance to the regulatory intervention. Trust between farmers and the regulator declined through the farmers perceiving the regional council had a lack of competency, care, commitment and predictability towards the farming community. These findings are similar to those of Fisher (2013), but her work was in relation to animal health policy interventions not water quality, and did not investigate the norm-trust dynamic. The norm-trust dynamic identified in this research can also be used to explain the collective resistance. The farmers in this research perceived that the regulator violated their cultural norms associated with private property ownership, fairness and equity and relationships, and their personal norms associated with the stewardship of land and water. These perceptions of norm violation contributed to reduced individual and organisational trust and contributed to resistance to regulation.

Insights into the process of practice norm change were obtained through this study. Practice norm change was clearly identified as a social process: exchanging information and knowledge, questioning, challenging current practice and reinforcing what is considered accepted practice around farming and water quality. Social interactions through social networks enabled social learning to occur, and through social learning, farmers exchanged new information and knowledge with those they trust. Social learning was found to be central to a change in farmer awareness and a deep understanding of the contribution of dairy farm practices to water quality. Importantly, social interactions facilitated the collective questioning of current practice, and facilitated the sanctioning of practice norm violation; sanctions that reinforced that a particular farm management practice is now the accepted and expected practice. Crucially, social interactions fostered the adoption of 'good' farm management practices that enhance water quality. Through social interactions, the farmers learnt about the possible mitigation strategies that can reduce the impact of dairy farming on water quality and could pragmatically choose the strategies of 'best fit' to their current farm system. As a result, farmers can demonstrate their knowledge, farming skills and consideration of water quality to other farmers, thereby, reinforcing their 'good farmer' identity. This research provides evidence that environmental farm practices are becoming part of 'good' dairy farm practice. Although farm management practice change is the desired outcome of environmental policy interventions and widely researched, other farmer response studies do not commonly explore farm management practice change from the socially collective perspective as has occurred in this research.

The role of social networks in shaping farmers' resistance to regulation was another key finding from this research. The strong bonding relationships between farmers and with family were found to provide support and information about the regulatory intervention in a time of upheaval and uncertainty. Importantly, regional government's approach towards farmers reduced organisational trust, and this hampered regional government-farmer information flows. The study also identified a new aspect of the dark side of social capital (Putnam, 2000), whereby the social interactions between farmers resulted in the modification and embellishment of certain information at times. This embellishment contributed to increased uncertainty about the impact of regulation, and fuelled farmer resistance to regulation.

This research provides a different perspective of a collective action group in a different context. The collection action in this research is a farmer-led collective action group that formed and acted in response to an environmental policy intervention that was focussed on individuals but with negative socio-economic impacts on their community, rather than a farmer group initiated by a government-led programme or intervention. An important contribution is to describe how farmers used their bonding, bridging and linking relationships, relationships that were built on trust and norms of reciprocity, to inform and involve the community. Informing and involving enabled a collective rather than an individual response, and galvanised community resistance to proposed regulation. Not only did farmers use their existing networks, but they created new networks both within and external to the community to access support, resources and information. These social networks reinforced the norms of reciprocity that were identified in this research as being crucial to successful collective action; norms also identified in studies of Landcare groups (e.g. Cary & Webb, 2000; Sobels et al., 2001).

Understanding how collective farmer sanctioning can influence the relationship between farmers and a regulator is another key and important finding from this research. The farmers sanctioned Horizons for perceived violations of their cultural norms associated with private property ownership and relationships, which in turn encouraged Horizons to change their behaviour. This action ensured relationship norms were not violated, which resulted in increased trust and respect between farmers and Horizons. This process of norm sanctioning and relationship change is not commonly described in the literature in a farming context or in relation to water quality interventions.

Implications from this research

Enhancing knowledge about environmental policy design and implementation, with respect to farm management practices and environmental impacts, is a key contribution from this research. As such, the findings from this research have implications for dairy farmers, staff from extension organisations and industry associations, and policy makers. The impetus of this research was to identify how individuals and organisations can work with, rather than seemingly against farmers, in order to better inform and support farmers in a transition to farm management systems with less impact on water quality.

Farmers can benefit from the findings of this research. Farmers in other regions of New Zealand are facing similar regulation of land use practices, and regulation that is based on nutrient loss estimates from a predictive model. This research gives examples of how Manawatu-Wanganui dairy farmers coped with unexpected regulation and how they now farm under N loss limits. The collective action evidenced in this study provides an example for farmers in other regions of how farmers can work collaboratively with other farmers, local businesses, industry and the regional council to improve water quality. It also illustrates how relationships between farmers and the regional council can be re-negotiated, and how farmers can be involved in plan implementation, including the negotiation of the terms of their Land Use Consents.

These research findings have implications for agency and government staff working with farmers. Trust was emphasised in this research as pivotal to encouraging behaviour change. Trusting relationships were built through predictability, commitment, an interest in and support of farmers and farming (care), and a recognition and acknowledgement of experience and knowledge (competency). Based on these findings about trust, staff from industry and government should consider the ways that trust can be demonstrated and built when planning and undertaking future rural community engagement, for example, during regional and strategic planning processes. In addition, those organisations working with farmers could be advised to employ field staff that have a practical understanding of farming and can build a good rapport with farmers. Regional government could provide some education for their policy staff about practical farm operations.

A key outcome from this research was identifying the disrespect farmers, the community and staff from some organisations felt was shown to them by regional government. Farmers were less likely to believe and trust information from government staff they perceive as showing them disrespect, and from staff they perceive have limited farm experience and knowledge, who are also attempting to exert control over their farm practices. Regional government is charged with managing regional water quality and driving environmental policy design to change dairy farm practice, yet their effectiveness in shaping the future could be hampered by their historical and current interactions with farmers. Regional government staff can demonstrate respect towards farmers in a number of ways, including: acknowledging farmer experience; recognising there are multiple ways that knowledge is constructed (e.g. policy-science and farm-based knowledge); valuing farmers' local knowledge; and acknowledging the on-farm changes farmers are making. The factors that contribute to building trust should be considered.

This research highlighted the importance of a collaborative approach between individuals and organisations. To ensure the ongoing support of farmers, all stakeholders, including farmers, need to continue to communicate, collaborate, share information and develop and maintain relationships built on mutual trust and respect. Trust and respect enables a mutual flow of information and resources between individuals and organisations, and this mutual information flow is essential from field to policy to executive levels. Communication and collaboration will contribute to the ongoing support of farmers who require support, resources, information and knowledge for farm management practice change.

A final point to consider about information and trust, is how agency and regional government staff could utilise the existing trusted farmer networks for information flow. It is important that the information provided is both accurate and timely to minimise the 'distorted truth' feedback loop identified in this research. Information flow can be improved when organisations identify and work with the individual(s) within a community who are trusted and respected by the farmers they wish to communicate with. These individuals may or may not be employed by the organisation delivering the message.

Policy makers can benefit from the findings of this research. This research highlighted the importance of using multiple environmental policy interventions rather than a single intervention to improve water quality outcomes for individuals and society. The suite of interventions used in this case contributed to a change in farmer awareness and understanding, and, combined to encourage and enforce farmer behaviour change. The voluntary intervention (industry accord) in this case raised awareness and understanding of dairy farming's contribution to water quality decline, and contributed to farmers being willing to accept practice change was required. The economic intervention (fencing subsidies) enabled some farmers to undertake more change at one time, and regulation (the One Plan) operated to ensure minimum standards were being met. Education underpinned the other intervention types. A critical point here: when designing and implementing environmental policy interventions, policy makers need to consider how the socio-cultural dynamics identified in this research can shape how farmers responded individually and collectively to these interventions.

This research illustrated a change in the social norms that reflect the culture of farming in this rural community, and how farmers resisted the interventions they perceived challenged their cultural and personal norms. It is crucial that policy interventions focus on a long-term change in collective farmer understanding and agreement on accepted farm management practice ('best' farm practice), rather than focussing on short-term changes in individual farmer behaviour. This finding emphasises the point that identifying and understanding who defines 'best' or 'good' dairy farm practice is crucial to understanding farmers' responses to policy interventions, and to influencing farmer behaviour change.

Policy makers need to consider the tools they use in implementing regulatory policy. This study highlighted farmers' varied understanding of Overseer, and their concerns about regional council use of Overseer. Although regional councils and industry are involved in a collaborative project to provide guidance for regional councils in the use of Overseer for regulation (Freeman et al., 2016), there is a need for ongoing communication with farmers about the use of Overseer, particularly as many farmers have little first-hand experience with this predictive modelling tool. Clear guidance from regional councils about how future version changes of Overseer will be accounted for is also needed, which will contribute to addressing farmers' concerns about the inaccuracy and predictability of this tool.

The power of cultural and personal norms in shaping behaviour should not be underestimated. It is important to accept and acknowledge that social norms govern the behaviour of both farmers and those who work with farmers in rural communities. As was demonstrated in this research, violating social norms can have a significant cost for individuals and for organisations, including regional government. Violating these 'unwritten rules' reduces trust and respect, and as previously stated, effective ways of working together are built on mutual trust and respect. It is also important for policy makers to understand that long term behaviour change is about gradually changing the social meaning of farm practice, which includes what it means to be a good farmer and farmer agreement on what is considered 'best' or 'good' farm practice. A combination of environmental policy interventions that acknowledge social meaning, and promote a socio-cultural influence over farmer behaviour, will contribute to long-term behaviour change.

Evaluation of the methodology

Social capital was a useful framework for investigating farmers' responses to water quality interventions in this case, and enabled an in-depth exploration of how networks, trust and norms shaped farmers' responses to interventions. Returning to social capital theory, social capital is theorised to be a non-physical form of capital and linked to other non-physical forms of capital such as cultural capital. Burton and Paragahawewa (2011, p.98) argued that 'social capital in agriculture is grounded in the practical skills and abilities necessary for being recognised as a 'good farmer'. What constitutes a 'good farmer' is one component of what Burton (2004a) identified as culture, and a 'good farmer' identity was another of the socio-cultural dynamics that were found to shape farmers' responses to water quality interventions in this study.

Trust and social norms are complex concepts that are difficult to obtain data on in the field. To overcome this problem, indirect conceptualisations rather than direct methods, or asking direct questions using the word 'trust' or 'norm', were used to explore trust and social norms in this study. Initial farmer pilot interviews indicated that trust and social norms are concepts with different social meanings for different individuals, with meaning developed through social interactions between individuals. This research developed and trialled an indirect method of investigating trust to explore the factors that can shape the dynamics of trust. Questions were worded to capture the conceptualisations of trust reported in the literature, and the narratives were analysed to identify these conceptualisations. This process enables a researcher to capture individuals' different meanings of trust, and in part, prevents the defensiveness Goodall (2015) reported from researchers using a direct method and participants not wanting to admit their lack of trust in others.

Practice norms in this research were conceptualised as the 'expected' or 'accepted and unaccepted' farm practices around water quality. Sanctions were discussed as the actions an individual may take '*if farmers aren't doing what others expect*', with the word 'expect' reinforcing the 'oughtness' component of social norms highlighted by Horne (2001). Narratives were also analysed for words and phrases that indicate the presence of norms (expectations of behaviour), for example, 'should' and 'have to', which indicate expectations or a sense of obligation or duty.

The literature emphasises the importance of building trust and rapport with research participants. In this research, it emerged that it is also important for the researcher to build trust and rapport with non-participants. The researcher-non-participant relationships were important, because they enhanced the qualitative research. The trust and respect that developed in these relationships facilitated access to resources useful to this study (e.g. unpublished and published documents, maps, scientific data, contacts with other individuals) and encouraged debate and discussion about farming and water quality. These social interactions enhanced the researcher's understanding of the historical socio-cultural context of this case. In essence, social capital was built and accessed by the researcher with non-participants to enable an investigation of how social capital shaped farmers' responses to interventions.

Limitations

Generalisability was the main limitation of the single case-study research strategy used in this study. Twelve dairy farmers from one water management zone (WMZ) were interviewed. This research does not capture the diversity of farmers from other WMZs, and farmers who may have different interactions with the regional council. In addition, the TCEIS centred on one community in the Tararua District, and the actions of this collective action group had a significant impact on farmers' responses and the implementation of environmental policy. The responses of farmers from other WMZs outside the Tararua District may have been different. This research was undertaken in one dairying region of New Zealand, where the regional council used a regulatory intervention to target intensive land use and address declining water quality. Other regions may have less area in dairying, face other natural resource management issues, and other regional councils may choose other environmental policy interventions. The Manawatu-Wanganui region was the first region in New Zealand where rules and regulations were introduced to control land use practices for water management purposes in a non-lake environment, and as such, regulation was unexpected. Other regions may not use regulation, or regulation may be commonplace. In addition, New Zealand does not use financial incentives to encourage farmer behaviour change, which contrasts with the de-coupled payments made to European farmers to protect and enhance the environment on their farms. The responses of New Zealand dairy farmers to water quality interventions are not generalisable to a European context.

Directions for future research

From the context of this research, a number of future research areas can be identified. This research was a single regional-based case study of dairy farmers' responses to a suite of water quality interventions under a relatively non-subsidised output-based policy framework. This work could be extended from a single regional study to multiple case-studies to investigate farmers' responses to interventions from other regions and different policy approaches. This study explored the response of dairy farmers to interventions during a time of upheaval and strong resistance to the introduction of regulations over land use practices in New Zealand. It would be useful to explore farmer response to regulation as controls over land use practices in New Zealand become more commonplace, and to repeat this research in a region where farmers are not facing enforced change through regulation. It would also be useful to repeat a similar study across and within different primary industries, for example, sheep and beef and horticulture. Furthermore, farmers' responses to interventions that are addressing other environmental management issues, such as greenhouse gas emissions and biodiversity loss, could be explored. These research avenues would provide further insights into farmers' responses to interventions, and aid in the design and implementation of environmental policy to address other resource management issues.

As a final thought, the influence of social norms on farmers' responses to interventions has not been previously studied in a New Zealand context. This aspect of the socio-cultural dynamics shaping farmer behaviour warrants further research, and there are several research avenues to explore. Although norms are defined and classified in the literature, there is limited empirical research exploring the mechanisms of how social norms operate. In particular, there is scant research exploring how different norms interact, the process of informal norm sanctioning within rural communities, and how cultural and personal norms influence the sanctioning of practice norm violations. The cultural component of the socio-cultural dynamics identified in this research also deserves extended study. The 'good farmer' identity identified in this research could be further investigated, other components of 'agri-culture' identified, and how these social meanings influence farmers' responses explored. These research areas would provide further insights into the socio-cultural dynamics, and how these dynamics shape farmers' responses to environmental policy interventions.

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Appendices

Appendix One: Conceptualisation of trust

Table 12: Conceptualisations of trust.

Trust factor	Description	Examples from the literature	Example questions from the farmer interviews
Competency	• An individual or institution's actions are judged to be competent. • Perceived technical competency of staff, perception that staff will provide scientifically sound information. • Perceived practical knowledge and understanding of practical farming.	Kasperson et al. (1992) Sutherland et al. (2013) Prazan and Theesfeld (2014) Fisher (2013)	How well do you think (staff) understand practical dairy farming? Can you explain?
Commitment	• A perception of fairness in the decision process (procedural justice). • Individuals do not perceive inequality or blame. • Provision of accurate information. • Commitment to achieving a goal.	Kasperson et al. (1992) Fisher (2013) Emtage and Herbohn (2012)	Do you think the rules for farming in the targeted zones are fair or unfair? Why?
Care	• Individual or institution will act in a way that shows interest in and concern for individuals. • Individuals and the community have a sense that they are being supported and understood. • A willingness to see the farmer's perspective.	Kasperson et al. (1992) Sutherland et al. (2013) Fisher (2013)	Did you feel that farmers were being listened to or supported? In what ways? By whom?
Predictability	• Fulfilment of faith and expectations. • Individual or organisation acts consistently. • Organisation has a clear direction.	Kasperson et al. (1992) Sutherland et al. (2013) Prazan and Theesfeld (2014) Fisher (2013)	Were (staff) contactable and available? In what ways? Was this (e.g. staff member's actions) what you expected? Why?
Longevity of relationship	• Long-standing advisors are a trusted source of advice.	Sutherland et al. (2013) Emtage and Herbohn (2012) Fisher (2013)	Length of time working with a farm consultant
External controls over on-farm practices	• External control reduces trust. Farmers perceive a loss of control over their on-farm actions	Emtage and Herbohn (2012) Mendham et al. (2007)	Can you tell me a bit about the on-farm checks. Who? Why? How often?

Appendix Two – Documented sources of data

National level – central government

- Resource Management Act (1991) (and amendments)
- National Policy Statement Freshwater Management (2011 and 2014) and consultation documents on the proposed NPS Freshwater Management
- New Zealand Coastal Policy Statement
- Statistics compiled by Ministry for the Environment (MfE), Ministry for Primary Industries (MPI), and Statistics New Zealand (e.g. New Zealand International Trade Investment & Travel Profile)
- Ministry webpages (MfE, MPI, Tourism New Zealand)
- Land and Water Forum (webpages and reports)
- Annual State of the Environment reports (MfE)
- Valuing New Zealand's Clean Green Image (MfE)
- Environment Court hearings evidence and decisions (the POP)
- High Court Decision on POP
- Parliamentary Commissioner for the Environment (PCE) webpages and reports

Science organisations

- Science providers' webpages (e.g. Cawthron Institute, AgResearch, Landcare Research)
- Cawthron Institute reports (prepared for Horizons, Department of Conservation)
- AgResearch reports (e.g. technical description of Overseer)
- Landcare Research report (impact on farm profit)
- Institute of Geological and Nuclear Science (GNS) reports (e.g. lag time research)
- National Institute of Water and Atmospheric Research (NIWA) webpages and reports
- NIWA commissioned research (for MAF Policy, Horizons, and Fish and Game)
- Land Air Water Aotearoa (LAWA) scientific data and webpages
- Land Use Capability Handbook

National and regional industry and farming organisations

- Dairy industry statistics compiled by the Livestock Improvement Corporation (LIC)
- Dairying and Clean Streams Accord 2003
- Sustainable Dairying: Water Accord 2013
- DairyNZ, Fonterra and Federated Farmers webpages
- Submissions to Horizons on the One Plan
- Federated Farmers Farm Confidence Survey (on website)
- Fonterra's Annual Reports
- DairyNZ Strategy
- Dairy NZ educational materials: booklets, leaflets, factsheets
- Speeches (e.g. Federated Farmers, as reported on webpages)
- Supply Fonterra Programme
- Dairy Diary (Fonterra)
- Code of Practice for Nutrient Management
- DairyNZ Sustainable Milk Plan template
- Fact sheets (e.g. DairyNZ)
- Stock exclusion survey (Prepared for the Ministry of Agriculture and Forestry)
- Progress reports on the Dairying and Clean Streams Accord and Sustainable Dairying: Water Accord

Horizons Regional Council

- Horizons Regional Council webpages
- Regional Policy Statement, regional plans, and management strategies
- Proposed One Plan (POP), POP as amended by the Environment Court decision, operative One Plan
- Public discussion documents (e.g. for the POP and management strategies)
- State of the Environment reports
- Science reports
- Section 42A reports
- Technical reports prepared to support the POP
- Educational material: leaflets, fact sheets
- Public submissions on the POP, appeals to the POP

- Submitter expert evidence (to the Environment Court)
- Water Management Zone maps
- Council meeting minutes
- Horizons Dairy newsletters
- Tararua Stream Fencing campaign promotional materials and reports)
- Manawatu River Leaders Accord Action Plan and progress reports
- Regional Action Plan for the Manawatu Wanganui region (Dairying and Clean Streams Accord)
- Resource guide for obtaining a Land Use Consent (produced by DairyNZ and Horizons)

International

- European Commission webpages and factsheets
- OECD research and reports
- Department for Environment Food & Rural Affairs (Defra) (webpages and reports)
- Australian National Landcare Programme (webpages and reports)

Other

- Public perception surveys
- Press releases (e.g. central government, Fish and Game, Forest and Bird, Fonterra)
- Radio NZ Newswire (news service)
- Articles in farming magazines (e.g. Dairy Exporter, Countrywide, Rural News, NZ Farmer
- Media articles from regional (e.g. Manawatu Evening Standard, Hawkes Bay Today, The Southland Times) and national newspapers (e.g. Dominion, The Herald)
- Regional Council webpages (e.g. Environment Waikato)
- Cost Benefit and Economic Impact Analysis report (Nimmo-Bell)
- New Zealand River Awards webpage

Appendix Three: Interview Schedules

Farmer Interview Schedule

Section 1: Farmer and farm system

1.1 Farmer and family

Farming history and background (how got into farming, length of time farming, length of time on this farm, whether a family owned farm)

Farm ownership structure (owner/operator, sharemilker, family trust, equity partnership).

No. of farms owned, whether sharemilking other farms

Plans and goals for the future

1.2 Current farm system

Area: total, milking platform, support/runoff blocks

Peak cow no. milked, once or twice a day

Pasture species/pasture mix

Wintering policy (on or off the farm, proportion of the herd and duration)

Cropping policy (area, crop, reason, winter and/or summer).

Supplementary feed policy (made or brought in, type, amount, where fed)

Fertiliser policy (supplier/s used, products, rate, when applied)

Effluent management (storage, application area and method)

Waterways through the property (rivers, streams, drains)

Irrigation (type, when, why)

Standoff pad or barn (how used)

Farm staff (family, staff, number, full-time/casual)

1.3 Changes made to the farm system or farm management over the past 5 years.

For each change: reasons why change was made (water quality or management reasons)

Discussion topics:

Supplementary feed policy (what, where fed, rate)

Pasture (management of, species used)

Effluent management (system, storage and volume, pond lined, application area, method of application, when applied, how to know when to apply, where applied)

Fertiliser policy (N and P: product, changes to rate and when to apply, method of applying, company used)

Cropping policy (what, when, where, grazing method, fertiliser)

Stocking rate

Other stock policies (breed change)

Wintering off

Stand-off pad, barns

Waterway management (drain and stream fencing, culverts, bridges, planting, management of waterway margins, whether used a Horizons fencing subsidy)

1.4 Changes planning to make in the future (water quality or other reasons)

Section 2 Water quality interventions

Proposed One Plan process

Personal involvement, organisations involved, level of support

Horizons One Plan

Knowledge and understanding of

Perceived impacts

Dairy Accords - Understanding of and impact on farm decision making

Supply Fonterra - Understanding of and impact on farm decision making

Dairylink project – awareness of

Collective/community action – description of

Sharemilkers and owners only: clauses in contracts around water quality

Section 3 Relationships and networks

Involvement in farming groups

Involvement with Federated Farmers

Attendance at discussion groups

Use of a farm consultant

Use of a fertiliser representative

Involvement in non-farming groups (e.g. church, sports)

Involvement in local community and school

Relationship with Horizons and staff

Longevity, practical farming experience

Relationship with DairyNZ

Relationship with Fonterra

Main source of information about farming and water quality (check for Horizons and DairyNZ)

On-farm checks of farm performance

Dairy farmers' relationship with the general public

General public's understanding of dairy farming practices and water quality

Do the general public trust dairy farmers to look after water quality?

Section 4 Norms of behaviour

Description of a good dairy farmer and good dairy farm management.

Accepted or expected farm management practices around water quality

How farmers learn about what is accepted/expected

How practices have changed over time

What happens if a dairy farmer doesn't do the accepted or expected farm management practices around water quality (sanctions)

Formal and informal community sanctions

Key informant interview schedule

Section 1 Participant's background

General background, any farming experience

Individual's role: current and previous

Organisation's role in farming and water quality

Section 2 Water quality interventions

Water quality interventions personally involved with

- Description of and changes over time
- Individuals/organisations interacted with
- Impressions of Overseer

Section 3 Contact and communication with farmers

Personal contact with farmers: when, who, why, how often

- Changes over time

Oganisation's contact with farmers – which staff, why

- Changes over time
- Training/background of staff who work with farmers
- How organisation manages non-compliance, changes over time

Staff changes (own organisation or others) – who, why,

- Relationship between staff changes and water quality interventions

Section 4 Relationships and trust

Personal level – with staff from other organisations:

- Individuals that work with/share information with, changes over time
- Interactions with Horizons' councillors
- Interactions with nutrient management consultants
- Interactions with key farmers, how use information gained

Organisational level – with other organisations:

Describe organisation's relationship with (Federated Farmers, Horizons, DairyNZ, Fonterra, TCEIS), changes over time

Level of trust with (organisation), changes over time

Information sharing between organisations

Farmer level

Organisation's current relationship with farmers, changes over time

Trust between organisation and farmers, changes over time

Influence of other organisations or groups on relationships and trust with farmers (e.g. TCEIS)

Others to interview

Identify others who would be good to talk with around farming and water quality.

Appendix Four: Information Sheet

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TE WĀHANGA PŪTAIAO

New Zealand dairy farmers' responses to water quality interventions: The role of social capital.

Introduction
My name is Heather Collins.

I'm undertaking a PhD in farm management. My study will investigate dairy farmers' responses to water quality interventions in the Manawatu-Wanganui region. The aim of this research is to inform farmers, policy makers and industry staff about how to improve their engagement with and support to dairy farmers, in order to achieve the desired water quality outcomes.

Water quality interventions include all the policies and programmes that are designed to improve water quality in the region. These consist of policies and programmes from organisations including the regional council, Fonterra and DairyNZ, and from community groups. I want to gain an understanding of how networks, trust and norms (also called social capital) have shaped dairy farmers' responses to these water quality interventions.

The supervisors for my research are Dr Janet Reid, Dr Dave Gray, Prof Nicola Shadbolt and Dr Liz Dooley from the Institute of Agriculture and Environment at Massey University. Our contact details are:

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The research

This case-study research will include semi-structured interviews, document collection and field observations. Up to 25 interviews will be completed with dairy farmers, people who work with dairy farmers in the Manawatu-Wanganui region and staff from relevant organisations.

Dairy farmer information sheet only
You have been randomly selected from the population of dairy farmers in the Upper Gorge Water Management Zone.

Key informant information sheet only
You have been identified by me or by other participants in the research as someone with knowledge and information that will assist me to complete my research.

All participants
The interview will be a maximum of 90 minutes. The interview will be at a location and time that you agree to. All your answers will be confidential and anonymous. Your name and identity will not be stated in the research to ensure confidentiality.

With your agreement, the interview will be tape recorded to make sure that I record your ideas accurately. The taped interviews will be transcribed and then analysed. A transcriber who is bound by a confidentiality agreement will transcribe the interviews. The recordings and transcriptions will be stored securely by the Institute of Agriculture and Environment at Massey for seven years and will then be destroyed.

A summary of the results will be available to you at the end of the project. I will contact you and let you know how this can be accessed.

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- decline to answer any particular question;
- withdraw from the study;
- ask any questions about the study at any time during participation;
- provide information on the understanding that your name will not be used unless you give permission to the researcher;
- ask for the audio tape to be turned off at any time during the interview; and
- be given access to a summary of the project findings when it is concluded.

Research ethics

"This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher(s) named above are responsible for the ethical conduct of this research.

If you have any concerns about the conduct of this research that you wish to raise with someone other than the researcher(s), please contact Professor John O'Neill, Director, Research Ethics, telephone (06) 350 5249, email humanethics@massey.ac.nz.

Making contact

If you have any concerns about this research or your involvement, please do not hesitate to contact me or my supervisors.

Thank you for your interest.

Appendix Five: Participant Consent Form

MASSEY UNIVERSITY

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TE WĀHANGA PŪTAIAO

New Zealand dairy farmers' responses to water quality interventions: The role of social capital.

Participant Consent Form

I have read the Information Sheet and have had the details of the study explained to me. My questions have been answered to my satisfaction, and I understand that I may ask further questions at any time.

I agree/do not agree to the interview being sound recorded.

I agree to participate in this study under the conditions set out in the Information Sheet.

Signature: .... **Date:** ....

Full Name - printed ....