Title: Exploring Dairy Farmers' Attitudes and Perceptions Towards Water Quality in Southland

Author: Isabella Paiva de Souza

Degree: Master of Applied Management, Southern Institute of Technology

Supervisor(s): Dr Christine Liang

Year: 2021

Exploring dairy farmers' attitudes and perceptions towards water quality in Southland

by

Isabella Paiva de Souza

Research Project Submitted in Partial Fulfillment of the
Requirements for the Degree of

Master of Applied Management

in the School of Business
Faculty of Business /SIT2LRN

SOUTHERN INSTITUTE OF TECHNOLOGY
(*An affiliate of the New Zealand Institute of Skills and Technology*)

Supervisor: Christine Liang

Due Date: 29/10/2021

Word Count (excluding contents and appendicies): 25066 words

Abstract

Water quality has been gaining attention in New Zealand, and dairy farming is in the spotlight as one of the contributors to water quality deterioration. This study provides insight into farmers' attitudes and behaviour towards water quality and the influence of social factors on farmers' decision-making. The Theory of Planned Behaviour and Social Capital Theory framed this study, and the combination of both theories contributed to exploring which social factors encourage farmers' behavioural change and how they shape farmers' attitudes. This qualitative study is based on an interpretive approach considering farmers' thoughts, feelings, and opinions. Semistructured interviews with five dairy farmers from Southland were used to collect the data.

Farmers' behavioural change is shaped by a range of connected social factors, including values and beliefs, financial resources, information, and education. Also, social networks and the engagement with community groups influence farmers' decision-making, besides improving communication, problem-solving and creating a collective responsibility between local farmers. Trust combined with social networks plays a key role in knowledge exchange and acceptance of advice, as farmers need to trust the source of information to accept and share it with other farmers. This study identified some research areas for future studies, including extending the study to other areas and agriculture sectors in New Zealand. Also, this study suggested exploring further the role of informational and financial incentives on farmers' behavioural change, besides investigating the influence of culture on farmers' attitudes and decision-making.

Keywords: water quality; influence; behavioural change; nutrient loss; external social factors; internal social factors; decision-making; social network; knowledge exchange; education.

Acknowledgements

To my husband: Thanks to my loved one who did not measure effort to help me get here. Thanks for believing in me. I could not do it without your love, caring and kindness.

To my family: Thanks to my parents, who sacrificed their lives for so many years to help me become an engineer. I would not be here finishing this master's if it were not for your support and unconditional love. Thanks to my sisters, my best friends. Thanks to my mother-in-law, your caring kept me going.

To my supervisor: Dr Christine Liang – Thank you for your patience, knowledge, encouragement, empathy, and support throughout this process.

To my participants: The farmers – Thank you for having me in your homes, for making this study much more interesting by sharing your stories, thoughts and opinions that were so valuable to this study and my personal and professional growth. Thank you so much for trusting me!

To the key informant: Thank you for providing the resources and farmers' contacts and sharing your knowledge with me. You made a considerable contribution to my studies.

To my friends: Thank you for supporting me and for being always interested in my research and my well-being.

More than ever, I want to thank God for enabling me in every way to get here, for having strengthened my mind in times of tiredness and discouragement, for having shown me that through challenges I could become more confident and capable. Doing a master's degree showed to be a roller coaster of emotions, which I needed to overcome fears and anxieties day after day, step by step. What seemed so far, now becomes a dream come true. To God, all my gratitude!

Table of Contents

List of Tables

List of Figures

List of Acronyms

SIT	Southern Institute of Technology
IVRM	Integrated Water Resource Management
FAO	Food and Agriculture Organisation of the United Nations
TPB	Theory of Planned Behaviour
PBC	Perceived Behaviour Control

Chapter 1. Introduction

1.1. Introduction

The intensification of agriculture and its impacts on water quality has become a priority of discussion worldwide. Dairy farming activities have been identified in the literature as a high contributor to water pollution for many reasons, but mainly due to the excess of nutrients from the use of fertiliser (Baucells et al., 2018; Cosentino et al., 2015; Cummings et al., 2013; Czycholl et al., 2020). As a result, water quality management has been widely discussed from a scientific perspective, but the approach to social factors within water quality studies still needs to be addressed (Bazan et al., 2019; Chau, 2007; Zonderland-Thomassen & Ledgard, 2012). Integrated Water Resource Management (IWRM) could present a suitable solution as it considers the multiple bottom lines by evaluating water policies and interventions considering culture, economic, environmental, and social impacts (White, 2013). IWRM has been rethinking water management by adopting a decentralised approach that emphasises the stakeholders' involvement, participation of the local community, and planners in the decision-making.

Farmers are important decision-makers when managing water pollution, and their voices in the wider water management discussion are often ignored. Considering that, farmers' contributions play an important role in water management, especially because they are a potential source of change. Furthermore, understanding farmers' perception of water quality can help achieve integrated management by identifying social factors that encourage farmers to adopt environmental changes to improve water quality. However, there is a scarcity of literature exploring water management that considers a social approach. Thus, this study is designed to explore Southland dairy farmers' attitudes and behaviour towards water quality and understand the influence of social factors on their behavioural change.

1.2. Statement of the problem

Water is a valuable source for human well-being and the global economy. Water quality plays an important role in the economy, and it affects the availability of freshwater for economic activities, such as food production (Food and Agriculture Organization of the United Nations, 2020, p. 14). In many parts around the world, sectors of the economy, especially the agriculture sector, are facing problems of getting freshwater because the water quantity available does not meet the water demand anymore, and the water quality issues have been potentially contributing to this extreme situation (Owusu-Sekyere et al., 2017a, p. 22).

According to the Food and Agriculture Organization of the United Nations (2017) (FAO), "global water scarcity is caused not only by the physical scarcity of the resource but also by the progressive deterioration of water quality in many countries, reducing the quantity of water that is safe to use" (p. 1). There are many studies on the literature linking farming intensification to water quality decline by reporting that the major contributors to water pollution are nutrients and sediments from the poor dairy effluent management and application of fertiliser (Baucells et al., 2018; Cummings et al., 2013; Payen et al., 2018; Ridoutt et al., 2014; Van-Middelaar et al., 2017).

Integrated water management practices combined with good farming practices are crucial to minimising risks related to water pollution. Farmers' willingness and behavioural change relies on a connected range of social factors (FAO, 2020, p. 23). Other studies claimed that social factors such as values, beliefs, social networking, and contact with a trusted source also influence farmers' behavioural change to improve water quality (Blackstock et al., 2010). However, some organisations which have been embracing water quality improvements argue that much still needs to be done to support farmers in this transition, since some water interventions require a dynamic and engaged approach to involve farmers and stimulate their behavioural change through inclusion (Food and Agriculture Organization of the United Nations, 2020, p. 25).

1.2.1. New Zealand context and background

New Zealand is well known for producing some of the best milk in the world (New Zealand Milk Products, 2021). Dairying is New Zealand's largest industry and makes a significant contribution to the local economy through its export revenue. According to New Zealand Dairy Statistics (2019), dairy farming contributed over 34% to the economy between 2019 and 2020, making the dairying sector the most profitable sector compared to the wood, meat, and wine sectors. Besides that, New Zealand produces three percent of the milk worldwide, holding the world's largest exporter position of dairy products (New Zealand Dairy Statistics, 2019). The dairying sector in

New Zealand is responsible for an impressive employment rate by providing income for more than 49.000 people, and 30.000 of these people are employed to work on dairy farms (New Zealand Dairy Statistics, 2019).

However, the Ministry for the Environment in New Zealand claims that farming activities have caused adverse effects on the water quality, and it has been extended to most of the rivers and some aquifers mainly located around farming areas (Ministry for the Environment, 2019). Furthermore, according to Ministry for the Environment (2019), the concentration of nutrients and sediments is fifteen times greater than in normal conditions, which is a risk for human well-being as it becomes unsafe for drinking and swimming (p. 46). Despite these analyses, the Ministry for the Environment (2019) claims that the water quality analysed at some locations today can be the result from many years ago, which means that farming activities from today may not affect the water quality in the future since farmers have been making progress towards conscious water management (p. 58).

Considering that, the context of this study is in Southland. The Southland economy was predominately based on beef, sheep, and deer farming, but the region has been experiencing a growth in dairy farming in recent years due to changes in the market (Ministry for the Environment, 2019, p. 58; Southland New Zealand, 2021). The South Island dairy production has been growing fast, and it currently represents 43% of the total New Zealand milk production (South Island Dairying, 2021). According to the Ministry for Primary Industries (2017), “farmers are continually looking at ways to use their farming technology more effectively to improve farm performance and deliver financial sustainability” (p. 2).

1.3. Research methodoly

The research philosophy of this qualitative exploratory study is interpretivism. Many studies assessed water quality in dairy farms through a scientific approach, but in some cases, they are not applicable in social science because they do not consider relevant factors that can influence the research (Pius & Helmi, 2020, p. 41). Interpretivism is guided “by the belief that social reality is not objective but highly subjective because it is shaped by our perceptions” (Collis & Hussey, 2009, p. 57). From that sense, through a qualitative design, this study aims to create a richer interpretation of dairy farmers and water contexts considering social factors, opinions, attitudes, and farmers' behaviour that goes beyond scientific studies seen in the literature (Thornhill et al., 2016, pp. 140-141). Five dairy farmers participated in this study, and they were selected using a purposive sampling strategy, a non-random technique based on participants' personal qualities. Data were gathered using semistructured interviews and analysed through inductive thematic analysis.

The chosen area for this study was influenced by the researcher's background, which is shaped by project experience with water quality and passion for water subjects. The main motivation for this research was the interest in exploring suitable solutions to benefit farmers and the environment and understanding the dynamic of social factors and farmers' behaviour is a crucial part of the solution. The researcher believes that an environment of blame and accusation has created a huge gap between farmers, the public and the government, making the discussion harder, which could impede any social research about water quality in New Zealand.

1.4. Significance of the study

There is a gap in the literature of studies exploring farmers' behavioural change, attitudes, and perceptions towards water management in general, particularly water quality. There are not many studies published that consider a social approach to understanding farmers' decision-making, and some social studies do not have a multidimensional approach considering factors, such as farmers' beliefs, values, and background. According to Blackstock et al. (2010), "there has been little research that specifically examines the social-cultural aspects of how stakeholders interpret, translate and respond to measures designed to mitigate diffuse pollution" (p. 5632). This author also explains that much research has been done regarding water policies and economic effects, but there is a scarcity of studies that take a social context to understand how farmers' behaviour is shaped in a social environment with different values, beliefs and backgrounds (Blackstock et al., 2010, p. 5634).

This research contributes to the water quality's literature by creating an in-depth interpretation of dairy farmers from Southland in New Zealand. Also, this study provides important evidence to the broader literature of Integrated Water Resource Management by exploring farmers' behaviour towards water quality. Future scientific research will also benefit from this paper by counting on farmers' contribution as important social drivers for water management. Furthermore, this study supports dairy farmers and policymakers by providing strategic insights and creating a transparent communication channel between farmers and the public.

The limitation of this research is related to the size of the sample and the limited geographic area chosen to carry out the study. Thus, the outcomes cannot be generalised to an entire population, as the variables can vary according to the location. The results and analyses can be applied only to farmers of this study. Also, as this research adopted an interpretive approach and focused on participants' feelings, opinions, experiences, and perceptions, it does not reflect the diversity of all farmers since others can have different opinions regarding water quality and related subjects discussed in this study.

1.5. Research question/aim and objectives

This research aims to explore farmers' attitudes and perceptions towards water quality and the influence of social factors on farmers' behavioural change in Southland, New Zealand.

Objectives:

1. To describe best water quality management practices.
2. To analyse the motivation for change made over the years and its constraints.
3. To describe the main factors that shape farmers' behaviour and decision-making towards water quality management.

1.6. Structure of thesis

This thesis is structured in six chapters. Chapter one introduces the research problem to be explored, research design and methodology selected, and it provides a background and context from which the study was developed. Chapter two reviews theories that framed this research, Theory of Planned Behaviour and Social Capital Theory. Furthermore, chapter two provides an overview of the dairy industry in New Zealand. Chapter three reviews the empirical literature from a global perspective around social factors and their influence on farmers' behavioural change, besides presenting a literature review regarding key water quality issues and management practices.

The qualitative research design based on an interpretive approach and the inductive thematic analysis used in this study is outlined in Chapter four. Chapter five presents the results and discussion. The results are organised in 4 themes: farmers' ability and intentions; water quality best management practices; perception of water quality and social network, sharing of information and trust. The findings' discussion compares the findings in this research with the literature. Also, this section is organised in four subheadings: farmers' ability, farmers' willingness, external factors, and good management practices. Finally, Chapter six presents the conclusion based on this study's aim and objectives. Chapter six also discusses the implications of the findings and suggest recommendations for future research.

Chapter 2. Theory and Industry Analysis

2.1. Introduction

The theoretical framework used in this study is discussed and reviewed in this chapter. The Theory of Planned Behaviour and Social Capital Theory presented in this chapter framed the research, and for that reason, chapter three of this study is based on both theories. Social Capital and the Theory of Planned Behaviour are not commonly connected in the literature, but both theories share some similarities, such as networks and social relationships, social trust, and norms in different ways. Besides that, both theories enable the analysis of behavioural change in different levels, at an individual level and in a group level, and both are highly significant to this study.

This chapter is divided into two sections, theoretical analysis, and industry analysis. Within the theoretical analysis section, there are two themes. Firstly, the influence of internal and external sources on an individual's behaviour is discussed and how these factors can impact the intention to act. The second section is regarding the forms of Social Capital in terms of civic engagement or network, social trust, and norms, and how the transfer of knowledge through social relationships can affect the adoption of a specific behaviour. The Industry Analysis section is divided into two themes. Firstly, the history of dairy farming in New Zealand is presented, showing some connections from the past that still influence farmers' behaviour in modern days. Secondly, water quality issues in New Zealand are outlined from a wider perspective, and the role of the government and some organisations towards water quality improvement is highlighted.

2.2. Theoretical analysis

2.2.1. Behavioural change at the individual level

Theory of Planned Behaviour

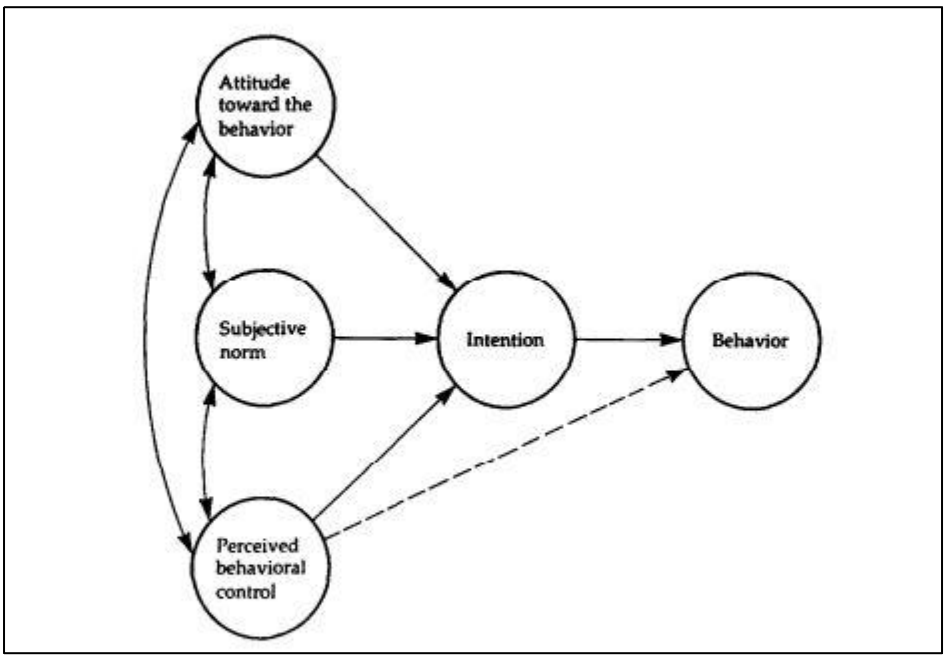
The Theory of Planned Behaviour (TPB) has become one of the most cited and influential models in the literature to describe human social behaviour, which focuses on individuals' attitudes and beliefs (Biological Emissions Reference Group, 2018, p. 15). The (TPB) is a social-phychological model to understand human behavioural intentions and assess how these intentions influence a specific behaviour (Adnan et al., 2021, pp. 2-3). According to Ajzen (1991), intentions are defined as individuals' motivation to perform a behaviour, and it reflects the willingness to take this action and the individual decision to engage in that behaviour (p. 181). Ajzen (1991) also claims that "the stronger the intention to engage in a behaviour, the more likely should be its performance" (p. 181).

According to Ajzen (2006), "human behaviour is guided by three kinds of considerations: i) beliefs about the likely consequences of the behaviour (behavioural beliefs); ii) beliefs about the normative expectations of others (normative beliefs); iii) and beliefs about the presence of factors that may facilitate or impede the performance of the behaviour (ease/difficulty)" (p.1). Behavioural beliefs can reflect a positive or negative attitude towards the behaviour. Normative beliefs are influenced by social pressure from external and internal sources (for example, government, non-governmental organisations, friends and family). Control beliefs or Perceived Behaviour Control (PBC) produce favourable or unfavourable outcomes depending on external factors that can influence an individual's capability to get involved in that behaviour, for example, skills, income and knowledge (Adnan et al., 2021; Ajzen, 2006, p. 1). The more positive attitudes and subjective norms are, the better is the self-efficacy or perceived control. Thus, given the control over the behaviour, individuals tend to follow their intentions in a changing situation, and some authors assume that "intention is the immediate antecedent of behaviour" (Ajzen, 2006, p. 1). Hence, these three social-phychological constructs can influence intention towards behaviour, either negatively or positively.

From the concept of PBC, according to Ajzen (1985), personal problems and external interferences can influence an individual's intentions towards an action or decision-making, and behavioural intention is the effort of having control over the issues that may appear between success and failure performance (p. 29). To explain in meaningful situations, Ajzen gives an example of a father who wants to take his son to go fishing at the weekend, and his intentions to perform this behaviour can be seen through the act of planning to go fishing and the arrangements along the week to do it (Ajzen, 1985, p. 29). In a different context but using the same analysis in this study, farmers' behavioural intentions to improve water quality can be interpreted as their effort invested in implementing changes over the years regarding water management. According to Ajzen (1985), "social behaviour follows more or less well-developed plans" (p. 36). Thus, the changes over the years regarding farming systems, water interventions, and possible existent planning as a goal to the future represent evidence of behavioural change intentions towards water management.

In general, a person will attempt to perform a behaviour if the possibilities of success outweigh the failure and based on personal motivations to take this action or change. It is also important to highlight that the success is a matter of the ability to take control over an external / internal factor that may interfere, plus the effort invested in performing a certain behaviour (Ajzen, 1985, p. 36). Besides that, success also depends on a range of factors, such as information, skills, time, opportunity, and financial abilities (Ajzen, 1985, p. 36). Thus, measuring attitudes towards behaviour is the key to understanding their beliefs and caring about the behaviour in question (Bautista & Bayang, 2015). The three considerations that guide human behaviour can be seen in Figure 1.

Figure 1: Theory of Planned Behaviour *(Ajzen, 1991)*



2.2.2. Behavioural change at the community level

Social Capital Theory

The concept of Social Capital Theory has become increasingly common in the literature to discuss social-cultural factors. Social Capital Theory is related to factors that affect behavioural change at a collective level (Adler & Kwon, 2002). These forces consist of the networks, norms, relationships, values, and beliefs that shape the behaviour at a community level and influence the outcomes of the collective action (Australian Public Service Commission, 2007, p. 17). In this study, the Social Capital Theory complements farmers' behavioural change in terms of social relations and how that can facilitate a certain type of action at a collective level based on farmers' community. Some important authors lead the studies of social capital in the literature. Coleman (1988) and Putnam (1995) are examples of valuable sources of contribution to understanding social capital and its effects on society. According to Coleman (1988),

"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 structures, and they facilitate certain actions of actors-whether persons or corporate actors-within the structure" (p. 98).

Putnam (1995), in his study about the consolidation of democracy, focused on social networking to understand the phenomena of how civic engagement and social- connectedness produce better results in the community. He defines Social Capital as "features of social organisation such as networks, norms, and social trust that facilitate coordination and cooperation for mutual benefit" (Putnam, 1995, p. 2). A single definition does not restrict Social Capital; instead, it includes a range of social relations determinants that enhance certain behaviours, such as adopting a management practice change.

Other authors also define Social Capital from different perspectives. For example, Adler and Kwon (2002) say that Social Capital is the social structure in which favours and benefits are exchanged (p. 18). Brehm and Rahn (1997) argue that Social Capital is a collective concept based on an individual's behaviour (p. 1000). Different definitions of Social Capital can be found in the literature, and there is a commonality between these definitions regarding network and relationships, norms, and trust, which are the forms of Social Capital discussed in most studies.

Forms of Social Capital: civic engagement (network), norms and social trust

Putnam (1995), argued that norms and networks generate better results in different and multiple contexts such as schools, government, crime rate and economic development by improving an individual's behaviour through civic engagement and social connectedness (p. 2). He also claims that life is less complicated in a community with a high level of Social Capital, and that is because a social network brings an environment of reciprocity and reinforces social trust between members (Putnam, 1995, p. 2). In addition to that, Putnam (1995) emphasised the positive effects of social networks at a community level as they contribute to a transparent communication and solve issues and dilemmas by creating a mindset based on "collective actions for collective benefits" (pp. 2 - 5). Thus, analysing social networks between farmers of this study enables the identification of benefits from that social interaction and how it works to solve water quality issues.

The other form of social capital analysed by Putnam (1995) is regarding social trust. According to him, "social connectedness and civic engagement have tacitly assumed that all the forms of social capital discussed are themselves coherently correlated across individuals" (p. 8). He also claims that individuals who belong to an organisation or a group are more likely to get involved in politics, engage with neighbours, and be more trusting (Putnam, 1995). It is important to mention the correlation between social trust and education and social trust and civic engagement or social network. The education level has risen while social trust decreases (Putnam, 1995, p. 8). Also, social trust and social networks are strongly connected. The number of associated members in a community is directly proportional to expressing social trust between peers (Putnam, 1995, p. 8).

Brehm and Rahn (1997) make similar assumptions regarding civic engagement and social trust. According to them, "the more citizens participate in their communities, the more they learn to trust others; the greater trust that citizens hold for others, the more likely they are to participate" (p. 1002). The dynamics that maintain civic engagement and social trust have relevant effects on the level of confidence from citizens towards political organisations, and individuals who express social trust to others have higher levels of confidence in political institutions (Brehm & Rahn, 1997, p. 1003). Furthermore, compliance based on fear is an inefficient approach, and individuals are more likely to behave themselves based on internalised norms (Putnam, 1993). It is important to contextualise the motivations for change in this study, which aims to analyse if the reasons for farmers change behaviour are more related to internalised norms or beliefs or based on regulations.

Coleman (1988) also agrees with the correlation between trustiness and network. According to him, constant participation leads to a greater trust in one another. He also emphasised the idea that a group with a high level of trustworthiness is more likely to be successful than a group without that trustworthiness (Coleman, 1988, p. 101). From a different perspective, he also introduced trust in terms of obligations and expectations. According to his study, whenever there is a high level of trust in a social environment, obligations will be repaid, creating a rotation-credit cycle that keeps members united and motivated to help each other (Coleman, 1988, p. 102).

Finally, social norms are social expectations about what is accepted or not in a particular context, and they are defined and reinforced by society through a collective sharing of beliefs and values. Both Coleman (1988) and Putnam (1995) mentioned the importance of social norms in their studies. From Coleman's perspective, social norms are outcome-oriented since they are accompanied by rewards or punishments (Claridge, 2020; Coleman, 1988). He further argues that norms are internalised or socially supported in some cases, and regardless of being internal or external, "norms of this sort are important in overcoming the public goods problem that exists in collectivities" (Coleman, 1988, pp. 104-105). From Putnam's point of view, social norms are not about individuals' preferences but collective realisations. He claims that norms potentially influence democracy and the performance of social institutions, and that influence is based on mutual obligation and social-collective action (Putnam, 1995, pp. 1-3).

Knowledge exchange and networks

Many studies found in the literature focused on analysing how the social context in which an individual is embedded can affect their behaviour in terms of transfer of knowledge (Adler & Kwon, 2002; Coleman, 1988). The flow of information between members, peers, friends and even neighbours facilitates the action by providing concepts for change (Coleman, 1988, p. 104). The role those social interactions play in promoting knowledge exchange is relevant to understanding farmers' behaviour in this study and the dynamic involved in farmers' relationships. Some authors have been exploring this theme in-depth, and they argue that, besides facilitating knowledge that flows through a network of members, friends or participants, social capital can also create new knowledge inside that network (Adler & Kwon, 2002; Montoro-Sanchez & Díez-Vial, 2014). According to Montoro-Sanchez and Díez-Vial (2014), the social network depends on the level of trust and the type of relationship established to encourage relevant behavioural change, either individually or in a group of people (p. 278). The level of trust and friendship makes people more willing to share knowledge and listen/accept knowledge from others. Also, locally adapted language, norms, culture and background can affect knowledge exchange by changing the individual perception about what is important and what is not (Montoro-Sanchez & Díez-Vial, 2014, p. 279).

2.3. Industry analysis

2.3.1. History of dairy farming in New Zealand

Dairy farms started to increase their number in New Zealand in 1969 (Science Learning Hub, 2021). By that time, there were more than 2.3 million cows and around 25000 farmers. From 1990 to 2001, the size of the farms increased from 72 hectares (ha) to 105 ha (Science Learning Hub, 2021). The dairying industry in New Zealand is strongly grounded in social and political factors as the New Zealand Government promoted a campaign between 1980 and 1990 to attract immigrants from the United Kingdom to settle in New Zealand due to the shortage of skilled labour to work on the dairy farms (Baldwin, 2016, p. 6). The New Zealand government was responsible for establishing measures and shaping the dairy's industry future by providing financial assistance, technical advice, setting regulations and standards and giving the power to enable the industry's growth through the creation of cooperatives (Baldwin, 2016, p. 15).

There was a suspicious environment between factories and dairy farmers because of a conflict of interests, as farmers believed that dairy businesses were looking for more than a fair share of their livelihood (Baldwin, 2016, pp. 17-21). The farmers' community emerged from the common feeling of social distrust, and the values of these pioneering days do influence farmers' behaviour lately. The bond drives industry's culture between farmers and the government, since the government established working closely with farmers (Baldwin, 2016). As a result, the relationship between farmers and government from the beginning still does influence farmers' behaviour nowadays as Baldwin (2016) states that "whenever problems arose, the industry turned to the government for special treatment" (p. 26).

2.3.2. Freshwater quality in New Zealand

Environmental concerns about water quality have been putting pressure on the dairy industry and have changed expectations towards farmers in New Zealand. The impacts of dairy farming have been extended to outside of farms boundaries. As a result, society has become less tolerant about the negative impacts of farming, despite acknowledging the dairy industry's relevant contribution to the New Zealand economy and society itself (Clark et al., 2007, p. 215). Dairy farming has intensified over the years, which has also contributed to some environmental issues, especially regarding water quality. According to Ministry for the Environment (2019), dairy cattle numbers have increased and "cows produce more urine with a higher nitrogen concentration than sheep" (p. 52). Besides that, the fertiliser rate has escalated over the years, and nitrogen and phosphorus, which are the main component of fertiliser, are also the major pollutants of waterways (Ministry for the Environment, 2019, p. 52). An additional factor to be considered in water quality evaluation is the farmers' values and attitudes, as they strongly influence their decision-making and adoption of measures to control diffuse water pollution (Clark et al., 2007, p. 215).

In response to water quality issues, the government, organisations, and the farming community have adopted some procedures to improve water quality. According to Dairy NZ (2019), farmers have made significant progress on their commitment to farming over the last five years, motivated by the Sustainable Water Accord. This water accord is a voluntary agreement between dairy farmers and dairy processors to improve the health of waterways in New Zealand by installing fences, bridges or culverts to avoid dairy cattle crossing over streams (Dairy NZ, 2019).

The government has also been stricter regarding environmental regulations. Recently, the Freshwater National Policy Statement 2020 and the National Environmental Standards for Freshwater were released, which providing to local councils instructions on managing farming activities that can affect the health of catchments and waterways. The primary purpose of these regulations proposed lately is to make mandatory the adoption of a farm environmental plan in every farm in NZ, to control high-risk farming practices such as winter grazing and nitrogen pollution (New Zealand Government, 2020).

Fonterra also has made important decisions towards water quality improvements. As a result of the new environmental regulations proposed by the government in 2020, Fonterra has launched a guide for its supplier's farmers focused on the environmental management practices managed by sustainable dairying advisors (Farm Source Sustainable Dairying, 2020a). According to Farm Source Sustainable Dairying (2020b), the programme was developed especially for Fonterra's farmers to help them meet the new standards by having specialised support to adopt best management practices for their farmers.

2.4. Summary

Behavioural change achievements result from combining intentions and the ability to execute that behaviour, and the success to perform a specific behaviour is strongly influenced by internal and external sources, such as information, time, financial resources, skills, opportunity, and effort. Analyzing farmers' intentions towards water quality improvement is a way to weigh what is a priority for them and what has been a barrier. Possessing a well-developed plan or big achievements in the past that still reverberates can be relevant evidence of farmers' efforts to change water management and adopt good management practices.

Network, trust, and norms are significant social factors that influence farmers' behaviour. An individual's behaviour is positively influenced through social connectedness and civic engagement in the community. Social trust and social networks are strongly linked, as individuals who belong to a group tend to be more trusting and accept the adoption of new procedures / new actions more easily. Norms are about social expectations of what is accepted and what is not, influencing behavioural change in terms of rewards and punishment.

Finally, knowledge exchange through social networks facilitates the action by providing concepts for change. However, some social factors, such as background, information and trust can influence an individual's perception of sharing information. Also, to which degree the transfer of knowledge influences their decision-making and based on which factors they judge information as reliable is part of this research.

Thus, the Theory of Planned Behaviour and the Theory of Social Capital contribute to addressing this study's three objectives proposed. By applying the Theory of Planned Behaviour, this study analysed the influence of social factors such as, financial resources, education, skills, and information on farmers' behavioural change, besides describing good management practices and changes adopted over the years. The Theory of Social Capital contribute to describing the main social factors which shape farmers' decision-making in this study.

Chapter 3. Literature Review

Material from the same author submitted as part of the requirements for MGT04 is included in this literature review.

3.1. Introduction

The decline of water quality has been gaining attention due to the high load of nutrients in waterways. The increasing need to understand farmers' behaviour and how to engage them to mitigate diffuse water pollution has become a priority of research. This literature review is structured into two themes, and it mainly discusses the factors that influence farmers' behavioural change and water quality in dairy farming. Firstly, it explores critical environmental issues of water pollution from dairy farming activities and discusses good management practices highlighted in the literature. The second theme is regarding critical factors that affect farmers' behaviour, which is divided into three topics. The first one is about farmers' ability to perform a specific behaviour. The second topic relates to farmers' willingness to adopt a new practice, such as intention and perceived easiness. Finally, it examines the literature regarding how broader social interaction can influence farmers' decision making.

3.2. key water quality issues and good management practices in the global dairy farming context

Globally, a high load of nutrients from farm activities into waterways can decrease the quality and health of freshwater. Freshwater eutrophication, which results from a high load of nutrients into the waterway, has been widely used in studies focused on dairy farming as a characterisation factor to quantify water pollution (Chau, 2007; Hu et al., 2018; Zonderland-Thomassen et al., 2014). A study by Cummings et al. (2013) that was carried out in the United States of America (USA) found that water pollution originating from crop production was much higher than dairy herb (p. 87). Likewise, Masoni et al. (2012) claimed that 97% of freshwater eutrophication was associated with nitrogen from farm operation, and 2% were from dairy processing through the discharge of wastewater (pp. 154-155). They also found that "emissions of nitrogen account for more than 80% of total eutrophication potential, which is mainly from chemical and organic fertiliser use" (Masoni et al., 2012, p. 155). Similarly, Tomasevic et al. (2014) assessed the environmental impacts of milk production in seven dairy farms located in Serbian, and they assured that the highest freshwater pollution was associated with the production of raw milk at the farm level (p. 67). They claimed that the main contributor was the loss of nitrogen that happened through the use of fertiliser on the farm (Tomasevic et al., 2014, p. 68).

A New Zealand study by Zonderland-Thomassen et al. (2014) regarding the environmental impacts of livestock production collected data from 426 farms during one year and showed that most of the water pollution was related to nitrogen leaching and phosphorous runoff from the paddocks (p. 258). These findings are supported by Baucells et al. (2018), who conducted research on a dairy farm in Catalonia and found that 99% of the impacts were related to feeding production. They claimed that feeding production contributed 59% to water eutrophication through emissions of phosphorous and nitrogen (Baucells et al., 2018, pp. 1323-1325). A study conducted by Czycholl et al. (2020) in German also analysed crop production to find its contribution to freshwater eutrophication. They found that crop production contributed to freshwater eutrophication through losses of phosphorous and nitrogen (Czycholl et al., 2020, pp. 6-8).

The practices proposed in the literature to reduce water quality deterioration are controversial. Some examples in the literature suggest areas of improvement such as reducing fertiliser in production, having appropriate manure management, wetlands, planting and fencing (Cummings et al., 2013; Drizo et al., 2015; Hu et al., 2018). However, according to a New Zealand study by Doole and Romera (2015), there is a direct relationship between loss of nitrogen and high milk production, and they claimed that the combination of low leaching of nitrogen and milk output is not profitable (p. 20). From another standpoint, Smith et al. (2018) argued that "improving the management of nitrogen is a way to increase profitability and reduce nitrogen losses to the environment" (p. 275). After testing seven fertiliser strategies in different farms, they claimed that fertilisers should be according to the seasons of the year rather than having a fixed strategy for the entire year (Smith et al., 2018, p. 279). Smith et al. (2018) also found that strategies based on the modified seasonal approach were more productive than the conventional or flat rate strategy due to less fertiliser application with lower nitrogen losses (p. 279).

A relevant gap in the literature was identified through those qualitative studies regarding water quality in dairy farms mentioned above, as they do not consider farmers' contributions to analysing not only the cause of water deterioration but also the analyse of "*why*" the loss of nutrients in waterways is a common issue, "*what"* are the difficulties of water quality management, and "*how*" to overcome these issues from a social perspective.

3.3. Key factors influencing farmer's behavioural change

3.3.1. Internal factors (Farmers' ability)

The lack of information is one of the main factors that constrain farmers' behavioural change. The role of information and knowledge exchange has been frequently discussed in some studies considering the adoption of new farming techniques and farmers' behaviour intention (Amacher & Feather, 1994; Zhang et al., 2010). For instance, Amacher and Feather (1994) carried out a study to investigate the role of informational incentives in the adoption of BMP's to improve water quality. The authors assessed important variables such as socioeconomic characteristics that can influence farmers' decisions (Amacher & Feather, 1994). Their findings showed that as the farmers become informed, the uncertainty regarding adopting best management practices decreases, and informational incentives through education may be more effective than direct regulations and financial support. (Amacher & Feather, 1994, p. 167). From a different perspective, Zhang et al. (2010) assessed farmers' acceptance of information, and they found that searching motivation and experience had a significant effect on the information's acceptance, which means that farmers who are willing to look for information voluntarily or who have experienced intake of information more than once are more likely to accept it (p. 218). The other variables included in that study, such as gender, age, and income, did not show significant correlations.

Education can affect farmers' decisions towards adoption and change in the farming systems. Education level is highly associated with farmers' behavioural change across the literature (Daxini et al., 2019; Issa & Hamm, 2017; Sepahvand & Gholamrezai, 2017; Wang et al., 2017). For instance, Wang et al. (2017) found through their study in Thailand that "a farmer with a relatively higher education level and a larger household was positively related to all adaptation methods" (p. 680). This finding is supported by Ringler et al. (2011), who reported that farmers with a higher level of education and larger families are more likely to perform a specific behaviour and better adapt in a new context than less-educated farmers with smaller families due to the possession of resource and capabilities in terms of knowledge and labour for the farming activities (pp. 28-29). Likewise, Gowda and Dixit (2015) assessed the influence of farmers educational level on comprehending, acting according to advice and sharing information. They found that farmers with higher education levels acted better upon instructions of advisors than farmers with lesser education (Gowda & Dixit, 2015, p. 169). A noticeable finding of this study is that the majority of the participants shared the advice with other farmers regardless of education level, including all illiterate participants, 88.6% of the graduate farmers and 78% of the professionally qualified farmers (Gowda & Dixit, 2015, p. 169). Similarly, a study from New Zealand also evaluated the role of education and its effect on farmers' decisions. Their findings showed that farmers with post-secondary education adopt more technologies than those with secondary education or less (Whenua, 2019). They also found that years of education were positively related to risk tolerance in New Zealand (Whenua, 2019, pp. 12-13).

There is also a relationship between farmers' behavioural change and personal characteristics such as age and experience. Burton (2014) and Schroeder et al. (2012) claim that these features can influence farmers' decision-making in adopting new technologies, the entry in farm-environmental schemes and farm environmental commitment. Age is seen in the literature as a common factor that influences the adoption of new technologies to improve farm environmental performance, for instance, Schroeder et al. (2012) carried out a study in Canada having farmers of different ages, and they found that farmers had different behaviour and attitudes towards adopting a specific new agricultural technique. Likewise, other studies also reported similar results suggesting that young farmers are more likely to engage in environmental programs than older farmers (Burton, 2006; O'Donoghue et al., 2011; Thenail et al., 2004). From another point of view, Wilson (1997) argued that there is no difference between age and behavioural change (p. 82), while Thenail et al. (2004) claimed that younger farmers are more willing to perform a new behaviour towards environmental issues than older farmers because they want to invest in a long term (p. 241).

From a different perspective, other studies also analysed the influence of experience in farmers' behavioural change (Atari et al., 2009; Knierim et al., 2006). For instance, Knierim et al. (2006)

found that higher levels of experience with a specific farming practice tend to decrease the probability to change farming systems or processes regarding environmental controls (p. 329). Similar results were found by Atari et al. (2009) in their studies in Nova Scotia. According to them, participants with a moderate level of experience were more likely to adopt new environmental measures than high experienced farmers, as they found that farmers with a high level of experience were more resistant to change and learn new practices than a farmer with a moderate level of experience (Atari et al., 2009, p. 1273).

The financial resource is an important variable to influence farmers' attitudes, as they can enable the adoption of new practices or constraint the change of behaviour due to the lack of money reserve. For instance, Barnes et al. (2018) found that economic factor (income) had the most substantial influence on adopting new practices. They claimed that farmers who showed a positive investment behaviour in the farming systems were more likely to adopt environmental technologies (Barnes et al., 2018, p. 875). Likewise, Ringler et al. (2011) argued that farm income strongly contributes to adapt intention since farmers with a higher income are more likely to commit to changes as they usually have reserve money and enough financial resources to manage any existent risk of adaption (p. 680). Similar results were found by Adrian et al. (2005), who reported that some changes in the farming system require a significant investment in capital, time and learning, and the cost associated with these changes can act as a barrier for smaller farms (p. 261).

From a different perspective, Wilson (1997) claimed that farmers who are not entirely dependent on farming income do not need to increase profits and are more likely to adopt environmentally friendly practices. On the other hand, farmers who rely on farm income to provide for their families may be more willing to adopt environmental practices to increase the probability of additional income (Wilson, 1997, p. 83). Similarly, Atari et al. (2009) reported that farmers with lower farm income were less likely to adopt environmental schemes, as they have farming as a part-time job; thus, part of the family income was an off-farm source (p. 1274). Another example was a study carried out in Canada by Serman (1999), who analysed factors influencing farmers' adoption of soil and water conservation practices. They argued that farmers with higher incomes tend to engage in environmental innovations as they have financial resources to invest in that innovation (pp. 112-

113). Additionally, Knierim et al. (2006) found in their study that “economic interests are of eminent importance when farmers think about participation in measures enhancing the environment” (p. 326), which according to them is not surprising, once farmers need to keep their business in a positive economic balance.

3.3.2. Theory of Planned Behaviour (Farmers’ willingness)

The intention helps to predict behaviour as it is linked to an individual’s willingness to perform a behavioural change. For instance, Daxini et al. (2019) carried out a study to analyse drivers of farmers’ intention to adopt a nutrient management plan (NPM - an environmental measure control to minimise diffuse water pollution), and understand which factors motivate farmers’ behavioural change. Their findings showed that farmers had a positive intention to adopt NPM in their farm systems by showing a positive attitude towards NPM adoption and a positive level of control related, but farmers also reported a feeling of social pressure to follow an NPM (Daxini et al., 2019, pp. 431-432). Furthermore, the authors claimed that perceived behaviour control was the most influential factor of intentions regarding NPM, and farmers’ perception of self-confidence and easiness to adopt NPM was crucial considering that NPM is a technique that requires skill and specialist knowledge (Daxini et al., 2019, p. 434). Likewise, Lansink et al. (2014), who performed a study in Brazil to analyse farmers’ intention to adopt improved natural grassland, found that attitude, subjective norm, and perceived behavioural control showed a positive correlation with intention by having more than 50% of the participants willing to adopt this measure in their farms (p. 170). Their findings also show that two intentions identified as attitude driver were preventing soil erosion and decreasing feeding cost. Family, friends, neighbours, consultants, and government were identified as drivers for the subjective norm (social pressure). Finally, the three main drivers of perceived behavioural control were knowledge, skills and availability of technical assistance (Lansink et al., 2014, pp. 172-173).

Their surrounded environment highly shapes farmers’ motivation to change. Masser et al. (2005) carried out a study to investigate the role of farmers’ beliefs in the decision-making about riparian zone management to improve water quality in Australia. Their findings showed that “strong intenders endorsed the potential benefits of riparian zone management and downplayed the costs relative to weak intenders” (Masser et al., 2005, p. 18). In addition to that, stronger intenders were more willing to comply with normative regulations regarding water quality than weak intenders because their involvement with environmental groups and catchment groups motivated them to conform according to their wishes (Masser et al., 2005, p. 18). Also, the findings showed that strong intenders felt that perceived barriers were less likely to constrain them to perform riparian zone management, except by the lack of financial resources, which was a typical response between farmers who had strong intentions to adopt this measure and farmers who did not (Masser et al., 2005, pp. 18-19). Different results were found by Bielders et al. (2010), who reported that only attitudes influenced farmers' intentions to adopt soil management practices and subjective norm and perceived control were not significant (p. 93). Also, Micha et al. (2018) reassured the importance of attitudes and perceived behaviour control in farmers' behavioural change, but they did not find subjective norms significant driver for farmers' intention to adopt grazing management practices in Ireland (pp. 103-104).

There is a gap in the literature identified in the social studies mentioned above, as they did not consider farmers' values and beliefs as an important social factor influencing behavioural change.

3.3.3. Social Capital (wider social influence)

Social networks such as local farm community, neighbours, farm consultant and family play a significant role in adopting good management practices and changing behaviour. The literature highlights the importance of contact with a trusted source to perform a behavioural change (Blackstock et al., 2010; Daxini et al., 2019; Engler et al., 2017; Mills et al., 2013). For example, Engler et al. (2017) conducted a study to assess the effect of social capital on the adoption of irrigation technology in Chile. Their findings showed that trust and networks positively influence irrigation technology adoption, and trust and network are positively correlated (Engler et al., 2017, pp. 225-226). They also reported that "trust and informal networks have a stronger relationship than formal networks" (p. 225). The authors reported that trust in organisations and water communities influence the adoption of irrigation technology positively by farmers as trust may help decrease the perception of risk and insecurity, and the results showed that farmers made their decisions regardless of informal network and based on benefits offered by formal networks (Engler et al., 2017, p. 227).

Moreover, according to Blackstock et al. (2010), behavioural change and the success of sharing information depend on the individual's trust in the source of advice, which can be an organisation, a friend or an advisor (p. 5632). They claim that experience and occupation are key factors to convince farmers of the source's reliability, and in-group messages, especially coming from an individual who has a farming background, are more well accepted by farmers (Blackstock et al., 2010, p. 5632). For instance, Koppen et al. (2004) discussed the judgment made by farmers towards scientific information regarding good management practices in Tanzania. This study made relevant statements regarding the role of scientists in water management. The authors claim that scientists need to focus on two aspects of water research, action research by conducting studies and assessments and action advising by integrating various dimensions of policy work, including stakeholders, farmers and policymakers (Koppen et al., 2004, pp. 148-151).

The social network is a mechanism for accessing resources and information and can contribute to farmers' cooperation. For example, Mathijs (2003) conducted a study in the United States to investigate the farmers' willingness to adopt an environmental scheme. According to his results, the social network played a relevant role in farmers' behavioural change since farmers who were more open to receiving advice were more likely to adopt environmental techniques to improve water quality (Mathijs, 2003, pp. 14-15). Likewise, Engler et al. (2019) found that farmers use different networks for making decisions based on their farming objectives and personal characteristics. For example, their findings showed that farmers performed different behaviours: - some farmers who wanted to adopt a high level of innovation made their decisions based on close contacts such as family members and peers and formal contacts (organisation, consultant advisors, catchment groups); - some farmers who preferred adopt practices that were validated by others restricted their decisions based on family and friends network; - finally, there was a group of farmers who adopted environmental practices and technologies without using much diverse network (Engler et al., 2019, pp. 56-60).

There is a gap identified in the literature review above regarding the influence of other external factors on farmers' behaviour. It was clear through those studies that social interaction influences farmers' decision-making, but the other factors involved in that change were ignored, such as values, beliefs, financial resources, and education. Thus, this study aims to cover a range of social factors involved in farmers' behavioural change by combining the Theory of Planned Behaviour and the Theory of Social Capital.

3.4. Summary

Research's objectives

This research has three primary objectives to be delivered:

1. To describe best water quality management practices.
2. To analyse the motivation for change made over the years and its constraints.
3. To describe the main factors that shape farmers' behaviour and decision-making towards water quality management.

Research's aim

The research's objectives are driven by the aim to explore dairy farmers' attitudes and perceptions towards water quality and to understand how social factors affect farmers' behavioural change in the specific context of Southland, New Zealand. This study used the literature discussed in this chapter and theories that framed this study, to deliver the research's objectives and answer the question.

1. This research describes good water management practices adopted by the participants and compare these practices with the literature using studies such as Cummings et al. (2013) and (Hu et al., 2018), which are some of the authors who assessed water pollution in dairy farms and explored practices to remediate the problem. The common sense in the literature is that the leading cause of water pollution from farming activities is emissions of nitrogen and phosphorous, substances found in fertiliser used in crop production. Through participants' responses regarding farming systems, wastewater technology and crop production systems and comparing the results with the literature, this study describes best water quality management practices adopted by the participants to minimise water quality issues.

2. This research used both theories, Theory of Planned Behaviour and Theory of Social Capital, and authors, such as Ajzen (1991) and Bordieu (1986) to compare the response from the participants and findings from the literature. Theory of Planned Behaviour argues that once an individual has an intention to perform a specific behaviour, changes will happen. However, this theory also highlights the influence of internal and external factors that can affect both the ability and willingness to take this action, such as information or knowledge, money reserve, and education. Thus, this study describes and discusses farmers' motivations to change and its contrainsts based on theories and findings from the the literature.

3. This study addresses the third objective by relating its findings with the Theory of Social Capital and Planned Behaviour and comparing with the literature review. Social Capital Theory claims that social aspects can encourage or discourage an individual's behaviour through sharing information, trust, and social pressure/norms. Individuals feel obligated to change in favour of a collective purpose or feel more motivated to change through others' experiences. This study describes the main factors that influence dairy farmers' decision making in Southland - New Zealand, based on internal and external factors and different types of social interaction.

This research explores social aspects related to farmers' behavioural change to mitigate diffuse water pollution. There is much evidence of scientific water quality studies in dairy farms discussing water pollution and its primary sources; however, a scarcity of social studies regarding water quality involving farmers' behaviour and perceptions in the literature was noticed. This research addresses an identified gap in the literature regarding the influence of farmers' values and beliefs on behavioural change and other social factors, such as education, experience, and financial resource, in farmers' behaviour studies. The lack of both perspectives integrated in common sense, scientific and social, has increased the gap to remediate water pollution. Based on the literature reviewed in this chapter, this research investigates the multi-dimensional factors associated with farmers' behaviour regarding the changes in farming management practices over the years or other types of behaviour and perception towards water quality issues. Combining Theory of Planned Behaviour and Theory of Social Capital, this research considers individual and collective farmers' behavioural change to explain how social interactions in the community influence farmers' behaviour and the influence of internal/external on farmers' intentions.

Chapter 4. Methodology

Material from the same author and submitted as part of the requirements for MGT04 is included in this chapter

4.1. Introduction

This chapter describes the qualitative research strategy of this research, and it is structured into six sections. The research philosophy and design are initially outlined, followed by the rationale for choosing a qualitative exploratory research methodology. Adopting an interpretive approach and how this philosophy relates to the qualitative design selected for this study is discussed. Likewise, section three outlines the research method chosen to collect the data. The purpose of the interviews, and the reason for choosing semistructured interviews using open-ended questions are presented. This section also contains the discussion about the population and sample size and the rationale for selecting purposive sampling as a strategy to select the participants. The inductive thematic approach used to analyse the data is also described. Finally, the following two sections, four and five, discuss this study's main limitation followed by ethical considerations that framed this research.

4.2. Research philosophy and design

The methodology chosen to carry out this study is presented in Table 1.

Table 1 – Research Methodology

Research Philosophy	**Overall Approach**	**Design**	**Method**	**Role of researcher**	**Kind of data collected**	**Intended Analysis**
Interpretivism	Exploratory	Qualitative	Interviews	Involved	Qualitative	Inductive

The adoption of an interpretive approach in this study focused on the whole experience of being a farmer, including attitudes, perceptions, behaviour, and the challenges related to water management in dairy farms, instead of just considering part of the process (Pius & Helmi, 2020, p. 42). An exploratory study fitted well on this research as its primary purpose was to clarify the understanding of water management in dairy farms from a different perspective (farmers' perspective), and to consider relevant social factors that have not been considered before (Thornhill et al., 2016, pp. 174-175). The qualitative design chosen for this study was explained by the need to collect data that relies on what is meaningful to the participants, in this case, farmers' contribution, and creating a different interpretative understanding about water context in dairy farms in Southland (Thornhill et al., 2016, p. 175).

In accordance with the interpretive approach (Pius & Helmi, 2020, p. 42), the researcher's involvement in this study happened by selecting the topic and part of the questions covered in the interviews, which focused on water management. The data collected was analysed through an inductive approach, which enabled building a theory that was adequately shaped in the data by considering farmers' attitudes and behaviour into a social context (Thornhill et al., 2016, p. 571). According to Thornhill et al. (2016), "the use of an inductive approach should allow a good "fit" between the social reality of the participants and the theory that emerges" (p. 571), which means that a new theory about water management in dairy farms and its impacts was created having social factors and farmers' contributions as the main drivers of it.

4.2.1. Research design - Qualitative research

The process of selecting a research methodology is based on the nature of the research problem or issue to be explored (Creswell & Poth, 2018, p. 45). Qualitative research is appropriate to use "to identify variables that cannot be easily measured or hear silenced voices" (Creswell & Poth, 2018, p. 45). This qualitative research was conducted to explore farmers' behaviour towards water quality, but most importantly, to hear farmers' thoughts and opinions and better acknowledge the issue. According to Thornhill et al. (2016), qualitative research enables meaningful data collection by exploring the participants' natural settings in a complex reality (p. 568). Creswell and Poth (2018), pondered relevant points to conduct qualitative research, but the most important motive is to use qualitative research to complement quantitative research. The theories and models provided in quantitative studies, in some cases, do not fit into reality because they do not consider feeling, thoughts, behaviour, experience and processes (Creswell & Poth, 2018, p. 46). As a result, quantitative research through statistical analysis is not entirely able to address the whole complexity of the problem of this study. Creswell (2013) postulates a qualitative study definition that justifies the rationale for adopting a qualitative design for this study.

> "Qualitative research begins with assumptions and the use of interpretive/theoretical framework that inform the study of research problems addressing the meaning individuals or groups to a social or human problem. To study this problem, qualitative researchers use an emerging qualitative approach to inquiry, the collection of data in a natural setting sensitive to the people and places under study, and data analysis that is both inductive and deductive and establishes patterns or themes. The final written report or presentation includes the voices of participants, the reflexivity of the researcher, a complex description and interpretation of the problem, and its contribution to the literature or a call for change" (Creswell, 2013, p. 44).

Another crucial feature of qualitative research is that the researcher's role is considered as a functional instrument within the study. In this study, the researcher focused on exploring the meaning and participants' point of view about the problem rather than relying on studies from the literature (Creswell & Poth, 2018, p. 44). Also, this study explored multiple farmers' perspectives regarding water quality, besides sharing diverse points of view. The researcher's background and work experience influenced the research's topic selection and data interpretation.

In the context of this research, individuals' behaviour and decision-making are socially constructed. Farming management and land use are changing due to some requirements made by the government to protect freshwater health (Ministry for Primary Industries, 2021). However, a range of factors can influence this attitude for change. For instance, farmers' interactions with other farmers and organisations may shape farmers' behaviour and other social factors such as education, access to information and knowledge, which can be best explored through qualitative research. Moreover, this study focused on participants' meanings rather than bringing what was expressed in the literature to the research. Also, the flexibility of this study contributed to exploring participants' emotions, feelings, and opinions.

Different methodologies were explored for this study, such as mixed methods and quantitative research, and a range of different methods of data collection (document analysis, interviews, questionnaire). The rejection of a quantitative approach was due to the nature of the research objectives aimed for this study since quantitative approach focus on measuring variables to answer theory-guided research questions, and a survey would not be able to collect meaningful data as the qualitative approach does (Creswell & Creswell, 2018, p. 147). The mixed-method approach, which involves collecting both qualitative and quantitative data, is also a useful approach to better understand the research problem (Creswell & Creswell, 2018, p. 217). However, it was rejected due to the nature of the research's aim of this study. This research did not focus on comparing processes or evaluating outcomes through an explanatory sequential process (Denscombe, 2010, pp. 150-151).

This study did not want to generalise results to an entire population once social factors and behaviours are dependent on a range of elements particular to each individual. It was common to find advantages and disadvantages of each of these methodologies and methods analysed prior (Creswell & Poth, 2018; Denscombe, 2010). The flexibility provided by qualitative research made it the most appropriate design for this research to explore this complex phenomenon of water quality in its specific context in Southland (dairy farmers).

Research philosophy

Interpretive framework – Social constructivism

According to Creswell and Poth (2018), interpretive frameworks are "paradigms or beliefs that the researcher brings to the process of research, or they may be theories or theoretical orientations that guide the practice of research" (p. 22). In social constructivism, the questions are broad and general, as the researcher can listen to what the participants say carefully (Creswell & Poth, 2018, p. 24). Also, researchers make their interpretations influenced by their experiences and background (Creswell & Poth, 2018, p. 24). Moreover, adopting an interpretive paradigm can provide an in-depth understanding of cross-social factors in a specific context creating complex conclusions that differ from other authors in the literature, characterising the interpretive paradigm's richness (Pius & Helmi, 2020, p. 42). According to Myers (2008), interpretive studies also generate data with a high level of validity since it is based on an individual's contributions considering different aspects (p. 47).

Social constructivism, often characterised as interpretivism, was the most appropriate research paradigm for this study. Therefore, this research focused on describing farmers' views of the water quality by creating a complex perspective rather than relying on limited meanings and ideas (Creswell & Poth, 2018, p. 24). Through social constructivism, this study assumed that the subjective meanings behind farmers' behaviour towards water quality are formed through social interaction with historical and cultural influence on farmers' attitudes. It was found that factors, such as education level, age, experience, and farm income can potentially affect their ability and willingness to perform a specific behaviour toward water quality, and social interactions, including peers, family and organisations, shape farmers' decision-making.

Other philosophical worldviews were also explored for this study, such as positivism, transformative and pragmatism. Overall, positivism is often described as the extreme opposite of interpretivism, as it holds a philosophical assumption of determination based on cause and effects and has rational considerations as the base of knowledge to verify existent theories (Creswell & Creswell, 2018, p. 6). Also, the methods used in a positive paradigm to understand an issue do not consider social variables due to generalisations made in this paradigm; thus, they do not apply to the real social word as it ignores individuals' intentions and behaviour (Pius & Helmi, 2020). Transformative focuses on exploring the needs of individuals/ groups that are marginalised, and the main purpose is to propose a change by giving voice to them (Creswell & Creswell, 2018, p. 11). Finally, pragmatism is not related to any of these philosophical assumptions. Instead, "pragmatics have believed in an external world independent of the mind as well as that lodged in the mind" (Creswell & Creswell, 2018, p. 11). Based on this study's aim and objectives, the interpretive paradigm prevailed over these three other paradigms mentioned above since their philosophical orientation did not match this study's research goal.

4.3. Method: Interviews

4.3.1. Purpose of interviews

An in-depth qualitative interview was the primary data source used in this study, which contributed to collecting relevant and reliable data. The purpose of using interviews was to explore further the experience of being a farmer and the internal/external factors which can potentially influence farmers' behaviour towards water quality (Collis & Hussey, 2009, p. 144). Detailed information based on open-ended questions was gathered through in-depth interviews that go beyond yes and no, agree and disagree questions commonly used in questionnaires (Rubin & Rubin, 2005, p. 29). According to Denscombe (2010), an in-depth interview is appropriate to gain a better understanding of specific things, such as individuals' opinions, feelings and experiences or sensitive issues, since the interview is considered a careful approach to motivate participants to have an open and honest discussion (pp. 173-174).

In-depth qualitative interviews fitted well on this study due to the opportunity to establish a relationship with the participants, besides asking clear questions that can generate more data through the development of the conversation (Thornhill et al., 2016, p. 388). Denscombe (2010) argues that the contact between participants and researcher enables privileged information and brings value to the data collected (p. 174). Exploring farmers' experiences and perspectives about water quality through interviews created a depth understanding of the setting as interview data is socially constructed by the participants and performed by the interviewer through reflection and interpretation of the data (Denzin, 2001, p. 25; Thornhill et al., 2016).

Due to lockdown restrictions and timing constraints, three interviews happened via Zoom and two interviews were conducted face-to-face. There were no disadvantages to this study regarding internet interviews since visual contact was facilitated using a webcam, and there were no further issues of slow connection. However, internet interviews were slower than face-to-face interviews taking around thirty minutes more. According to Rubin and Rubin (2005), waiting to receive an answer or to ask a question makes the interview slow compared to face-to-face interviews; however, it gives time to the researcher to formulate follow-up questions (p. 30).

4.3.2. Interview design – Semistructured interviews

Semistructured interviews were the data source used in this study, considering that semistructured interviews are well suited to gather data regarding people's perceptions and opinions about sensitive or complex issues (While & Barribal, 1994). According to Thornhill et al. (2016), "in semistructured interviews, the researcher has a list of themes and possibly some key questions to be covered, although their use may vary from interview to interview, and additional questions may be required to explore the research questions and objectives" (p. 391). Questions of significant relevance for this study were explored, but most interviews flowed according to the conversation to explore other ideas. In semistructured interviews, there is a chance for probation to better understand the meanings, which can lead to areas that would not be covered but are relevant to the research aim and objectives (Collis & Hussey, 2009, pp. 144-145).

The flexibility of the questions, and more importantly, to let the participants speak expansively about the issues raised by the researcher, brought diversity and complexity into this study regarding points of interest and perspectives (Denscombe, 2010, p. 175). An interview schedule was used in this study to encourage participants to share their experiences. For example, this research used open-ended questions, "*How would you describe*" and "*Tell me about*". Prompts and probes, such as "*why*", were used to explore more farmers' answers and create a natural and comfortable environment for the interview. Participants could express their ideas without interruptions to collect the most meaningful data and explore other perspectives not covered by the key questions (Riessman, 2005). This study used the same interview schedule with all participants; however, prompt questions were also included to help the interviewee elaborate on answers. According to While and Barribal (1994), interview schedule enables the researcher to collect important participants' characteristics once the different responses are due to the personality differences rather than questions asked. Also, using semistructured interviews, it is possible to change the words without changing the meaning of the questions to adapt the questions according to each participant (While & Barribal, 1994, p. 330).

The literature review guided the interview schedule into four areas of interest. First, the farmers' background introduction to establishing a comfortable environment for the interview. Questions asked were related to age, education level, years of experience, farm ownership structure, farming history and their plans and goals for the farm. These questions helped to achieve the third objective of this research to describe the main factors that shape farmers' behaviour and decision-making towards water quality management. The second topic of the interview was the farming system, which focused on environmental management practices related to farmers' production, such as effluent and nutrient management and water management practices. Besides answering the first objective of this research, the second section was fundamental to collecting data regarding farmers' perception of water quality in their farms.

The following area of discussion in the interview was networking and how social interaction can influence farmers' decision-making, which contributed to the third objective of this study to describe the social factors that shape farmers' behaviour towards water quality management. Finally, there was an open-ended question to analyse the source of information and its reliability, which also collaborated with this study's second and third objectives. It is important to mention that there was an income question; however, it was asked differently to farmers without changing the question's meaning, for example, "*How financial resources are important to adopt changes*". By paraphrasing, the income question enabled this study to collect more data rather than just a number.

4.3.3. Procedure

This study used a purposive sampling strategy to select the farmers' participants (Etikan et al., 2016). According to Etikan et al. (2016), "data gathering is crucial in research, as the data is meant to contribute to a better understanding of a theoretical framework" (p. 2). Purposive sampling is a non-random technique based on the personal qualities that the participants possess, and there is no particular number of participants to be achieved (Etikan et al., 2016, pp. 2-3). The selection of farmers to this study was based simply on their willingness to be part of it and their knowledge and experience to provide rich information about the phenomenon of interest (Etikan et al., 2016), water quality. The main idea was to concentrate on farmers who would give a better understanding of the setting. To assist in the analyses of other social and personal factors, the sample of participants had farmers of different ages, backgrounds, and farming experiences.

A key informant from a non-governmental organisation from Invercargill was crucial in the process of selecting farmers. The informant provided a list of farmers with phone numbers, emails, and other personal information about each farm situation. From that list, the researcher selected eight farmers to make the first contact through a call. Through a phone call, the researcher explained the purpose of the study and the process to obtain farmers' contact. Five farmers accepted being part of the research, one refused, and two did not show much interest. For these five farmers who agreed, the researcher emailed them a copy of the information sheet, date and location for the interview and researcher's contact details for any questions that could arise.

The informed consent was sent through email to them one day before the interview. As mentioned before, three interviews were held online via Zoom meeting, and two interviews were face-to-face at the participants' homes. Four interviews were conducted with one interviewee and one with two interviewees, of which the extra-participants was the farmer's spouse. The interviews ranged from 30 minutes to 1:15 hours, and as mentioned before, the online interviews were longer than face-to-face due to waiting time of listening and talking. With the interviewee's permission, all the interviews were recorded. The online interviews were recorded via Zoom and mobile phone, and the face-to-face interviews were recorded only using a mobile phone. An app called Otter helped with the audios' transcriptions, and each transcript was carefully read and edit by the researcher after each interview while the memory was fresh. The compilation of the whole record done straight away after the interview avoided confusion by losing information and memories or getting confused with another interview (Thornhill et al., 2016, p. 412). The transcripts were sent over to all participants to reassure reliability.

4.3.4. Participants

The participants of this research were dairy farmers from Southland. Local farmers were the right people to interview because the researcher is interested in exploring the experience of managing a farm business. Thus, to truly understand what happens on a farm, no one is better than a farmer. Five farmers participated in this research. In four interviews, the main interviewee was male; in one interview, the farmer's spouse did participate as an extra participant, and in one interview, the main interviewee was female; she was speaking on behalf of her husband, who could not participate in the interview, as they run the farm together. This study used pseudonyms to guarantee participants' anonymity and confidentiality. Also, interviewees were given pseudonyms instead of identified numbers to give naturality to the responses. The author felt that conducting research based on social values would be abstract to identify participants using numbers. The summary of the participants is in Table 2 below.

Table 2 – Participants' Summary

Mary	Female, 65 years old, 42 years of farming experience working as a farm worker at the beginning, and after a few years as a farm owner, a degree in Engineering.
Jim	Male, 33 years old, 6 - 7 years of farming experience, a degree in Engineering.
Robert	Male, 66 years old, 48 years of farming experience, a degree in Agriculture Sciences.
Mark	Male, 55 years old, 39 years of farming experience working in different roles (farm worker, manager, share milker, farm owner), studies in Advanced Trade.
Tom and Alice	Male, 79 years old, 60 years of experience, High School. Female, 80 years old, Certificate in Farm Management.

4.3.5. Data analysis

An inductive thematic analysis strategy was used in this study to analyse the data from semistructured interviews. The selection of this method was due to the possibility of representing the experiences and stories narrated by the participants as precisely as possible as this approach requires a high level of involvement and interpretation from the researcher (Guest et al., 2012, p. 9). The thematic analysis is a flexible approach to analysing the data and generating a rich and meaningful account (Braun & Clarke, 2006, p. 78). Additionally, Guest et al. (2012) postulate that "thematic analysis moves beyond counting explicit words or phrases and focus on identifying and describing both implicit and explicit ideas within the data, that is, themes” (p. 9). Thus, themes occurred across the data analysis.

The inductive approach fitted well with this research because of the interest in understanding the social context of the participants and avoiding being manipulated by predetermined theories, considering that themes identified strongly connect to the data itself (Braun & Clarke, 2006, p. 83). The data analysis focused on developing a conceptual framework rather than an existent theory (Thornhill et al., 2016, pp. 570-571). It is relevant to mention that reliability is of great concern when using thematic analysis as its focus is on interpreting the meaning of the data rather than analysing word-based sentences (Guest et al., 2012, p. 9).

Thus, each interview transcript was analysed carefully, and additional notes contributed to an accurate understanding of the data. Identifying themes, sub-themes and patterns from the data guided topics to be further explored (Thornhill et al., 2016, p. 579). These themes and sub-themes were considered relevant information related to the research question, and they also configurated some patterned responses within the data (Braun & Clarke, 2006, p. 82). The comparison of themes and sub-themes across participants’ transcripts helped to find similarities and differences among them. The context around each participant was relevant to understand the similarities and differences between them, for example, farming system, age, years of experience and education level. At this stage, returning to the literature review was important to better understand the data and create relevant connections between the findings from the literature review and the findings from this research. Themes identified within the data guided the findings and discussion of the next chapter (chapter five), and the transcripts were very useful to guarantee that researcher’s interpretation matched the participants’ meaning.

4.4. Limitations, reliability, and bias

Generalisability was the main limitation of this research. Five dairy farmers from one region in New Zealand were interviewed. As a result, this research does not reflect the diversity of farmers from other regions with different forms of social interaction and sources of information that influence their decision-making and behaviour. Thus, this study cannot generalise its results to an entire population since the data came from a small sample (Thornhill et al., 2016, p. 400). The limitations of this research were also related to concerns about reliability due to the lack of standardisation. However, considering the interpretive approach of this exploratory study, the reliability did not have significant relevance as the focus was providing authentic findings with low reliability but high validity from small samples (Collis & Hussey, 2009, p. 62). Thus, reliability had little importance in this study, considering the research's flexibility and the nature of the findings. Besides reliability, semistructured interviews can also be related to concerns about bias. Bias can be demonstrated in an interview from different angles, such as interviewer and interviewee bias. To overcome those biases, the researcher avoided showing her own beliefs/perceptions and exploring themes or subjects that were sensitive for the participants (Thornhill et al., 2016, p. 397). These were crucial details that enabled the collection of relevant and reliable data in this study.

4.5. Ethical considerations

4.5.1. Method: Interviews

This study followed ethical procedures for research required by the Southern Institute of Technology Ethics Committee. A copy of the approval letter and ethics application is attached in Appendix A and Appendix B. The ethical issues considered in this research include respecting participants regarding privacy and confidentiality, avoiding participants' deception, minimising harm to the participants, informed and voluntary consent and avoidance of conflict of interest. Participants' identification and the information provided by them remained anonymous and confidential. The adoption of pseudonyms contributed to ensuring the confidentially of the participants. Thus, they cannot be identified across the data. The participants had the right to decide if they wanted to be part of it or not, and the researcher fully respected their decisions. The voluntary nature of participation and right to withdraw (which was be predetermined) were part of this research.

The researcher provided sufficient information to the participants about the implications of participation through informed consent and participation information sheet. The purpose of these formal documents was to give them the right to be fully informed about participation rights and the use of data, ask questions, and decide freely without pressure if they wanted to be part of the research. Thus, all participants received a participation information sheet (Appendix C). Also, as this study conducted individuals' interviews, the informed consent was supported by a more detailed written agreement, such as a consent form (Appendix D), which both parties signed. Interview questions can be found in Appendix E. Participants were aware of the possibility of making the results of this study public through a presentation in seminars and publications in journal articles. The data will be kept in safety by passwords and lockers for five years and then destroyed afterwards. The risks of this study were evaluated in advance to avoid possible harm to participants and the researcher.

4.6. Summary

This study posed three research objectives:

1. To describe best water quality management practices.
2. To analyse the motivation for change made over the years and its constraints.
3. To describe the main factors that shape farmers' behaviour and decision-making towards water quality management.

An interpretive research paradigm framed this qualitative research which explored farmers' attitudes and perceptions towards water quality and the influence of social factors on farmers' behavioural change. The region selected for this study was Southland, and five dairy farmers from different areas within Southland participated in this research. Semistructured interviews was the method chosen to collect data, as this study focused on collecting meaningful data based on participants' thoughts, opinions, and feelings. This chapter presented a detailed description of the interview process and data analysis. The interview base was open-ended questions connected to the objectives of this research and to the literature review, which enabled comparisons and connections.

The inductive thematic approach was the most suitable method to analyse the data as it focused on describing participants accurately and comprehensively manner without considering predetermined theories. Themes and patterns were identified across the data through the inductive thematic analysis, which contributed to address all three objectives proposed in this study. This chapter also highlighted the limitations, bias, and ethical procedures of this research. The main limitation of this study is generalisability. How to overcome bias, especially in the process of data collection were also presented. This study was granted with ethical approval by the SIT Ethics Committee, and integrity and well-being of the participants were of great concern of this study, including their privacy, anonymity, and confidentiality. Thus, a qualitative design based on an interpretive approach enabled exploring farmers' experiences using descriptions provided by them, which was the best methodology to analyse farmers' attitudes and behaviour towards water quality.

Chapter 5. Findings and Analysis

5.1. Introduction

Chapter five shows the findings of this study and the discussion of the results based on theoretical analysis and literature review. The results' presentation is organised in themes based on a thematic analysis. Farmers' demographic information is presented first, providing context for the following themes. The first theme is farmers' ability and intentions, which presents the influence of social factors, such as age, educational level, experience, and financial resources, on farmers' behavioural change. The second theme is water quality best management practices, which shows practices that farmers of this study have adopted over the years. The following theme is the perception of water quality, which presents farmers' thoughts about water quality. Also, this theme discusses the farmers' difficulties and motivations related to changes made over the years. The fourth and last theme is the social networks and their influence on farmers' decision-making which discusses the influence of social factors, such as social interaction, sharing of information and trust, on farmers' decisions of this study.

The method chosen for data collection was semistructured interviews. Five dairy farmers from Southland participated in this research. The data was presented most originally and accurately using quotes from the participants in italics across the chapter. Data regarding good management practices addressed the first objective of this study. Findings regarding changes over the years, motivations and constraints addressed the second objective. The data collected of internal and external social factors, such as social interaction, personal characteristics and background, and financial resources, addressed this research third and last objective.

5.2. Results

5.2.1. Method: Interviews

Farmers' demographic information

As mentioned in chapter 4, interviewees were given pseudonyms to guarantee anonymity and confidentiality to all participants.

Age, experience, educational level, income, farming history

Farmers who participated were between 30 and 80's years old. The youngest farmer was Jim, who is 33 years old, and the oldest was Alice, who is 80 years old, who is currently retired from the farm, and her partner, Tom, 79 years old. Mary and Robert are 65 and 66, respectively, and Mark is 55 years old. Most of the participants have a graduation or a course in a specific area and over forty years of farming experience, except Jim, who has almost seven years of running his farm. All farmers of this study grew up on a farm, except Robert, who grew up in town and learned about farming through his studies in agriculture. This study focused on understanding the relationship between behavioural change and financial resources. Thus, instead of collecting each farmer's annual income, the author captured how relevant financial resource is to adopt new practices.

Theme 1: Farmers' ability and intentions – "We are still reliant on the profitability of the dairy system to be able to do the things we want."

Educational level, age, and experience

The farmers of this study spoke about how knowledge and skills from studies and years of experience are important in the context of change. It was clear from their experiences that knowledge and skills influence farmers' decision-making, as behavioural change requires technical assistance in some cases. Thus, this study found that the lack of knowledge impacts farmers' ability to perform a specific behaviour, and education level and access to information are social factors that contribute to farmers' behavioural change of this study. The knowledge acquired from their studies and the reflection of it in the business was a highlight:

I was a project manager in my career, so I use a lot of that now. Probably take on projects that usually you pay someone else to do. (Jim)

It definitely helped a little bit with the business side of it. (Mark)

It taught me where to get information from, and it gave me a basic grounding in farming. (Robert)

It taught me how people farm in New Zealand. (Alice)

This study aimed to analyse how the level of experience and age influence behavioural change. According to the literature review, a high level of experience and age constrain the adoption of new practices (Burton, 2006; Knierim et al., 2006). It was clear that most farmers' high level of experience and their age do not influence their decision-making negatively. For example, Alice and Tom, who are the most experienced farmers in this study, shared that: "*We change things every year, we are always adding more".* Additionally, Mark mentioned his experience as a positive factor for change: "*I have worked on lots of different farms, I knew what I wanted when I was had my own farm".* Robert, who is 66 years old, showed being open-minded to consider ideas, knowledge and opinion that are different from his perception to improve his farming system: "*We are changing our style because we are learning better ways of doing things"*. Thus, the findings showed that age and experience do not persuade farmers' behavioural change in this study.

Views for the farm

According to the Theory of Planned Behaviour, behavioural change is based on well-developed plans (Ajzen, 1985). The farmers of this study shared different farms' visions for different reasons, which demonstrated their intentions regarding water quality and how committed they are to preserving the waterways. For example, Jim is building accommodation around the waterways to bring people to his farm. Thus, the waterways are an important asset for his business. Mark also shared that his goal is to change his farming system gradually by decreasing the number of cows to have less impact on the waterways.

It has been built on the spot on one of the biggest waterways, with a cool view of the wildlife that lives here in the pond. (Jim)

Part of the reason why I'm doing it is if you have got less cows walking around, that is less mud and less impact on the environment. (Mark)

The other farmers of this study are retired or semi-retired. Robert and Mary plan to sell the farm at some stage. Tom said that his son has taken over it, but he and Alice still help on the farm when required. In this case, farmers' attitudes in the past also reflect their commitment to the environment. For example, Mary made a covenant on her land to protect native bush and natural wetlands:

No one can cut that bush down, and they cannot drain the wetland. It is protected forever. (Mary)

The second theme of this study, water quality best management practices, supported this finding by describing practices and changes made over the years. The author did not interpret farmers' retirement as the lack of plans, but instead, the author recognises farmers' commitment over the years as their intention to keep the "hard work" for the next generations. Thus, behavioural change is based on well-developed plans; however, it is essential to consider the context of each farmer and their attitudes based on previous events.

Financial resources – "You cannot be green in the red."

The income question was essential to understand the influence of financial resources on farmers' decision-making and behavioural change as an external social factor. All farmers said that the lack of money reserve constrain the adoption of new environmental practices, except Alice, who said that the lack of financial resources would not stop her from doing what she needed:

We would never do less for any reason at all, and that includes income. (Alice)

Despite the divergent response, most farmers believe that money reserve is a relevant aspect to consider when adopting change, as some changes are associated with cost, which can act as a barrier for them. The reliance on profits to adopt changes in the farming system was a highlight between some farmers:

It is important to consider that profitability is why my family is still here after 110 years, is because the farm made enough profit for them. We are still reliant on the profitability of the dairy system to do the things we want. (Jim)

About four years ago, dairy farming went through two very bad financial years, and there was no environmental stuff done at all. In contrast, the last two years have been high income. So, a lot of money has been spent, environmental work. There is a say you cannot be green in the red. (Robert)

Thus, this study found that financial resources do influence farmers' ability to perform behavioural change, but it is important to highlight the significance of reporting that one farmer in the group responded differently from the others. It would be useful to address this finding in future research.

Theme 2: Water quality best management practices

Effluent management, Nutrient management, Fencing and Planting

The farmers in this study agreed that effluent into the waterways is not an accepted practice. The results of this study showed that wetlands and storage ponds were the most common water management practice to treat the effluent on the farm:

We have got wetlands, and we have got plantings around the waterway. (Mark)

We have built a wetland to work as kidneys for the farm over the last four years. (Robert)

We have effluent ponds; it gets spread out through a whole system of irrigation as liquid effluent. (Alice)

All our effluent is collected in a pond. We are trying to get that across most of the land that we found. (Mark)

Also, planting and fencing were usual practices mentioned by the farmers to protect the waterways. Most of the farmers highlighted that fence and planting has not been a change for them, as these practices were implemented years ago and have been maintained to these days:

All our waterways have been fenced for twenty years. (Jim)

Right from the time we bought the farm, we started fencing off the native bush, and w*e did riparian planting. We were considered all those odd islanders because people just weren't environmentally aware. (Mary)*

Effluent spreading was also common practice among the farmers of this study to avoid discharging into waterways, as the dairy effluent has important nutrients to the soil. Spreading the effluent into the soil is a good management practice as it recycles the nutrients; however, mitigations must be taken to ensure that nutrient, such as potassium and nitrogen gets oversaturated in the soil (Beuger & Daly, 2016). The farmers' awareness regarding this practice was a key finding of this study. The farmers understand that effluent cannot be applied in wet soils: *We are trying to put it on at the* *time of the year when the soil is not so weak (Mark),* and farmers are aware that they need to monitor some nutrients to avoid water contamination:

We do sample paddocks where we test the soil to see what fertiliser it needs every year. (Mary)

We have got to watch things like the K (potassium); it gets quite high in the effluent. (Mark)

Nutrient management technologies and strategies – "We have the most modern effluent system."

The implication of applying effluent into the soil was a highlight between the farmers of this study, who used words, such as *less nitrogen, enough nitrogen,* and *less fertiliser* to explain that the effluent practice for irrigation contributes to decreasing the fertilisation rate.

They also commented on adopting simple strategies that help to keep the fertiliser out of waterways, such as "*try to avoid spreading fertilizer on tracks and drains" and "making sure that the gradients are not too steep". Farmers also highlighted that using less fertiliser is a goal, but fertiliser is what makes the business profitable, as it grows grass to produce milk: It is also a very good tool for us to grow more grass and feed the animals, still very profitable (Jim).* It is important to consider that water quality is important and environmental practices need to be encouraged, but it is also crucial to consider that as every business has its tool to make money, farmers rely their profits on fertilisers. Farmers have worked to find the right balance between both aspects, fertiliser, and the environment. This issue has been addressed through the adoption of nutrient management technologies, such as fertiliser scam and nutrient surplus to map the fertiliser runoff and access the amount of nitrogen into the environment, which helps to minimise its side effects and increase the efficiency of the farm, as it saves fertiliser and time:

We have what they call a nitrogen surplus. It works out how much nitrogen coming into the environment and how much has been taken out right through milk production. (Mary)

We have the most modern effluent system. All the runs hit the right direction. I am trying to minimize human errors with fertiliser application. It has got to be effective and efficient. (Mark)

This study found that farmers are adopting water quality best management practices such as,

Theme 3: Perception of water quality

This study found that the farmers' perceptions of water quality are highly related to perceived risk. The diversity of response and the discussion behind this topic makes the perception of water quality a key finding of this research. Some farmers discussed this topic based on specific criteria regarding water quality to explain their statements, reflecting their awareness regarding the relationship between water quality and the environment surrounding it. For example, Jim, Mary, and Mark indicated biodiversity as a performance indicator of water quality:

There has been a whole new colony of birds in the pond area. (Jim)

Biodiversity is another big KPI (Key performance indicator) of mine. (Mark)

Our catchment has been particularly aware of water quality and fish now. (Mary)

Divergent responses came out from farmers regarding drinking the water. Alice said, "*We're very happy with it. Beautiful water", while* Mark stated, "*I wouldn't want to drink it, even swim in the river at times, just to duty today".*

One farmer denied that water quality has declined over the years by saying*, "it is just the same"*, while others believe that it has improved, "*water quality is a way better than it was in the 1960s because the method of farming has improved*". Mark claimed that "*farmers cannot keep doing what was always done".* He also made statements that reflected his concern regarding water quality besides acknowledging his sense of collectivist when explaining that water quality is made of cumulative effects:

It is accumulated for feet and is a cumulative effect. That is why it makes a difference what everybody does to the water, regardless of what the water is on your property. That is the effect of what you do on your property that will make it better or worse. (Mark)

Other participants stated that dairy farming is not the only sector responsible for that water decline, even though the sector has taken the blame:

You cannot blame dairy for everything. We are only 1/3 of the pastoral land use in New Zealand. (Mary)

This study found that farmers' perception of water quality and judgment regarding environmental conditions depend on their beliefs, attitudes, and feelings formed through social conditions and circumstances. Behind each farmer's response to this study, there was an emotional contribution that explains so many diversities into this topic.

Constraints of behaviour changing – "Its mindset, Its cost of production, Its perception."

Understanding the constraints regarding behavioural change was a key contribution of this study. The results showed that external factors and circumstances could inhibit the adoption of new practices, but internal factors need to be considered a potential barrier to change, as it requires rethinking some actions and attitudes before performing a behavioural change.

Some farmers brought financial resources back to the discussion when talking about constraints of behaviour change. Most of them stated that financial resource is an important asset to adopt environmental practices and it influences their decisions regarding changes in the farming system. The farmers used words, such as "*low profitability", "money" and "cost of production"* to describe the difficulties regarding adopting a different practice. Farmers of this study also acknowledged that access to the correct information, time and mindset can restrain changes. Mark pointed that those changes in the farming system take time to get through, and time has become a challenge for them:

The challenge with farming is that people want to fix it now, but the process is a lot slower to work through and to think about where you put your tracks. (Mark)

They recognised that the lack of information, advice and mentorship delays the process of behavioural change that they are going through. The farmers discussed that the lack of education makes difficult the process of behaviour change, as they are unlearning old practices and adopting best practices over the years. There were some highlights regarding education between the participants:

It is about teaching best practices rather than demanding something that you might not know how to do. (Robert)

It is also the way that we do what we do on grass and how we do it. That is what we have told ourselves as being good, and it is not good. It is unlearning that too and then rethinking about how we do. (Mark)

A lot of the change in the last 20 years has been an education for us about what can be good. Education has been the biggest change. (Jim)

However, Mark raised an important point to be considered in the context of education and information:

There is a culture within farming that people do not realise that exists, they have an opinion that is already formed before you get to the conversation, and their opinion is usually fairly strong. (Mark)

Education can work as an efficient strategy of behaviour changing if farmers are willing to listen and learn new practices; otherwise, nothing changes if they are unwilling to talk about new practices, changes, and water quality improvement. Thus, this study found that financial resources, education, mindset and culture are social factors that influence farmers' decision-making of this study.

Reasons for change – Farmers' philosophy - "It is just natural that you want to look after your water."

Farmers were asked about the reasons for changes made over the years and their motivation to perform that change and adopt a different behaviour towards water quality and the farming environment in general. Most of the farmers said that the changes were encouraged by their beliefs and philosophies:

It was probably thinking beyond just making production. I would say a lot of my philosophy was around nurturing rather than manipulating or getting the most from the land. (Mark)

It is just natural that you want to look after your water, you want to look after your whole environment, and it also goes down to looking after the people on the farm as well providing healthy homes for them and it becomes philosophical for us. (Mary)

To do it better. Lots of them was me trying to do better. No matter what, a few strive for best practices. If you do better and better, you will never get the best, but you will get better. (Robert)

However, Mark also highlighted those regulations still plays an important role in water quality.

If you don't have that, you just carry on doing what you do. You try and get away with what you can get away with. (Mark)

The results showed that farmers of this study are influenced by their beliefs and philosophies, built based on social interactions, the environment they live in, and social circumstances. It was clear that the reasons for change for most of them was more related to care for their farms and the environment surrounding them, which includes workers, their families and the community. Farmers of this study want to manage their farms in a way in which they feel proud of what they are doing. Despite regulations being considered a relevant part of behavioural change, farmers of this study are changing because they want to be better. Better for the animals, the environment, the water, food production, and the community.

Theme 4: Social network, sharing of information and trust – "Farmers learn best from other farmers."

It was clear that catchment groups were a big step to establish efficient communication between local farmers, local councils, and the government. Farmers showed satisfaction towards the authorities due to the respect conversation that has established between them, which is a benefit from the social interaction in catchment groups:

The reason why the government is listening to us is that it is not a reactive status. It is proactive. We are being engaged. (Mark)

Environment Southland has been working on our behalf. (Alice)

Besides social interaction from catchment groups working as a communication channel with local and national authorities, it also improved the communication between local farmers. Farmers used the term "respectful conversation" many times to describe the discussion groups, besides being a place to engage young farmers. They also used words, such as *engagement, collective* *responsibility*, *collective ownership*, and *education* when emphasising the benefits of working as a group:

Catchment group enabled everybody to come into the room and talk about this stuff, for questions to be asked rather than told. It has been about clicked of engagement and clicked of education, and that seems to have worked well. (Mark)

Peer groups and discussion groups are very good. Some of the young ones come in too, and they have just loved the fellowship of having a farm discussion group. (Alice)

Environment Southland has a land sustainability team, and there are many other organisations that we sought help from. (Mary)

This study also showed that social networks allow the flow of information between farmers, which encourage the adoption of new strategies, besides enabling the creation of new strategies and solutions.

It is just so exciting that it has led me on to all these other things. It is the people finding minded people who want to do better and then figuring out what tools we have, what we can do, and where to go

The influence of external advice from farm consultants and other organisations on farmers' behavioural change was another key contribution of this study. Farmers shared that part of their decisions was based on advice from farm consultants, organisations, such as Fonterra, Dairy New Zealand and Environment Southland:

There is advice from Dairy NZ and Fonterra about how we do. It is good for our customers because they like to know that their milk comes from people who look after the environment. (Jim)

Also, Robert mentioned that his farm consultants usually share successful experiences with other farmers, which confirmed that social network and sharing of information are important social factors that influence farmers' decisions, and Jim confirmed that by sharing his experience of learning from farmers:

We have a farm consultant, so he is encouraging us. He is always seeing better ways of doing things that he learns from his clients. At the same time, we all try to do different things because that is how our New Zealand farmers operate for better; what he sees that somebody is doing better, he can help others do it. (Robert)

Farmers learn best from other farmers, and that is whom they trust the most. (Jim)

Finally, the findings also showed that trust in the source of information strongly influences farmers' acceptance of advice. According to some farmers, it is a difficult point to accept advice because each at the end of the day, farmers need to take responsibility for their farms:

A reliable source is a challenge in everything that we do. The problem is that quite often, you don't know, and therefore you end up making the wrong decision based on the people you consider to be experts and doing the right thing, and therefore you pay the consequences. (Mark)

Mary also shared an experience from some advice she received that did not work on her farm. She emphasised that knowledge and farming systems have changed over the years; therefore, much needs to be considered before adopting any strategy.

We probably lost 15% of the many 1000 plants we planted, but it is not a criticism. It just shows how much knowledge has changed.

Thus, this study showed that social interaction, sharing of knowledge and trust are social factors that influence farmers' decision-making and behavioural change. However, it is important to consider that farmers also shared the difficulties of accepting advice, as each farm can respond in different ways to the same strategy or practice.

5.3. Discussion

Internal factors (Farmers' ability)

This present study explored farmers' behaviour and perceptions towards water quality and how internal and external factors can influence decision-making. The results show that educational level can influence farmers' ability to perform a specific change. Most participants mentioned that their diploma or certificate helped them run their business and adopt new strategies when needed. Also, financial resources were highly mentioned in many parts of their interviews as an important asset to adopt different techniques and change behaviour. These findings are consistent with previous studies that show that a high educational level helps farmers adapt better in a new context (Daxini et al., 2019; Issa & Hamm, 2017; Wang et al., 2017). The findings are also consistent with Barnes et al. (2018) and Ringler et al. (2011), who found that cash reserve encourages farmers to commit to changes. However, it is worth mentioning that this result did not apply to all participants, as one said not letting income interfere in their environmental practices, which is a different finding for the literature.

Previous research has reported that age is a common factor influencing farmers' decision-making in adopting better practices and farm environmental commitment (Burton, 2014; Schroeder et al., 2012). Studies conducted by Burton (2014), Schroeder et al. (2012) and Thenail et al. (2004) suggested that young farmers are more likely to engage in environmental programs than older farmers because they want to invest in the long term. However, this study found different results. Despite some of the farmers being retired or semi-retired, they all showed being engaged with their farming system. For example, Mark adopted fertiliser scam technology and Mary a nutrient report, and both were over their 50's. This result is not consistent with a study conducted by Wilson (1997), who found no relationship between age and behavioural change, and it is not compatible with studies that found younger farmers are more engaged than older farmers (Burton, 2006, 2014; Schroeder et al., 2012; Thenail et al., 2004). Additionally, the experienced farmers of this research did not show resistance regarding changes in the farming system, and they are all trying to adapt to this new reality. This finding is also not compatible with previous studies conducted by Knierim et al. (2006) and Atari et al. (2009), who found that a high level of experience tends to decrease the probability of changing the farming system and adopting new practices, which configures a different finding for the literature.

External factors (Farmers' willingness)

Some of the participants mentioned that the changes made over the years were taken voluntarily. Most of them said that they want to do better and take care of the environment. Also, they want to align their philosophies to their farms through nurturing the land rather than only taking what they need from it. However, they believe that regulations are also necessary, and catchment groups have supported them through this period. These findings are consistent with the Theory of Planned Behaviour which shaped this study. According to Ajzen (2006), external factors can influence an individual's capability to perform a specific behaviour, including skills, income, knowledge, personal beliefs and social pressure. Previous studies assessed farmers' intentions and attitudes and reported similar results as this study (Daxini et al., 2019; Lansink et al., 2014; Masser et al., 2005). Daxini et al. (2019) found that skills and knowledge were the most influential intentions regarding adopting a nutrient plan. Lansink et al. (2014) found that social pressure and general external factors were positively related to behaviour changing.

Additionally, they found that family, government and organisations were identified as the main drivers of social pressure, and knowledge, skills and technical assistance were the mains drivers of potential external factors that influence change decisions (Lansink et al., 2014). The farmers of this study discussed their plans showing their intentions towards the environment, especially water quality, including those who are or will be retired soon, as they are maintaining the hard work done in the past twenty years and making sure it will be carried for the next generations. This result is also compatible with the Theory of Planned Behaviour, which says that social behaviour follows well-developed plans, evidence of performing an intention (Ajzen, 1985).

External factors (Social network and interaction)

The results show that farmers' decision-making is highly shaped by their social network including, catchment groups, Fonterra, Dairy NZ, farm consultants and exchange of knowledge farmer to farmer. This finding confirms the Theory of Social Capital, which says that social interaction enhances certain behaviours (Putnam, 1995). It was clear that the interaction in catchment groups enables efficient communication between local farmers and local councils, which has brought farmers together to fight for collective action. It was also noticeable that the network from farmer to farmer or consultant to farm is a significant channel to share information and suggest new ideas. These findings are consistent with a previous study conducted by Collins (2018), who found that social-cultural dynamics shape farmers' behaviour through social interaction, rules, regulations, identities and beliefs.

The word "trust" was used for two of the participants, Mark and Jim, when talking about the source of information, and both showed different points of view about it, which confirm the relevance of trust in the context of seeking information or sharing it. Mark pointed that he feels concerned about getting external advice due to the uncertainty about the source. Similar results were found by Blackstock et al. (2010), who claimed that trust in the source of information is crucial to sharing information and accepting advice. This result is also compatible with a previous study conducted by Engler et al. (2017), who found a positive existent relationship between trust and social network by analysing irrigation technology adoption between farmers in Chile. From a different perspective, Jim said farmers learn the best from farmers because there is trust between them. This finding is also consistent with Blackstock et al. (2010), who found that the probability of accepting information from an individual who has the same background is much higher than from a person without experience or any occupation-related.

The catchment group was a joint discussion between all farmers. Most of them said that the catchment group allows them to find their commonalities through collective action, besides learning and sharing. This finding is consistent with Engler et al. (2017), who reported that the interaction with organisations and water communities influence behaviour changing as that relationship helps decrease the perception of risk and insecurity.

Best water quality management practices

Most of the farmers in this study were aware of nitrogen leaching as the biggest problem of water quality decline. This finding is consistent with previous studies that assessed the water quality in dairy farms, and they reported that 90% of water quality declining lies on nitrogen leaching (Baucells et al., 2018; Masoni et al., 2012; Tomasevic et al., 2014; Zonderland-Thomassen et al., 2014). It is worth mentioning that this result does not apply to all farmers. Some of them denied that water quality has declined over the years due to dairy farming activities. All farmers of this study have a storage pond to stock the effluent until there are adequate conditions to spread the effluent in the soil, and all of them are aware of the special care that this practice requires, such as time and soil's condition. This result is also compatible with a previous study conducted by (Beuger & Daly, 2016), who found that effluent spreading is the most commonly used method to treat dairy effluent in New Zealand, and they confirmed that the soil plays an important role in that technique. The farmers also mentioned wetlands, constructed and natural, and planting as good management practices to treat the effluent in their farms, and that is consistent with a study conducted by Drizo et al. (2015), who found that wetlands efficiently reduced the amount of nutrient into the water, especially in the summer, the best growing season of plant and microbiological activity. Some farmers also highlighted the relationship between the use of fertiliser and farm's profitability. Despite recognising the necessity of reducing the use of fertilisers, they acknowledged that fertilisers make profits for the farm. This finding is also consistent with some studies in the literature (Doole & Romera, 2015; Smith et al., 2018). Doole and Romera (2015) found that the relation between low leaching of nitrogen and milk output is not profitable, but Smith et al. (2018) reported that improving the management of nitrogen can increase profitability and decrease nitrogen loss to the waterways. Some farmers have been adopting cutting-edge nutrient management technology, as mentioned before.

5.4. Summary

This chapter presented the findings of this study, followed by the discussion, which was based on chapters two and three, theoretical analysis and literature review. The results showed that farmers of this study have adopted good management practices to improve water quality in their farms. The most common practice were storage ponds, wetlands and fencing planting around the waterways. Another common technique adopted by all farmers was the spreading effluent on the soil to recycle the nutrients as the effluent has a high concentration of nitrogen. Most farmers recognised that fertilisers need to reduce, and they have been investing in technology and adopting procedures to ensure that nutrients stay out of waterways. Thus, this study's first objective, "to describe best water quality management practices", was achieved through these findings.

The change management made by the farmers of this study over the years was based on their beliefs and philosophies, regulations proposed by the government and advice from organisations, farm consultants, friends, and family. However, it is important to mention that most of the changes mentioned by the farmers were related to their values and beliefs rather than a feeling of obligation due to regulations. The financial resources were the most common constraint mentioned by the farmers, but also pointed to mindset, reliable sources, and access to information as barriers to adopting new practices. They also highlighted the importance of having regulations, technical assistance, catchment groups and access to information to make decisions and adopt new techniques. Through these findings, this study achieved the second objective, “to analyse the motivation for change made over the years and its constraints”.

Their environment highly shaped farmers’ decision-making. This study provides evidence that external and internal factors can influence farmers’ behaviour and intention to adopt a specific practice or change. This study also shows that age and experience do not influence farmers’ behaviour, but educational level, skills, access to information, beliefs, social pressure, and financial resources effects their decision-making. Besides achieving the third objective of this study, “describe the main factors that shape farmers’ behaviour and decision-making towards water quality management”, this research also filled the gap found in the literature regarding farmers’ behaviour and perceptions towards water quality by adding social data to the literature.

Chapter 6. Recommendations and Conclusion

6.1. Introduction

Chapter six presents the conclusions and recommendations of this study. This chapter is divided into five sections. The first section discusses the purpose of the research, in which research aims and objectives are revisited and discussed related to the findings. The second section presents the relationship to previous research to discuss the implications of this study. The next section explains the limitations of the research, followed by recommendations for future studies and practice. Finally, there is a conclusion summarising the information presented in this chapter.

6.2. Purpose of the research

This research explored farmers' attitudes and perceptions towards water quality and the influence of social factors on farmers' behavioural change in Southland, New Zealand. This study had three objectives to be addressed. The first objective was to describe best water quality management practices shared by the farmers who participated in this study. As the second objective, this study proposed to analyse the motivation for change made over the years and its constraints from the farmers' point of view. The third and last objective was to describe the main factors that shape farmers' behaviour and decision-making towards water quality management. Chapter two of this study was essential in choosing a framework that would best shape this research to achieve the objectives proposed.

The Theory of Planned Behaviour and Theory of Social Capital framed this research to understand farmers' behaviour and the relationship between social interaction and decision-making. According to the Theory of Planned Behaviour, human behaviour is guided by three considerations: behavioural belief, normative belief, and perceived behaviour control (Ajzen, 1991). Those three considerations lie on internal and external factors that can influence an individual's intention to perform a specific behaviour, including social pressure, personal beliefs, skills, knowledge, and financial resources (Ajzen, 1991). The Theory of Social Capital also says that individuals' behaviour is influenced by their social connectedness and engagement with the community (Adler & Kwon, 2002). Additionally, trust and norms play an important role in that context of the social networks, as trust can decrease insecurity and encourage the change of behaviour, and norms reinforce the collective actions over an individual's preferences (Putnam, 1995).

This study selected a qualitative design to collect meaningful data by exploring participants' settings in a complex reality. An interpretive approach to this research provided an in-depth understanding of cross-social factors that differed from the literature in some cases. The data collection method was semistructured interviews using open-ended questions to better understand farmers' feelings, perceptions, and opinions. Five farmers participated in this research, and they were selected using a purposive sampling strategy (Etikan et al., 2016), a non-random technique based on each participants' personal qualities. Here, their personal qualities are simply their willingness to be part of the study and their knowledge and experience regarding the phenomenon of interest, water quality. This research followed ethical procedures of participants' confidentiality and anonymity, and the well-being of the participants and the researcher were a priority during the process.

This study identified a change in the farming systems over the years mentioned by all farmers due to several factors, such as regulations, education, and awareness. The findings showed that farmers of this study are aware of good management practices. They showed high knowledge and experience regarding farming systems and management practices adopted over the years. Besides fences, all farmers mentioned adopting planting around waterways, wetlands to filter the waste and storage ponds to spread the effluent. Some of them also mentioned periodical water and soil tests to guarantee quality and watch the development of trends over the years. Also, they were aware that nitrogen leaching is the most significant cause for water quality decline, and some have been addressing this issue by investing in modern nutrient management technologies.

The establishment of simple practices was also an option to minimise the impacts of nitrogen leaching by avoiding spreading fertiliser close to tracks, drains and waterways, and by watching the best season to spread the effluent on the soil, which is also a critical stage in farming management. Based on all these findings, it was clear that farming management among the participants has been improving over the years, and farmers of this study are conscious of the necessity to protect waterways and the environment surrounded by them. Thus, the first objective of this research was addressed by describing good management practices adopted by the farmers from this study.

The results also showed that behaviour change was more related to farmers' values and beliefs than norms and regulations. The participants mentioned having their philosophies aligned with their management practices, and they wanted to look after the environment and community surrounding the farms. However, some also acknowledged that norms, regulations, and education are essential to respect some limits. This study also provided evidence that the most common constraint to adopt changes between farmers was financial resources, as some changes require money reserve for implementation, followed by mindset and perception. However, it was clear that most of the farmers of this study are inspired by their values of looking after the land, resources, water, and biodiversity, making the reasons for change more philosophical than practical. Through these findings, this research addressed the second objective, which was to analyse the reasons and constraints for change from farmers' perspectives.

Finally, the last objective of this research was to describe the main social factors that shape farmers' decision-making. The results showed that social interaction enables farmers to exchange their knowledge, having efficient communication and help each other based on a collective responsibility. This study found that catchment group provides ownership to farmers to discuss matters, but also to establish the feeling of reuniting and respect for one another because of the collective action. Also, this study identified that farmers value information as an essential part of behaviour change, and access to the "right information" has a significant impact on their decisions. This research indicated that the social network between farmers includes farm consultants, industry organisations, and catchment groups, and there is evidence that they tend to adopt practices tested by other farmers if the practice applies to the farm's needs.

The findings showed that trust increases the probability of accepting advice and sharing information; therefore, influencing farmers' behavioural change. Some farmers believe that trust is the reason why farmers learn best from farmers. Others said that the source of information is one of the biggest challenges of farming nowadays. As discussed before, this study also provided evidence that external and internal factors influence farmers' behaviour change, such as skills, knowledge, financial resources, and personal beliefs. However, personal characteristics, such as age and experience, did not influence behavioural change in this study, as farmers between sixty and eighty years old with more than forty years of experience showed the same level of engagement as young and less experienced farmers, which was a different finding from many studies found in the literature.

6.3. Relationship to previous research

Complementing knowledge regarding farming management practices to support environmental policymakers and encourage the adoption of environmental programs was the key contribution from this research. Thus, the findings from this research have implications for dairy farmers, policymakers, the government, the dairy industry, and organisations. The motivation of this research was to identify how farmers can benefit themselves from their social interactions and how those interactions work together, besides analyisng the influence of internal and external factors on performing a change of practice. According to Blackstock et al. (2010), studies are scarce regarding water quality, which consider social factors to analyse how farmers' behaviour is shaped in a social environment with different values, beliefs and backgrounds. It is important to bring this type of information into the literature since there is a gap concerning the social aspect of water quality and farmers' contribution. This research aimed to work as a transparent communication channel between farmers and the public by informing them about dairy farmers' reality and supporting farmers in this transition.

The findings of this research can help farmers from other regions in New Zealand who are facing similar challenges as the farmers from this study. This study gave examples through farmers' experiences showing how they are coping with nutrient management, which seems to be the biggest issue for water quality. Also, this study provided an understanding to other farmers about how social interaction between farmer to farmer, farmer to organisations, including regional councils and the government, and farmer to farm consultants might help them work as a team to achieve the best outcomes to improve water quality. The government can benefit from these findings, as this study provided evidence that financial resources can become a barrier in changing behaviour for some farmers; thus, subsidies could support that transition. This study also showed that skills, knowledge, and access to information encourage changes; thus, the informational incentives should be further explored.

Other studies benefit from this research. For example, Chau (2007) conducted a study of integrated water management to analyse water quality in Tokyo; however, the author did not consider social factors such as behaviour and perceptions. Cummings et al. (2013) evaluated the impacts of dairy production on the water quality by measuring nitrogen loss but did not include farmers' perspectives on their studies to give social meaning and opinions to their statistical results. Farmers' contribution brings richness to all water quality studies, regardless of being quantitative or qualitative. This study helps researchers who adopted a social approach in their studies but did not include background. For instance, Masser et al. (2005) investigated the role of farmers' beliefs in adopting riparian zone to improve water quality but did not analyse farmers' backgrounds, such as education level, financial resources, experience and age. Furthermore, studies that only assessed the role of social connectedness and trust in farmers' behaviour but did not consider other external factors also benefit from this research (Daxini et al., 2019; Engler et al., 2017; Mathijs, 2003).

6.4. Limitations of the present study

The main limitation of this study was regarding generalisation. Five dairy farmers participated in this research from one region in New Zealand. Thus, this research cannot generalise the findings to all dairy farmers in New Zealand or other places globally, as the variables can vary from region to region. As this research adopted an interpretive approach and focused on participants' feelings, opinions, experiences, and perceptions, it does not reflect the diversity of all farmers since other farmers can have different opinions and responses regarding water quality and related subjects discussed in this study. For example, some farmers may have a different perspective of social interaction and knowledge exchange or different philosophies and values that can influence their responses. Thus, this research does not capture the whole picture of dairy farmers and cannot be applied in different contexts. Also, the lack of standardisation does not allow replicability as this study provided authentic findings with high validity.

6.5. Recommendations for future research and practice

This research allowed several research topics to be identified, and it could be extended to other areas in New Zealand to explore farmers' perceptions in different contexts. Additionally, the interviews conducted enabled the identification of areas to be further investigated. For example, other farming sectors, such as sheep, beef, and horticulture, could also be included in this study to investigate their management practices and their thoughts about water quality since they are also dealing with nutrient management. Also, it would be helpful to compare two groups of farmers, farmers who have a high level of engagement with water organisations and community and farmers who have not, to investigate the extension of catchment groups and access to information on farmers' decisions.

The participants raised other environmental issues that need to be addressed such as, greenhouse gas emissions; biodiversity, which was mentioned for three participants as an indicator of water quality; and soil quality as the soil plays a strategic role in effluent spreading, the most common irrigation method practice in New Zealand. Informational and financial incentives to encourage farmers' behaviour change are a research area that would be useful to explore further, as it was a topic in this research that generated one different response comparing to the others. Finally, the last recommendation is regarding an interesting topic discussed by a participant of this study, the culture that possibly exists within the farming community should also be investigated. All these research areas could add different meanings to the social factors and how they shape farmers' behaviour.

6.6. Conclusion

This research argues that social factors are essential variables to be considered regarding farmers' decision-making. The social environment where farmers live, and their beliefs influence their behavioural change. Understanding how these social factors operate enabled the identification of issues and strengths. Treating water quality as a unidimensional variable based on environmental measurements and scientific theories do not reflect the whole system. Adopting an interpretive approach for this research provided multidimensional perspectives into water quality studies by focusing on farmers' experiences and contributions using semistructured interviews to collect meaningful data with high validity.

This study was framed by two theories that complement each other. The combination of both theories in this study, the Theory of Planned Behaviour and Social Capital Theory, provided a broad understanding of several factors not included in studies found in the literature; therefore, filling an existent gap. This study benefits a range of sectors by adding new insights to their management assets, including farmers, policymakers, the government, the dairy industry, and other organisations. This study raised critical social factors that need to be considered to promote behavioural change, including a harmonic dynamic between all the above mentioned sectors. Moreover, other studies benefit from the findings of this research, as it complements qualitative studies by bringing farmers' contributions on a deeper level as a significant social driver, besides complementing previous social studies.

Generalisation was the main limitation of this research. Five farmers participated in this study, and all of them represent one region in New Zealand. Thus, the findings of this study do not apply to all farmers in New Zealand, as other farmers might have different responses regarding the aspects discussed in this study. Therefore, as a recommendation for future research, this study suggests carrying it in other areas in New Zealand and having more farmers to represent the group, bringing more response diversity into the research. This study allowed the identification of several research areas to be further investigated, such as farming culture, greenhouse gas emission. Also, soil quality and biodiversity should be investigated as key performance indicators of water quality. Furthermore, this study recommends further exploring the role of financial incentives against informational incentives in behavioural change and comparing different groups of farmers, the one with a high level of engagement with discussion groups and the one which does not show that level of involvement in the community.

The study addressed all three objectives proposed in chapter one by describing best water quality management practices, analysing reasons for change and its constraints, and identifying the main social factors that shape farmers' decision-making. Therefore, this research's aim was also achieved. The findings showed that farmers have made changes, good management practices have taken place over the years, and they have been keeping themselves informed to improve practices and make their system better and more sustainable. This research showed that the motivation for change is more related to nurturing the land than practical obligations. Farmers adopt changes because they want to take care of the whole environment of their farms, not only including water but also biodiversity, the animals and the staff who work in the farms. There is also evidence to reassure the importance of regulations to guarantee good compliance between all farmers.

Finally, social factors shape farmers' decisions as farmers' environment influence their behaviour, including the availability of resources to invest in new practices, such as financial resources and capability resources (skills, knowledge, access to information). Also, farmers' values and beliefs are reflected in their management skills and lands, which confirms that individuals' beliefs shape farmers' attitudes. Social networks and knowledge exchange create a sense of collective action between farmers and trust is a critical asset to accept advice and guarantee efficient flow of information. Age and experience as personal features did not influence farmers' behavioural change in this study, as all participants showed engagement, knowledge, and willingness to learn regardless of their age or level of experience.

Thus, this study is a transparent communication channel between farmers, government, policymakers, and the community, which shows important social factors involved in their behaviour and decisions. Water quality decline can only be defeated through a collective action involving the whole society. Awareness, training, and education are required for good environmental management practices. The results of this study are consistent and meaningful; thus, this research could be used for clarification, besides being considered a potential guideline for future policies and decisions towards water quality and sustainable development.

References

Adler, P., & Kwon, S. W. (2002). Social capital: Prospects for a new concept. *Academy of Management Review, 27*(1), 17-40. https://www.researchgate.net/publication/51992897_Social_Capital_Prospects_for_A_New_Concept/link/0fcfd50b7ccdede6f6000000/download

Adnan, K. M. M., Ying, L., Yu, M., Hoque, M. M., Tama, R. A. Z., & Sarker, S. A. (2021). Assessing farmers' intention towards conservation agriculture by using the Extended Theory of Planned Behavior. *Journal of Environmental Management*, *280*, 1-10. https://doi.org/10.1016/j.jenvman.2020.111654

Adrian, A. M., Mask, P. L., & Norwood, S. H. (2005). Producers' perceptions and attitudes toward precision agriculture technologies. *Computers and Electronics in Agriculture, 48*(3), 256-271. https://doi.org/10.1016/j.compag.2005.04.004

Ajzen, I. (1985). From intentions to actions: A Theory of Planned Behaviour. In *Action control: From cognitive to behaviour* (pp. 12-36). https://fatunasam.com/fatdocs/UP2018/Ajzen.From%20Intentions%20to%20Actions-TPB.1985.pdf

Ajzen, I. (1991). The Theory of Planned Behavior *Organizational Behavior and Human Decision Processes*, *50*, 179-211. https://www.researchgate.net/publication/272790646_The_Theory_of_Planned_Behavior

Ajzen, I. (2006). *Behavioural interventions based on the Theory of Planned Behaviour*. https://people.umass.edu/aizen/pdf/tpb.intervention.pdf

Amacher, G., & Feather, P. (1994). Role of information in the adoption of best management practices for water quality improvement. *Agricultural Economics*, *11*, 159-170. file:///C:/Users/User/Downloads/agec1994v011i002-003a005.pdf

Atari, D., Yiridoe, E., Duinker, P., & Smale, S. (2009). What motivates farmers to participate in the Nova Scotia environmental farm plan program? Evidence and environmental policy implications. *Journal of Environmental Management, 90*(2), 1269-1279. https://doi.org/10.1016/j.jenvman.2008.07.006

Australian Public Service Commission. (2007). *Changing Behaviour: A public policy perspective*.

https://mungabareena.org.au/cdn/CTHG_Directory/Workforce_Development/Documents/Changing_Behaviour-A_Public_Policy_Perspective.pdf

Baldwin, T. (2016). *Dairy industry – History*. http://www.tonybaldwin.co.nz/publications/dairy%20publications/2016/Industry%20history.pdf

Barnes, A. P., Burnett, F., Mathews, K., Toma, L., Sutherland, L. A., & Thomson, S. (2018). Impact of information transfer on farmers' uptake of innovative crop technologies: A structural equation model applied to survey data. *The Journal of Technology Transfer*, *43*(4), 864-881. https://doi.org/10.1007/s10961-016-9520-5

Baucells, F., Feijoo, G., Noya, I., Berzosa, J., Moreira, M. T., & González-García, S. (2018). Environmental and water sustainability of milk production in Northeast Spain. *Science of The Total Environment*, *616-617*, 1317-1329. https://doi.org/10.1016/j.jenvman.2008.07.006

Bautista, R., & Bayang, M. (2015). Social network, social trust and shared-goals towards organizational-knowledge sharing. *American Journal of Educational Research*, *3*(5), 662-667. http://article.scieducationalresearch.com/pdf/EDUCATION-3-5-21.pdf

Bazan, I., Boguniewicz-Zablocka, J., & Naddeo, V. (2019). Water quality and resource management in the dairy industry. *Environmental Science and Pollution Research*, *26*(2), 1208-1216. https://doi.org/10.1007/s11356-017-0608-8

Beuger, B., & Daly, J. (2016). *Challenges and innovations in dairy factory wastewater treatment*. https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=1655

Bielders, C., Mathijs, E., Wauters, E., Govers, G., & Poesen, J. (2010). Adoption of soil conservation practices in Belgium: An examination of the Theory of Planned Behaviour in the agri-environmental domain. *Land Use Policy*, *27*(1), 86-94. https://doi.org/10.1016/j.landusepol.2009.02.009

Biological Emissions Reference Group. (2018). *Literature review and analysis of farmer decision making with regard to climate change and biological gas emissions*. https://www.agfirst.co.nz/wp-content/uploads/2018/12/Farm-Behaviour-GHG-Literature-Review-Final-Dec-2018.pdf

Blackstock, K. L., Ingram, J., Burton, R., Brown, K. M., & Slee, B. (2010). Understanding and influencing behaviour change by farmers to improve water quality. *Science of The Total Environment*, *408*(23), 5631-5638. https://doi.org/10.1016/j.scitotenv.2009.04.029

Bordieu, P. (1986). The forms of capital. In *Handbook of Theory and Research for the Sociology of Education* (pp. 241-258). Greenwood Press. file:///C:/Users/User/Downloads/Bourdieu%20The%20Forms%20of%20Capital.pdf

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77-101. https://biotap.utk.edu/wp-content/uploads/2019/10/Using-thematic-analysis-in-psychology-1.pdf.pdf

Brehm, J., & Rahn, W. (1997). Individual-level evidence for the causes and consequences of Social Capital. *American Journal of Political Science*, *41*(3), 999-1023. https://faculty.washington.edu/matsueda/courses/590/Readings/Brehm%20and%20Rahn%20AJPS%201997.pdf

Burton, R. J. F. (2006). An alternative to farmer age as an indicator of life-cycle stage: The case for a farm family age index. *Journal of Rural Studies*, *22*(4), 485-492. https://doi.org/10.1016/j.jrurstud.2006.02.005

Burton, R. J. F. (2014). The influence of farmer demographic characteristics on environmental behaviour: A review. *Journal of Environmental Management*, *135*, 19-26. https://doi.org/10.1016/j.jenvman.2013.12.005

Chau, K. W. (2007). Integrated water quality management in Tolo Harbour, Hong Kong: A case study. *Journal of Cleaner Production*, *15*(16), 1568-1572. https://doi.org/10.1016/j.jclepro.2006.07.047

Claridge, T. (2020). *Social Capital Research*. https://www.socialcapitalresearch.com/social-norms-and-social-sanctions/

Clark, D. A., Caradus, J. R., Monaghan, R. M., Sharp, P., & Thorrold, B. S. (2007). Issues and options for future dairy farming in New Zealand. *New Zealand Journal of Agricultural Research*, *50*(2), 203-221. https://doi.org/10.1080/00288230709510291

Coleman, J. (1988). Social Capital in the creation of human capital. *Chicago Journals*, *94*, 95-120. https://www.bebr.ufl.edu/sites/default/files/Coleman%20J.%20(1988)%20Social%20Capital%20in%20the%20Cration%20of%20Human%20Capital.pdf

Collins, H. (2018). *Dairy farmers' responses to water quality interventions: A case study in the Manawatu-Wanganui region of New Zealand* Massey University. https://mro.massey.ac.nz/handle/10179/13415

Collis, J., & Hussey, R. (2009). *Business research: A practical guide for undergraduate and postgraduate students.* (3rd. ed.). Palgrave Macmillian.

Cosentino, C., D'Adamo, C., Adduci, F., Pecora, G., Musto, M., Freschi, P., Paolino, R., & Valentini, V. (2015). Low vs high "water footprint assessment" diet in milk production: A comparison between triticale and corn silage based diets. *Emirates Journal of Food and Agriculture*, *27*(3), 312-317. https://www.researchgate.net/publication/274192229_Low_vs_high_water_footprint_assessment_diet_in_milk_production_A_comparison_between_triticale_and_corn_silage_based_diets

Creswell, John. (2013). *Qualitative inquiry & research design: Choosing among the five approaches* (3rd ed.). Sage.

Creswell, D., & Creswell, J. (2018). *Research design: Qualitative, quantitative and mixed methods approaches* (5th ed.). Sage Publications.

Creswell, J., & Poth, C. (2018). *Qualitative inquiry and research design: Choosing among five approaches* (4th ed.). Sage Publications.

Cummings, E., Thoma, G., Cothren, J., Wilson, J., Leh, M., & Matlock, M. (2013). Geospatial analysis of potential water use, water stress, and eutrophication impacts from US dairy production. *International Dairy Journal*, *31*, S78-S90. https://doi.org/10.1016/j.idairyj.2012.05.001

Czycholl, I., Krieter, J., & Drews, J. (2020). A life cycle assessment study of dairy farms in northern Germany: The influence of performance parameters on environmental efficiency. *Journal of Environmental Management*, *273*, 1-10. https://doi.org/10.1016/j.jenvman.2020.111127

Dairy NZ. (2019). *Five years of Water Accord shows dairy farmers doing their bit to improve water quality*. https://www.dairynz.co.nz/news/five-years-of-water-accord-shows-dairy-farmers-doing-their-bit-to-improve-water-quality/

Daxini, A., Barnes, A. P., O'Donoghue, C., & Ryan, M. (2019). Understanding farmers' intentions to follow a nutrient management plan using the theory of planned behaviour. *Land Use Policy*, *85*, 428-437. https://doi.org/10.1016/j.landusepol.2019.04.002

Denscombe, M. (2010). *The good research guide for small scale social research projects* (4th ed.). Open University Press.

Denzin, N. (2001). The reflexive interview and a performative social science. *Qualitative Research in Psychology*, *1*(1), 23-46. http://www.geocities.ws/visisto/Biblioteca/DENZIN_reflexive_interview.pdf

Doole, G. J., & Romera, A. J. (2015). Trade-offs between profit, production, and environmental footprint on pasture-based dairy farms in the Waikato region of New Zealand. *Agricultural Systems*, *141*, 14-23. https://doi.org/10.1016/j.agsy.2015.09.005

Drizo, A., Tunçsiper, B., & Twohig, E. (2015). Constructed wetlands as a potential management practice for cold climate dairy effluent treatment. *Catena*, *135*, 184-192. https://doi.org/10.1016/j.catena.2015.07.028

Engler, A., Cofré-Bravo, G., & Klerkx, L. (2019). Combinations of bonding, bridging, and linking social capital for farm innovation: How farmers configure different support networks. *Journal of Rural Studies*, *69*, 53-64. https://doi.org/10.1016/j.jrurstud.2019.04.004

Engler, A., Hunecke, C., Poortvliet, P. M., & Jara-Rojas, R. (2017). Understanding the role of social capital in adoption decisions: An application to irrigation technology. *Agricultural Systems*, *153*, 221-231. https://doi.org/10.1016/j.agsy.2017.02.002

Etikan, I., Abubakar, S., & Sunusi, R. (2016). Comparison of convenience sampling and purposive sampling. *American Journal of Theoretical and Applied Statistics, 5*(1), 1-4. https://www.researchgate.net/publication/304339244_Comparison_of_Convenience_Sampling_and_Purposive_Sampling

Farm Source Sustainable Dairying. (2020a). *Farm environment plan*. http://www.owlfarm.nz/Content/upload/Documents/Fonterra_Tiaki_FEP_OwlFarmUpdate_v1005.pdf

Farm Source Sustainable Dairying. (2020b). Farm environmental plan. https://www.fonterra.com/nz/en/campaign/tiaki.html

Food and Agriculture Organization of the United Nations. (2017). *Water pollution from agriculture: A global review*. http://www.fao.org/3/i7754e/i7754e.pdf

Food and Agriculture Organization of the United Nations. (2020). *The state of food and agriculture: Overcoming water challenges in agriculture*. http://www.fao.org/3/cb1447en/cb1447en.pdf

Gowda, M. J., & Dixit, S. (2015). Influence of farmers educational level on comprehending, acting-upon and sharing of agro advisories. *Journal of Agriculture and Rural Development in the Tropics and Subtropics*, *116*, 167-172. https://www.researchgate.net/publication/286856824_Influence_of_farmers_educational_level_on_comprehending_acting-upon_and_sharing_of_agro_advisories#:~:text=Farmers%20with%20higher%20education%20level,sharing%20and%20acting%20upon%20advisories.

Guest, G., MacQueen, K., & Namey, E. (2012). Introduction to Applied Thematic Analysis. In *Applied Thematic Analysis*. Sage Publications. http://antle.iat.sfu.ca/wp-content/uploads/Guest_2012_AppliedThematicAnlaysis_Ch1.pdf

Hu, M., Zhou, N., Khanna, N. Z., Ren, X., & Bai, X. (2018). Comprehensive water footprint assessment of the dairy industry chain based on ISO 14046: A case study in China. *Resources, Conservation and Recycling*, *132*, 369-375. https://doi.org/10.1016/j.resconrec.2017.07.021

Issa, I., & Hamm, U. (2017). Adoption of organic farming as an opportunity for syrian farmers of fresh fruit and vegetables: An application of the Theory of Planned Behaviour and structural equation modelling. *Sustainability*, *9*, 1-22. https://doi.org/10.3390/su9112024

Knierim, A., Toogood, M., & Siebert, R. (2006). Factors affecting european farmers' participation in biodiversity policies. *European Society for Rural Sociology*, *46*(4), 319-340. http://clok.uclan.ac.uk/6491/1/Siebert%2C%20Toogood%20and%20Knierim%2C%202006.pdf

Koppen, B., Lankford, B., Mahoo, H., & Franks, T. (2004). Entrenched views or insufficient science? Contested causes and solutions of water allocation: Insights from the Great Ruaha River Basin, Tanzania. *Agricultural Water Management*, *69*(2), 135-153. https://doi.org/10.1016/j.agwat.2004.04.005

Lansink, A., Ribeiro, C., Borges, J. A., & Lutke, V. (2014). Understanding farmers' intention to adopt improved natural grassland using the Theory of Planned Behaviour. *Livestock Science*, *169*, 163-174. https://doi.org/10.1016/j.livsci.2014.09.014

Masoni, P., Buttol, P., Pergreffi, R., & Fantin, V. (2012). Life cycle assessment of Italian high quality milk production. A comparison with an EPD study. *Journal of Cleaner Production*, *28*, 150-159. https://doi.org/10.1016/j.jclepro.2011.10.017

Masser, B., Terry, D., Fielding, K. S., Hogg, M., & Bordia, P. (2005). Explaining landholders' decisions about riparian zone management: The role of behavioural, normative, and control beliefs. *Journal of Environmental Management*, *77*(1), 12-21. https://doi.org/10.1016/j.jenvman.2005.03.002

Mathijs, E. (2003). Social capital and farmers' willingness to adopt countryside stewardship schemes. *Agriculture*, *32*(1), 13-16. file:///C:/Users/User/Downloads/social%20capital%20paper%20(1).pdf

Micha, E., McKillop, J., Hyland, J. J., & Heanue, K. (2018). Factors underlying farmers' intentions to adopt best practices: The case of paddock based grazing systems. *Agricultural Systems*, *162*, 97-106. https://doi.org/10.1016/j.agsy.2018.01.023

Mills, J., Dwyer, J., Ingram, J., Blackstock, K., Sutherland, L.-A., & Burton, R. (2013). Considering the source: Commercialisation and trust in agri-environmental information and advisory services in England. *Journal of Environmental Management*, *118*, 96-105. https://doi.org/10.1016/j.jenvman.2012.12.020

Ministry for Primary Industries. (2017). *Southland Dairy Farm: Focus on farm technology for long-term financial sustainability*. https://www.mpi.govt.nz/dmsdocument/20483-2016-Farm-System-Change-Dairy-Farm-Case-STudy-Southland-Dairy-Farm

Ministry for Primary Industries. (2021). *Protecting freshwater health*. https://www.mpi.govt.nz/agriculture/farm-management-the-environment-and-land-use/protecting-freshwater-health/

Ministry for the Environment. (2019). *Environment Aoteroa 2019: New Zealand's environment report series*. https://environment.govt.nz/assets/Publications/Files/environment-aotearoa-2019.pdf

Montoro-Sanchez, A., & Díez-Vial, I. (2014). Social capital as a driver of local knowledge exchange: A social network analysis. *Knowledge Management Research & Practice*, *12*. https://doi.org/10.1057/kmrp.2014.7

Myers, M. (2008). *Qualitative research in business and management* (3rd ed.). Sage.

New Zealand Dairy Statistics. (2019). *QuickStats about dairying – NEW ZEALAND*. https://www.dairynz.co.nz/media/5794072/quickstats-about-dairying-new-zealand-2020-web.pdf

New Zealand Government. (2020). New rules in place to restore healthy rivers. https://www.beehive.govt.nz/release/new-rules-place-restore-healthy-rivers

New Zealand Milk Products. (2021). *What makes New Zealand milk so good?* https://www.nzmp.com/global/en/news/what-makes-nz-milk-so-good.html

O'Donoghue, C., Murphy, E., Murphy, G., Hynes, S., & Green, S. (2011). Assessing the compatibility of farmland biodiversity and habitats to the specifications of agri-environmental schemes using a multinomial logit approach. *Ecological Economics*, *71*, 111-121. https://doi.org/10.1016/j.ecolecon.2011.08.010

Owusu-Sekyere, E., Jordaan, H., & Scheepers, M. E. (2017). Economic water productivities along the dairy value chain in South africa: Implications for sustainable and economically efficient water-use policies in the dairy industry. *Ecological Economics*, *134*, 22-28. https://doi.org/10.1016/j.ecolecon.2016.12.020

Payen, S., Falconer, S., & Ledgard, S. F. (2018). Water scarcity footprint of dairy milk production in New Zealand – A comparison of methods and spatio-temporal resolution. *Science of The Total Environment*, *639*, 504-515. https://doi.org/10.1016/j.scitotenv.2018.05.125

Pius, A., & Helmi, H. (2020). A Review of key paradigms: positivism VS interpretivism. *Global Academic Journal of Humanities and Social Sciences,*, *2*(3), 39-43. https://www.gajrc.com/media/articles/GAJHSS_23_39-43_VMGJbOK.pdf

Putnam, R. (1993). The prosperous community: Social capital and public life. *The American Prospect*, *4*(13), 1-11. http://faculty.washington.edu/matsueda/courses/590/Readings/Putham%201993%20Am%20Prospect.pdf

Putnam, R. (1995). “Bowling Alone: America's Declining Social Capital". *Journal of Democracy*, 65-78. http://mktgsensei.com/AMAE/Consumer%20Behavior/bowlingalone.pdf

Ridoutt, B. G., Xu, C.-C., Chen, F., Zhang, H.-L., Huang, J., Liu, J.-J., & Li, Y. (2014). Water availability footprint of milk and milk products from large-scale dairy production systems in Northeast China. *Journal of Cleaner Production*, *79*, 91-97. https://doi.org/10.1016/j.jclepro.2014.05.043

Riessman, C. K. (2005). *Narrative analysis: Qualitative research methods*. Sage Publications. https://books.google.co.nz/books?hl=en&lr=&id=9ffAwoYi7E0C&oi=fnd&pg=PA10&dq=Riessman,+C.+K.+(1993).+Narrative+Analysis.+Qualitative+Research+Methods+Volume+30.+United+States:+Sage+Publications+Ltd.&ots=Usot_En0hM&sig=MJQcCzk1qNLztOVJerZDvqf67FQ#v=onepage&q&f=false

Ringler, C., Hassan, R., & Deressa, T. (2011). Perception and adaptation to climate change by farmers in the Nile basin of Ethiopia. *The Journal of Agricultural Science*, *149*, 23-31. https://doi.org/10.1017/S0021859610000687

Rubin, H., & Rubin, I. (2005). *Qualitative Interviewing: The Art of Hearing Data* (3rd ed.). Sage. https://books.google.co.nz/books?hl=en&lr=&id=bgekGK_xpYsC&oi=fnd&pg=PP1&dq=rubin+%26+rubin+2012+qualitative+interviewing&ots=tJ6weHl9Li&sig=LZnNHZyCU9HuXtZUM8E1Nl2W8Xs#v=onepage&q=rubin%20%26%20rubin%202012%20qualitative%20interviewing&f=false

Schroeder, A., Aubert, B., & Grimaudo, J. (2012). IT as enabler of sustainable farming: An empirical analysis of farmers' adoption decision of precision agriculture technology. *Decision Support Systems*, *54*, 510–520. https://doi.org/10.1016/j.dss.2012.07.002

Science Learning Hub. (2021). *New Zealand dairy farming – Timeline*. https://www.sciencelearn.org.nz/resources/2095-new-zealand-dairy-farming-timeline

Sepahvand, F., & Gholamrezai, S. (2017). Farmers’ participation in Water User Association in western Iran. *Journal of Water and Land Development*, *35*, 50-56. https://doi.org/10.1515/jwld-2017-0067

Serman, N. (1999). *Factors wch influence the farmer's adoption of soil and water conservation practices in Souteewestern Ontario* The University of Guelph]. https://www.collectionscanada.gc.ca/obj/s4/f2/dsk2/ftp01/MQ40441.pdf

Smith, A. P., Christie, K. M., Rawnsley, R. P., & Eckard, R. J. (2018). Fertiliser strategies for improving nitrogen use efficiency in grazed dairy pastures. *Agricultural Systems*, *165*, 274-282. https://doi.org/10.1016/j.agsy.2018.06.017

South Island Dairying. (2021). *South Island dairying within the NZ dairying industry*. http://www.siddc.org.nz/about-siddc/south-island-dairying/

Southland New Zealand. (2021). *Agriculture*. https://southlandnz.com/work/agriculture

Thenail, C., Kristensen, L. S., & Kristensen, S. P. (2004). Landscape changes in agrarian landscapes in the 1990s: The interaction between farmers and the farmed landscape. A case study from Jutland, Denmark. *Journal of Environmental Management*, *71*(3), 231-244. https://doi.org/10.1016/j.jenvman.2004.03.003

Thornhill, A., Saunders, M., & Lewis, P. (2016). *Research methods for business students* (7th. ed.). Pearson Education.

Tomasevic, I., Djekic, I., Miocinovic, J., Smigic, N., & Tomic, N. (2014). Environmental life-cycle assessment of various dairy products. *Journal of Cleaner Production*, *68*, 64-72. https://doi.org/10.1016/j.jclepro.2013.12.054

Van-Middelaar, C. E., Murphy, E., De Boer, I. J. M., Upton, J., Shalloo, L., Holden, N. M., & Curran, T. P. (2017). Water footprinting of dairy farming in Ireland. *Journal of Cleaner Production*, *140*, 547-555. https://doi.org/10.1016/j.jclepro.2016.07.199

Wang, C., Pumijumnong, N., Arunrat, N., Sereenonchai, S., & Cai, W. (2017). Farmers' intention and decision to adapt to climate change: A case study in the Yom and Nan basins, Phichit province of Thailand. *Journal of Cleaner Production*, *143*, 672-685. https://doi.org/10.1016/j.jclepro.2016.12.058

Whenua, M. (2019). Gender, educational attainment, and farm outcomes in New Zealand. *Journal of Land*, *8*(18), 1-16. https://www.mdpi.com/2073-445X/8/1/18

While, A., & Barribal, L. (1994). Collecting data using a semi-structured interview: A discussion paper. *Journal of Advanced Nursing*, *19*, 328-335. https://www.researchgate.net/publication/234055873_While_A_Collecting_data_using_a _semi-structured_interview_A_discussion_paper_Journal_of_Advanced_Nursing_192_328-335

White, C. (2013). *Integrated water resources management: What is it and why is it used?* https://globalwaterforum.org/2013/06/10/integrated-water-resources-management-what-is-it-and-why-is-it-used/

Wilson, G. A. (1997). Factors influencing farmer participation in the environmentally sensitive areas scheme. *Journal of Environmental Management*, *50*(1), 67-93. https://doi.org/10.1006/jema.1996.0095

Zhang, J., Zheng, X., Zhang, X., & Fu, Z. (2010). Farmers' information acceptance behavior in China. *African Journal of Agricultural Research*, *5*(3), 217-221. https://academicjournals.org/journal/AJAR/cited-by-article/019CEF637043

Zonderland-Thomassen, M. A., & Ledgard, S. F. (2012). Water footprinting – A comparison of methods using New Zealand dairy farming as a case study. *Agricultural Systems*, *110*, 30-40. https://doi.org/10.1016/j.agsy.2012.03.006

Zonderland-Thomassen, M. A., Lieffering, M., & Ledgard, S. F. (2014). Water footprint of beef cattle and sheep produced in New Zealand: Water scarcity and eutrophication impacts. *Journal of Cleaner Production*, *73*, 253-262. https://doi.org/10.1016/j.jclepro.2013.12.025

Appendix C. Participants' Information Sheet

EXPLORING FARMERS' ATTITUDES AND BEHAVIOUR TOWARDS WATER QUALITY IN SOUTHLAND

Information Sheet for Participants

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether to participate. If you decide to participate, I thank you. If you decide not to take part, there will be no disadvantage to you of any kind and I thank you for considering my request.

Introduction

I am Isabella Paiva de Souza, a master's student at the Southern Institute of Technology and my research project is about water management in dairy farms in Southland.

What is the aim of the project?

This project aims to explore farmers' attitudes and behaviours towards water quality. Exploring dairy farmers' perspective related to a water management context will be helpful to describe important social factors regarding management practices such as, changes and reasons for that as well as challenges, and social-cultural factors that influence in farmers' behaviours and decision-making.

What type of participants are being sought?

I am looking for participants who are dairy farmers in Southland because they are inserted into an environment that I want to explore, and they know better than anyone else about water management practices that have been adopted, about issues and challenges related to environmental changes and about the experiences to run a dairy farm.

What will participants be asked to do?

Should you agree to take part in this project, you will be asked to attend an interview. Your level of participation is entirely voluntary. You will not be asked to answer questions that you are not comfortable with in any part of the interview. The interview will take around 30-45 minutes and the information will be recorded. Talking will be led by the researcher who will have some questions to be covered, but most of the interview will depend on the flow of the conversation. Only subjects relating to water management will be discussed, such as reasons for change(if there are some) and constraints, water management practices adopted as well, lease be aware that you may decide not to take part in the project at any time without any disadvantage to yourself of any kind.

Can participants change their minds and withdraw from the project?

You may withdraw from participation in the project at any time up until the point at which the data is anonymised and amalgamated into the report, without any disadvantage to yourself of any kind.

What data or information will be collected and what use will be made of it?

Sessions will be taped using a mobile phone, so researchers are able to describe sessions in detail. The records will not be played to people outside the research group. Data given in the interview will be transcribed by the researcher and analysed afterwards. Your name will not be used in the final report, and you will not be able to be identified in any way. All information will be kept confidential, and the data will be used by the researcher only for the purposes of this study.

What will happen to the results?

The results of the project may be presented at conferences and/or published in an academic journal, and a copy of the report will be available in the Southern Institute of Technology library (Invercargill, New Zealand). You are most welcome to request a copy of the results of the project should you wish.

How will the data be stored?

The data collected will be securely stored in such a way that only the researcher and the supervisor will be able to gain access to it. At the end of the project any personal information will be destroyed immediately except that, as required by SIT's research policy, any raw data on which the results of the project depend will be retained in secure storage for five years, after which it will be destroyed.

What if you have any questions about the project?

If you have any questions about the project, either now or in the future, please feel free to contact: -

Researcher: Isabella Paiva de Souza

Southern Institute of Technology

[redacted]

Supervisor: Christine Liang

Southern Institute of Technology

[redacted]

This research has been approved by the Human Research Ethics Committee at SIT.

If you have concerns about the **ethical conduct** of this research or the researcher, the following procedure should occur. Write to the following:

The Secretary of the Human Research Ethics Committee, Southern Institute of Technology, 133 Tay St INVERCARGILL 9840 NZ, Tel: 03 211 2699

All information is confidential and will be handled as soon as possible.

Appendix D. Consent Form

Declaration of consent to be interviewed for the research project about exploring farmers' attitudes and behaviour towards water quality in Southland

I have had the scope and nature of the research fully explained to me. Any questions about the research have been satisfactorily answered, and I understand that I may request further information at any stage.

I accept and note that:

1. My participation in this research is entirely voluntary.
2. I may withdraw from participation in the research at any time up to the point at which the data is anonymized and amalgamated, without explanation, disadvantage or disincentive.
3. Any information given during the interview is being utilized solely for the purpose of the specific research project and will not be disclosed to any other person or agency without my express consent.
4. The interview will be recorded for later transcription.
5. This information may be incorporated into the research report, but actual names or other characteristics that may lead to identification of individuals will not be disclosed.
6. I may request to view any completed drafts or sections of the research report to which I have contributed, at any time.
7. A copy of the completed research report will be made available to me, on request, at the conclusion of the research.

I have read and understood the information set out on this form and give my informed consent to be interviewed in accordance with the stated terms and conditions.

Name of Research Subject/Participant	**Name of Researcher**
Signature ………………………………………………	………………………………………………..
Date …………………………………………………	…………………………………………………

Appendix E. Interviews Questions

- **Introduction**

Farmer and background

Could you please say your age and if you feel comfortable the gender that you identify yourself?

Could you tell me about the farming history and your background? For example, how did you get farming? How many years of experience do you have? Education Level?

What is the farm ownership structure? For example, you are the owner, it is a family business or partnership with someone else.

Do you have plans or goals for your farm in the future?

- **Development**

Farming system and changes

If you feel comfortable, could you share your annual income and the area of your land ownership?

Tell me about the farming system, for example, waterways through the property, effluent management if exists, fertilisation management, irrigation, things that you usually deal in your daily routine, and that can be directly or indirectly related to water management.

How would you describe the water quality in your farm? And how has it evolved over the years?

How would describe your reasons to make some change over the years (water quality or management)? And constraints to make changes as well?

Water quality intervention and networking

How would you describe your actions taken over the years towards water quality? For example, they were based on advice, or from organisations, based on accords or regulations, or they were taken voluntary?

How would you describe your involvement with your peer, community, catchment groups, family? And how these networking influence in your decision-making? Or they do not influence at all.

Source of information and behavior

How would you describe a good dairy farmer and a good farm management?

Tell me about how do farmers learn about what is expected to do?

- **End of the interview**

We are heading to the end of the interview. Would you like to add any more comments?

Notes: Some of these questions were based on the gaps found on the literature review and suggestions from other studies as well. Also, I would like to say that some of the questions will be used just in need to prompt the participants. Thus, I will not necessarily follow this structure, just in the case I cannot get the information that I want from previous questions. The interview will follow the flow of the conversation.