

Nutrient Regulation effect on the value of farmland in New Zealand

Gary Owen Garner

Lincoln University, Christchurch, New Zealand

Edward Percy

Lincoln University, Christchurch, New Zealand

Abstract

The National Policy Statement for Freshwater Management 2011 and 2014 heralded freshwater regulation rollout in Aotearoa-New Zealand, largely coming into full effect in 2017. New rules introducing a framework for management of freshwater resources are being progressively introduced at regional levels to reduce pollution through a focus on nonpoint source nutrient leaching and runoff from farms. Areas of differing environmental risk and set nitrate leaching limits for different zones create water management zones where specific nutrient rules apply. As a result, the regulations associated with this serve to place controls on productivity in accord with the particular zoning rules applying for a particular region. On the basis that land value is closely linked to its productive capacity, the value of land is also potentially affected since management systems and farm inputs are constrained. This report endeavours to understand how this new wave of regulation is currently impacting land values in the Selwyn-Waihora District of the Canterbury Plains of New Zealand's south island. Following a period of what has been mooted as extensive community collaboration with the regulators, it also looks at what the perceived impacts are as regulations come into effect.

Keywords:

Nutrient, freshwater, nitrate leaching, productivity, farmland value, regulation, property value

Contact: Dr GO (Gary Owen) Garner
Faculty of Agribusiness & Commerce, Department of Land Management & Systems
Room C001D Commerce Building
P O Box 85084, Lincoln University
Lincoln 7647 Christchurch, New Zealand

p +64 423 0274 | m +64 21288 2092 | f +64 3 325 3847
email: gary.garner@lincoln.ac.nz

1 Introduction

1.1 An overview of the problems associated with nutrient leaching into freshwater

Farming is constantly looking at ways to produce more from a finite area of land. Irrigation can capacitate this with very good effect, especially in drier areas like the Canterbury plains of Aotearoa-New Zealand. But water quality is increasingly being scrutinised. The impact on rivers and lakes due to pollution through the likes of nitrogen leaching and phosphate runoff as a result of changing land use, irrigation schemes and a drive to increase productivity and profitability to remain economically competitive is impacting on freshwater quality, cultural values, and habitats' health and diversity.

The primary significance of nutrient leaching into freshwater probably relates to human health. For example, a severe and adverse consequence as a result of high levels of nitrate or phosphorous being present in underground and surface water is the possibility of “blue baby syndrome” or methaemoglobinaemia - an oxidized form of haemoglobin that is unable to release oxygen to the tissues (Stevenson & Lindberg, 2010, pp. 16-17). This condition mainly affects babies less than 6 months old or in the womb; high levels of nitrates either absorbed by the placenta in the womb or in water given to bottle fed babies prevents their blood from delivering oxygen effectively to different parts of their bodies, resulting in blueness around the mouth, hands and feet (CDHB, 2013). If severe enough, it can affect breathing and subsequently may become life threatening; adults with specific rare metabolic disorders may also be at risk of methaemoglobinaemia.

Over recent years there have been various reported concerns (e.g. Young, 2013) about rising nitrate levels via monitoring of Canterbury wells; indeed, Environment Canterbury's November 2012 groundwater survey finding (ECAN, 2012) highlights that nitrate levels had been increasing in about 30 per cent of tested wells over the previous 10 years. Accordingly, there is little doubt that the environment has become degraded by an excess of nutrients, exacerbated by the intensification of dairy farms in New Zealand and linkages with increasing nutrient emissions to waterways (Cameron, Di, & Moir, 2013; Doole, 2010; Petersen, 2014). As a result, rules are being introduced to regulate nutrient leaching/runoff from farms.

1.2 Environmental control effected by nutrient management and limits

In concert with a number of authorities located throughout New Zealand, Environment Canterbury – known as ECAN, the regional council for the Canterbury region - have embarked on a course of regulation which places limitations on how farms operate by setting nutrient limits within several designated nutrient management zones. This research covers a part of this region, being the Selwyn-Waihora District which lies within Canterbury, between the Waimakariri River to the northeast and the Rakaia River to the southwest, the Southern Alps to the northwest, and the Pacific Ocean and Lake Ellesmere to the southwest (refer Figure 1) – an area comprising approximately 255,900 hectares (Canterbury Maps, 2015). Lake Ellesmere collects much of the water running off the Canterbury Plains before it runs into the Pacific Ocean, and consequently is a major collection area for nutrients leached and running off. According to Lomax, Johnston, Hughey, and Taylor (2015), it has long been recognised that the health of the lake and its tributaries has declined, with the area recently experiencing an expansion of intensive land use in both rural and urban areas. The Lomax report also highlights that in recent years, the recreational water quality has been graded poor, with an increased risk of becoming ill from water based recreational activities that result in full immersion. In fact, the site is no longer considered suitable for recreational purposes, with potentially toxic cyanobacteria in the lake representing a public health risk for both recreational activities and cultural practices such as mahinga kai (food) gathering (Lomax et al., 2015, pp. 16-17).

Increasingly intensive agricultural pursuits conducted in the region has aggravated the situation, resulting in most of the district being classified “highly threatened” as a nutrient allocation “Red Zone” where water quality outcomes are not met (refer Figure 2). Within a red zone there can be no increase in nitrogen leaching beyond the leaching baseline. Farms with medium nitrogen leaching rates in the red zone (less than 20kg/ha/yr) can continue to operate as a permitted activity. Farms with higher

leaching losses (more than 20kg/ha/yr), can continue to operate until 1 January 2017, but after this date a resource consent is required (ECAN, 2014).

Increasing sensitivities are also apparent by virtue of other complications such as the areas around Lake Ellesmere being co-classified within a designated Cultural Area (CLMVA)¹, and / or a Phosphorous Sediment Risk Area (PSRA). Additional to these zone rules are rules relating to land with access to water from irrigation schemes, whereby the principal water supplier holds a discharge permit that specifies the maximum annual amount of nitrate-nitrogen that may be discharged or leached (ECAN, 2015a). The end result has seen the development of the Canterbury Water Management Strategy establishing a sub-regional chapter (Variation 1) of the Land and Water Plan for Canterbury via the Selwyn Waihora Zone Committee. Variation 1 now has legal effect.

1.3 Matrix of Good Management & land use constraint

An information source for use by communities and local regional councils – known as the Matrix of Good Management (MGM) – has been designed to credibly support the development of relevant water quality policy relating to nutrient losses from different land uses under what is considered to be “good management practices” (ECAN, 2016). The MGM is to come into effect in 2017 with the impact of a 14% reduction of nitrogen leaching across the district including a 30% reduction of nitrogen losses from dairy farms, and 7% from arable farms from 2022 for those farms emitting more than 15 kilograms of Nitrogen (N) per hectare per year (kgN/ha/yr). The MGM essentially supports dictated nitrogen leaching limits for each farm in Selwyn - within a maximum timeframe of 2022 if they are still farming over 15 kgN/ha/yr at that point. This is an important part of policy in Variation 1 that may be in farmers’ minds, but has not eventuated yet. As at date of writing, whilst the MGM project “aims to quantify the typical nutrient losses that are expected to occur from the range of farming systems, soils and climates across Canterbury when managed to good management practice” (ECAN, 2015b, p. 4), industry agreement achieved thus far provides implementation guidance only rather than set rates.

In consideration of the foregoing, it may be appreciated that the regulatory environment in which farmers operate in Selwyn is both complex and changing rapidly. Furthermore, it will likely undergo further considerable change in the future, especially around the rules coming into effect in 2017 and 2022.

This scenario therefore entreats the question as to how associated regulations might affect communities - particularly at the farm-gate level. This is perhaps even more particularly within the highly threatened “red zone” environments in the Selwyn-Waihora district, where the ability to carry out certain land uses hitherto commonplace is likely to be constrained or otherwise limited. The implications for productivity are significant – yet perhaps somewhat paradoxically, production is the one critical factor farmers usually have considerable control and influence over. It is traditionally held by many rural valuation theorists (for example, Baxter & Cohen, 2009; Frizzel, 1979; Hargreaves & McCarthy, 2010; Prag, 2003; Rost & Collins, 1993; Tímár, 2011) that farms are typically bought and sold on the basis of their perceived productive capacity, since profitability is a reflection of productivity. It is within this framework that this research investigates how rules, which have the capacity to impact on productivity of farms, are impacting on land values and how they might be perceived to impact land values in the future.

¹ A Cultural Landscape/Values Management Area acknowledges the significance of a particular area to Māori, recognising the cultural and ecological sensitivity especially with regards discharges of contaminants and the taking and use of fresh water. Such a designation requires special management to facilitate restoration and protection of food (mahinga kai) and treasures (wāhi tapu and wāhi taonga). The study area encompasses this designation with the inclusion of Te Waihora/Lake Ellesmere, its margins and wetlands (ECAN, 2015d).

1.4 Stakeholder perceptions – set to change?

Preliminary studies such as McCarthy (2016)² suggest that farmland values could be reduced significantly by a low nitrate leaching limit, with the reduction in value explained by the potential loss in long term income earning potential. However studies like this, whilst useful in developing theoretical models, have relied upon imputed values (i.e. utilising productivity valuation methodology modelling) in order to estimate the expected decrease in land value due to conditions imposed under the resource consent over a very limited number of cases - with limited or no observable or empirical evidence presented. Another recent investigator (Austin, 2014) conducting research within the same study area as this investigation found that stakeholders have very minimal understanding concerning regulations about to be imposed upon them, with an overall absence of knowledge and understanding regarding the proposed regulatory changes prevailing. Austin also determined that there was widespread concern that attempts for regulatory control was unlikely to be fair and equitable: for example, particular concerns around authenticity and accuracy in measuring losses, and variability in measuring compliance inconsistencies. (This principally relates to the use of Overseer – a software program widely accepted by government / statutory authorities and other stakeholders as a means to measure nutrient use on-farm via “nutrient budgets”, and assess likely losses to the environment). That study concluded that farmers have a strong degree of apprehension around the likely effect of regulation on production gains or losses, profitability, and any likely influence on farm values.

Finally, it may be observed that although the Proposed Land and Water Regional Plan and Variation 1 have been discussed and publicised for some time, the rules are progressive and do not necessarily impact on farmers directly until 2017, unless a land use change is proposed. Moreover, because these rules are relatively new there is a dearth of literature on, or evidence of, how nutrient regulation might impact on land values in Selwyn. This research endeavours to fill that gap by presenting some initial, albeit limited empirical evidence.

2 Methodology

2.1 Approach & Rationale

The primary objective of this study is to gauge the effect of nutrient regulation, having particular regard to impact on land values in the Selwyn-Waihora district - both now, and if possible, what is likely in the future. In this instance, reliance upon a more classical quantitative approach that seeks to determine farm value trending over time that might be explained by regulation as an independent variable is problematic. This mostly relates to shortened time-series and as noted later, a lack of homogenous transactional data. Alternatively, this research seeks to investigate a range of matters relating to the foregoing by endeavouring to determine:

- How nutrient regulation is impacting on decisions farmers have made with regard to a land transaction or management system.
- Whether farmers are taking action now to mitigate any perceived impact.
- How stakeholders perceive nutrient regulation has or will impact on their future use and/or disposal of their land.

² This study - offered recently as a conference presentation - was a preliminary investigation of the impact of the 2014 National Policy Statement for Freshwater Management on farmland values in priority catchments in the Manawatu region, North Island, New Zealand. Some interesting discussion around restrictions placed on land use and the impact this has had on income earning potential and value were submitted, however as at date of writing a formal paper or publication has yet to issue.

This knowledge might then ultimately inform, together with any quantitative empirical analysis conducted, how the regulation is impacting on land value. Understanding how farmland stakeholders in the Selwyn-Waihora District are considering the nutrient regulation in Selwyn in relation to the value of their landholding can be achieved by assembling the perceptions of farmers in the district. After all, by and large farmers are the people making the decisions when it comes to land purchases, land sales and overall farm management. Within these decisions is an accumulation of knowledge and experience around nutrient regulation and a perception of how regulation will impact that land. They may be taking advice from various consultants and listening to the perceptions of public and professionals alike but their decision is their own, no matter how well informed or ill-informed. It is understanding this decision, and the reasoning behind this decision, that is of fundamental concern to this study.

This research is therefore primarily a qualitative study, conducted utilising a case study approach as follows. Participatory instruments have been employed using a semi structured interview guide to allow interviewees to converse openly about their experiences within the context of this study, guided by the interviewer. Rather than theory testing, this approach seeks insight and understanding to build theory - Eisenhardt (1989) considers this approach of inducing theory using case studies as being especially appropriate in new topic areas. Certainly, the introduction of nutrient regulation into New Zealand's rural landscape is new - and especially new in Canterbury and the Selwyn-Waihora zone.

2.2 Design

During the course of developing this study, any precedents linking regulation impact on productivity and land use, and land value have been considered. However, it cannot be assumed that the experience in Aotearoa-New Zealand necessarily follows that established in other regimes. The study has therefore proceeded on the basis of gathering local evidence in the specific study area.

Whilst some quantitative analysis of farm sales in the Selwyn Waihora Water Management Zone has been undertaken (in addition to the examination of several other relevant datasets), to see if there has been a discernible trend in sales which might indicate regulation has impacted land values, the essence of this research is qualitative. It endeavours to understand the perceptions of farmers involved in dairy farm land transactions and dairy farm management in Selwyn and gauge the impact of nutrient regulation on land values. The reasons for this approach are threefold:

1. The regulations being introduced are quite new, and historical transactional (time series) evidence is likely to be limited in terms of homogeneity, time-frames, and quantity (*n* observable sample population size).
2. Accordingly, perceptions of those involved or potentially involved in current market transaction(s) – as farmer buyers or sellers - are likely to provide a more reliable guide as to existing market trending.
3. The isolation of just one factor (i.e. regulations) in order to explain value-price movements is problematical enough when quantitatively modelling in the context of a complex and multifarious property market, but even more so especially where even non-stochastic independent variables have no exact linear relationship necessarily existing between them (i.e. the assumption of no perfect multicollinearity may be difficult to ascertain).

This approach nonetheless represents a mixed method, explanatory approach which is useful since the quantitative analysis, albeit modest, supplements or otherwise serves to inform the qualitative results.

2.3 Participant selection

In prospecting for participants the initial criteria was to find cases where a land transaction had taken place (purchase or sale), or where a property was currently on the market and a transaction therefore imminent. The study also interested itself in nutrient sensitive locations particularly where land had recently been converted to dairy from other farm uses. The focus here was larger enterprise dairy operations and in established farming operations. The reasons for the aforementioned criteria were based largely around balancing the pragmatism of managing a relatively small sample size at the same time against obtaining a reasonable cross-section of spread of participant understanding of nutrient regulation – at least, those more likely to be in a position to be involved, or poised to involved, in property transactions impacted (or likely to be impacted) by the new regulatory environment. The general approach facilitated perception to be gauged against knowledge. To achieve this, participants were gathered from a relatively wide geographical spread across the Selwyn-Waihora district, located near Christchurch on the Canterbury Plains of the South Island of Aotearoa-New Zealand. Representation was sought from three representative sections of this zone, i.e. Upper Selwyn (north of Hororata and Darfield Townships); Mid Selwyn (north of State Highway 1 and south of Hororata and Darfield); and Lower Selwyn (south of State Highway 1). Figure 1 provides a general overview of the study area location.



Figure 1 - Investigation study area: the Selwyn-Waihora district of Aotearoa-New Zealand

2.4 Instruments

This qualitative research is based around an interview guide which is made up of two sections.

The first section is structured with quantitative questions around the physical nature of their property, transactional information relating to a land purchase or sale, production information and nutrient regulation related information such the existence of a Farm Environment Plan, Good Management Practice and Nitrogen Baseline. Lastly, a Likert scale was used to gauge the participants understanding of the nutrient regulation.

The second section is semi structured and more qualitative in its form, broken into three sections as follows:

- Perception of whether nutrient regulation is having an impact on land values now.
- Actions (if any) been taken by participants to mitigate nutrient regulation.
- Perception of how nutrient regulation will impact participant acquisition/disposal of land in the future and ultimately how they will impact land values in the future.

The semi structured section is designed to generate open discussion around each participant's situation because – as is typical with farmland - each situation is very different. It also enabled the researcher to delve into areas topical to respective participants with greater autonomy.

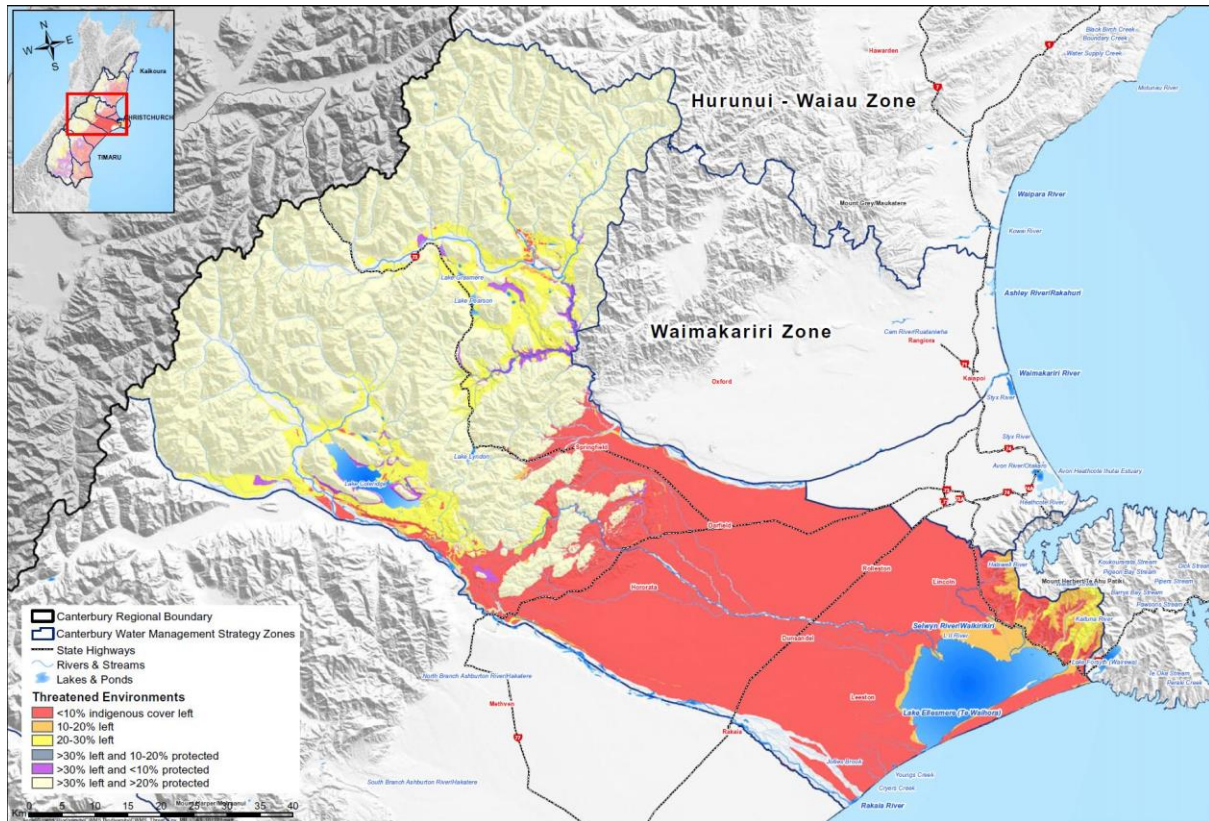


Figure 2 - Threatened environments in the Selwyn-Waihora district within the Canterbury Water Management Strategy zones, categorised by percentage of indigenous cover. The study draws participants primarily from those located within the highly threatened “red zone” (less than 10% indigenous cover).

Map source: ECAN (2015c)

2.5 Procedures

The primary procedure involved a personal visitation, normally on farm, by the researcher. This was preceded by the instruments being made available to each interviewee at least one week prior to visitation. Participants were assured of best efforts to be taken concerning anonymity, with each interview recorded and subsequently transcribed. However, complete anonymity is difficult since although specific locations have been guarded, the number of transactions occurring within the study area is quite limited and this information - taken together with property size and land use – makes it typically fairly easy for those with good local knowledge to work out the identity of individual case study participants.

2.6 Case Study Context

Eight case studies were conducted on operators farming irrigated dairy farms in the Selwyn Water Management Zone. The mix of case studies was diverse; geographically, demographically and contextually. Despite the relatively small sample size, richness of content is achieved with the majority of case studies being farmers who were demonstrably (albeit anecdotally) very well informed around the regulation in Selwyn District. Whilst this might indicate sample bias, in that a more representative sample might prove to be less acquainted with regulatory reform in the region, the respondents were either recently involved, in a position to be involved, or poised to involved, in property transactions impacted or likely to be impacted by the new regulatory environment (refer Table 1 - Land Transaction Context). They were therefore in a good position to be responsive – negatively or positively – to the regulatory setting now impacting the market.

As mentioned previously, this general approach facilitated perception to be gauged against knowledge – but additionally, in a manner consistent with the generally accepted definition of a market value

transaction which, inter alia, integrally requires both parties to act “*knowledgably, prudently, and without compulsion*” (as per national and international valuation standards API-PINZ, 2009; IVSC, 2011).

Table 1 - Land Transaction Context

Transaction Context	Seller	Purchaser	Dairy Conversion (after purchase)	Other
Case Study 1		X	X	
Case Study 2		X		
Case Study 3	X			
Case Study 4		X	X	
Case Study 5	X			
Case Study 6				X
Case Study 7				X
Case Study 8		X		

All case studies are located in the most highly threatened “red zone” [see Table 2 - Nutrient Zone (Threatened Environment designation) Context] where there is unacceptable water quality and failure to meet and cultural, recreational and ecological values as a result of increasing nutrient concentrations (ECAN, 2014). Several of the participants were also affected by Phosphorus and / or by local irrigation scheme rules and constraints, as shown at Table 2.

Further context is provided by brief detail / statistical overviews of each case study, as shown at Table 3 - Production statistics for Case Study participants. It may be seen that the majority of participants are farming an area of between 200 to 400 hectares in size, and running 500 to 1,000 head of dairy cattle. This represents the typical size and scope of many dairy farms established in the region. The one exception was a large corporate operator with multi-site holdings.

Table 2 - Nutrient Zone (Threatened Environment designation) Context

Nutrient Zone	Red Zone	Phosphorous Area	Cultural Area	Irrigation Scheme
Case Study 1	X			X
Case Study 2	X	X		
Case Study 3	X	X	X	
Case Study 4	X			X
Case Study 5	X		X	
Case Study 6	X	X		
Case Study 7	X			X
Case Study 8	X			

Table 3 - Production statistics for Case Study participants

Case Study	1	2	3	4	5	6	7	8
Farm size (ha)	150	300+	200	350	200	200	4,200	200+
Cows (no.)	580	1,050	590	1,050	500	670	14,000	650
Cows/Ha	3.8	2.7	3.0	3.5	3.1	3.4	3.3	3.7
kgMS/Cow	474	293	390	381	440	328	393	400
kgMS/Ha	1,821	798	1,150	1,333	1,375	1,100	1,310	1,469
N-Baseline kgN/ha/yr.	50.25	44	22	35	22	11	35-75	19

Table 3 also provides detail of the *current* Nitrogen baseline established for each enterprise, indicating a range of between 11 to 75 kilograms per hectare per annum.

2.7 Additional Information – Quantitative

Proceeding with quantitative analysis of the dairy land market in Selwyn District assisted in evaluating the impact of nutrient regulation on land values – undertaken primarily to inform the qualitative results. A number of datasets have been employed for this purpose, including an examination of dairy property sales across Canterbury, analysed to a land only rate per hectare and tracking the change in value from 2007 to 2014; and land values of a “model dairy farm” in Canterbury across the period from 2000 to 2014. Much of this information is of limited use given the small volume of transactions over the relatively short period to the present day since regulatory reform has been introduced or even first mooted by government.

Nonetheless, for the sake of completeness, a smaller dataset of dairy properties that have sold in the Selwyn District over the last two years come under examination, with each sale analysed back to a workable common denominator (i.e. land value and land rate per hectare).

3 Results

3.1 Case Study Responses

All but one of the case studies were informed enough about the nutrient regulation to form an opinion on their situation with respect to nutrient regulation and its impact on land value. Across the sample there were varying degrees of uncertainty around how the rules were going to impact on their respective landholdings; but regardless of this uncertainty, each was proactively implementing mitigation to meet the requirements of the rules.

Case study 1 sold in Lower Selwyn to be in Mid Selwyn to gain scale but also to divest from what they perceived was a potential problem with the impact of nutrient regulation in Lower Selwyn. Their perception was built not only on a self-admitted broader public perception, but also on an understanding of the rules. On the flipside, case study 8 purchased their farm in Lower Selwyn considering there was opportunity in this location and paid what appears to be in line with the market price. Case study 8 has a number of farms that he can enterprise so he can manage nutrients across the portfolio. The property purchased in Mid Selwyn by case study 1 was a bare-land arable (cropping) farm which they converted to dairy. They saw opportunity in purchasing a farm with a high Baseline N that enabled them to comfortably convert within the rules. These two case studies highlight that every land transaction decision is built on different business strategies and horizons.

Case study 3 and 5 are both trying to sell their properties. They farm near Lake Ellesmere, both in the PSRA and one in the CLVMA. Both have and are doing things on-farm to mitigate against nutrient regulation to improve saleability. Each of these case studies noted they were battling public perception which was that land located close to the lake would be difficult to sell in the current environment of nutrient regulation. Consequently, it appeared they were having trouble selling as their properties had been on the market for an extended period of time. Case study 8 had made an offer on case study 5's property at a level well below the expectations of case study 5 and was subsequently turned down; eventually, a farm was purchased not far from case study 5 at near market price. The key factor here was that the property case study 8 purchased was outside both the PSRA and the CLVMA. Case study 8 considered that case study 5 and 3 were inferior opportunities due partly to their proximity to Ellesmere Lake, and being within the PSRA and the CLMVA.

Case study 2, relative to the other case studies, was less informed about nutrient regulation. Their business by their admission was tenuous but according to the participant, this was more to do with purchasing just before a fall in the dairy pay-out prices and farming through drought, rather than about nutrient regulation. Nutrient regulation did not enter their strategic thinking to the same level as the

other cases even though there appeared to be some barriers ahead with how they farmed their land being in the PSRA.

Case study 4 had a very good knowledge of the rules and had proactively educated himself on the rules and Overseer software since they were first introduced. He consequently converted a block of land in mid-Selwyn earlier than he might otherwise have done had the nutrient regulation not been a factor. He has converted using a high level of technology, especially around his irrigation, within the rules. Being a shareholder of CPW also helped his nutrient leaching profile. So nutrient regulation has been at the forefront of this case study's strategy to farm.

Case study 7 is a corporate farmer with a number of dairy farms in Selwyn. There was a concerted focus on the impact of nutrient regulation and enterprising their operation to bring everything under on resource consent. Being able to manage their nutrient status was a strategy being used to mitigate the rules.

Case study 6 is actively mitigating for the rules, as are all the other case studies. The opportunity this respondent saw was his location in Lower Selwyn on heavy soils where he could easily farm within the 15 kgN/ha/yr limit, and therefore be a permitted activity. It is noted that this farm is operating at a lower stocking rate to other comparable dairy farms in the locality.

Case study's 7 and 8 both believed that an incentivised method of regulation would be preferable to the 'stick' of nutrient limits. This is also considered as a good option by Joy (2015) in the literature.

The majority of case studies respondents strongly suggested that land values would increase in the future. This was not because of nutrient regulation, but in spite of it. (A comprehensive summary of perceived impacts, both now and in the future, is shown at Table 6 - Response Summary concerning the perceived impact of regulation).

3.2 Other (Quantitative) Results

This study's focus is on the dairy farmland market, looking at any discernible differences observed over recent years which could be potentially attributed to the introduction of nutrient regulations. In order to appreciate the general trending evident for such farms nationally in time-frames leading up to the present time, Figure 3 is provided. This tracks the land value of a "model dairy farm in Canterbury" from 2000 to 2014, against the National Dairy Price Index. These two datasets compare:

- The model dairy farm analysis is of a 200 hectare flat irrigated dairy farm in Canterbury. This analysis uses the Quotable Value New Zealand Limited 'Dairy Land Price Index' together with analysed open market dairy farm transactions to track the change in value every six months (Petersen, 2014).
- The National Dairy Price Index is produced by REINZ (2015). The indices have been developed in conjunction with the Reserve Bank of New Zealand. It adjusts sale prices for property specific factors such as location, size and farm type which can affect the median \$/hectare calculations.

The graph at Figure 3 demonstrates an upward moving trend interspersed with periods of declining value through the Global Financial Crisis 2008/2009 together with periods of depressed commodity prices.

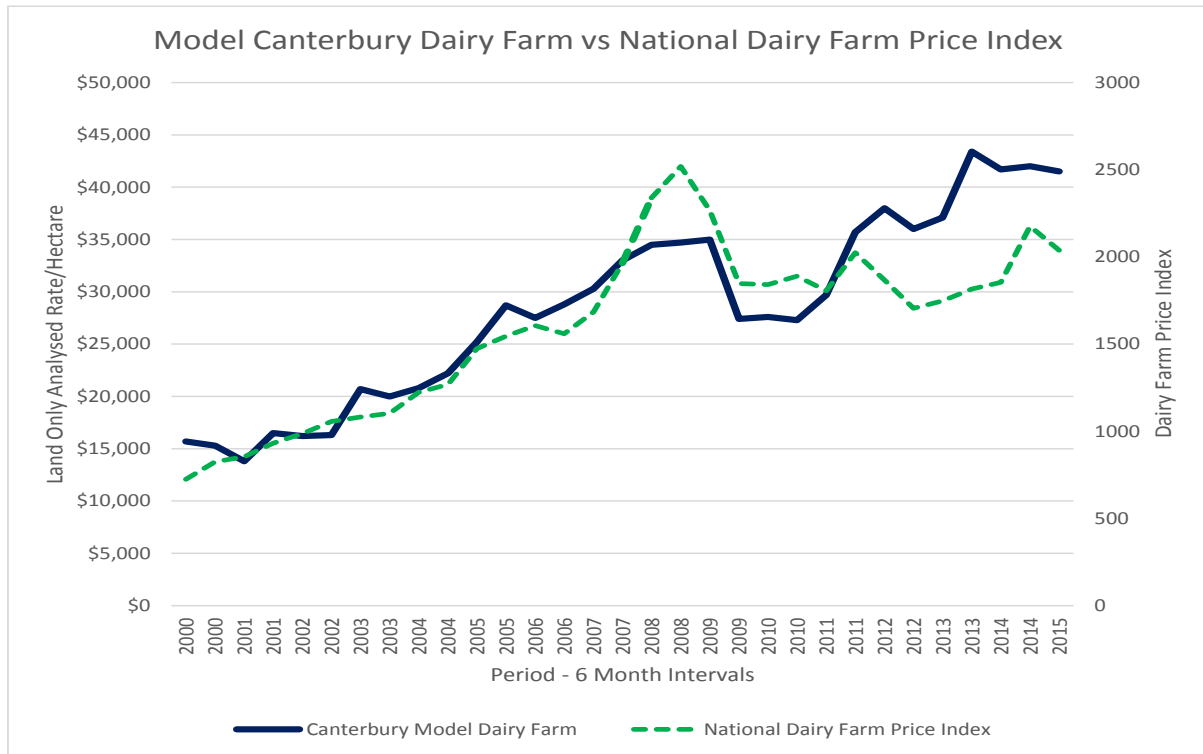


Figure 3 - Model Canterbury Dairy Farm vs National Dairy Farm Price Index – source: Petersen (2014)

In order to more clearly distinguish whether nutrient regulation was impacting land value, individual properties which have sold multiple times across a time period have been tracked – refer Figure 4 - Dairy land farm sales in Selwyn 2012-2015. This incorporates the period where nutrient regulation is of greatest influence. (It was ascertained that there were no such easily discernible cases in Selwyn, especially as in the time between sales there is often either a change of use or significant development impacting on value which overshadows other factors). Whilst there is some evidence of a general upward trending in values, based on median sale prices achieved since 2012, trending based on moving averages, and a “best fit” linear regression analysis demonstrates a relatively poor fit, with the latter trend having an r^2 correlation coefficient of only 0.12.

A smaller dataset of dairy properties that have sold in the Selwyn District over the last two years, with each sale analysed back to a land value and land rate per hectare, is shown at

Table 4. The reason for undertaking this analysis is because nutrient regulation in the Selwyn district has been most prevalent over the last three years. Perceptions will have been built over this specific period, and if there was a clear indication of an adjustment in dairy land values as a result of nutrient regulation it would be within this period.

Graphing the analysis at Figure 5 (Regional analysis of dairy farm sales in Selwyn-Waihora District, 2014-2015) was also conducted in order to attempt to find a trend. This shows dairy land in Lower Selwyn area and around the Burnham and Greendale areas is generally selling at similar rates per hectare. There were two outliers in this grouping of properties located nearer Lake Ellesmere selling for somewhat lower; one of these sales being right on the shores of Lake Ellesmere.

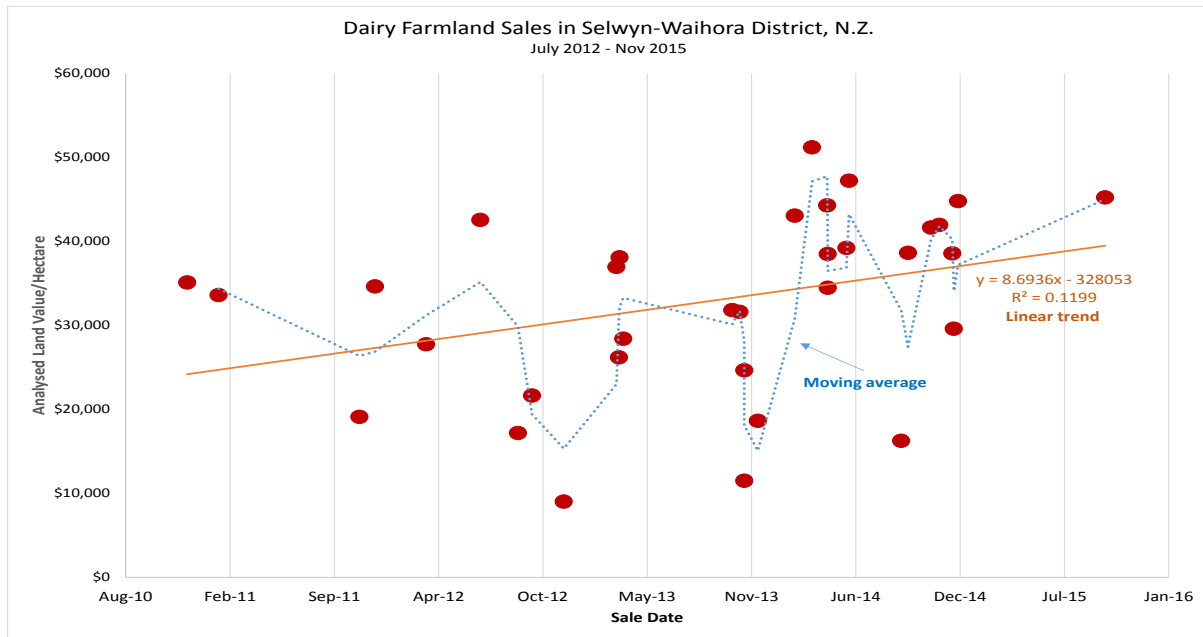


Figure 4 - Dairy land farm sales in Selwyn 2012-2015

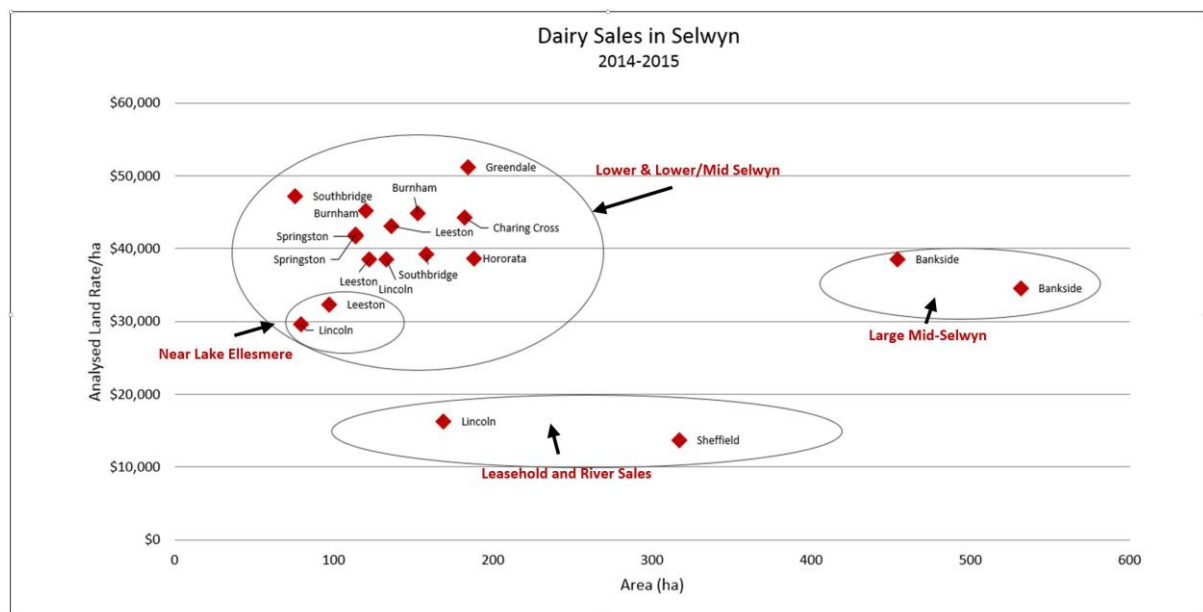


Figure 5 – Regional analysis of dairy farm sales in Selwyn-Waihora District, 2014-2015

Table 4 - Dairy Farm sales in Selwyn-Waihora District, 2014-2015. Extracted from data provided by Property Guru (2015) with analysis by authors.

Sale #	Location	Sale Date	Sale Price	Area (ha)	Overall Rate per hectare	Analysed Land Rate per hectare
1	Greendale	18-Mar-14	\$11,408,000	184.2	\$61,937	\$51,214
2	Southbridge	28-May-14	\$3,850,000	75.7	\$50,875	\$47,241
3	Burnham	23-Dec-14	\$7,000,000	153.0	\$45,752	\$44,804
4	Charing Cross	16-Apr-14	\$9,600,000	182.2	\$52,675	\$44,308
5	Leeston	13-Feb-14	\$7,000,000	136.4	\$51,321	\$43,073
6	Springston	17-Nov-14	\$5,800,000	113.8	\$50,981	\$41,972
7	Springston	01-Nov-14	\$5,763,000	113.8	\$50,656	\$41,669
8	Southbridge	23-May-14	\$7,100,000	158.0	\$44,929	\$39,234
9	Hororata	18-Sep-14	\$8,000,000	188.0	\$42,543	\$38,650
10	Lincoln	12-Dec-14	\$6,065,000	133.1	\$45,568	\$38,581
11	Bankside	17-Apr-14	\$20,339,625	454.2	\$44,779	\$38,522
12	Leeston	11-Nov-13	\$6,625,000	122.0	\$54,303	\$38,484
13	Bankside	17-Apr-14	\$22,800,000	531.5	\$42,900	\$34,497
14	Leeston	30-Oct-13	\$3,900,000	97.1	\$40,167	\$32,340
15	Lincoln	15-Dec-14	\$3,375,000	79.3	\$42,535	\$29,617
16	Lincoln	05-Sep-14	\$3,350,000	169.0	\$19,822	\$16,272
17	Sheffield	08-Nov-13	\$6,300,000	316.9	\$19,883	\$13,650
18	Burnham	01-Oct-15	\$6,840,000	120.0	\$57,000	\$45,250

4 Discussion

4.1 The Impact of Baseline N and Propensity for Mitigation

Most of the interviewees were comfortable with their respective nitrogen baseline figure (refer Table 3 for details) and their ability to operate the dairy farming system they wanted within that baseline as a limit. There was a general confidence that when the rule limits become effective from 1 January 2017 that they could either maintain their system within the limits or could adopt mitigation that would easily enable them to remain compliant.

Interestingly a majority of the interviewees saw an opportunity as to how they could manage their nutrient leaching and remain compliant while still remaining productive and profitable - and as a result, maintain or even enhance their land value.

All of the interviewees had implemented some level of mitigation over the last two years. The most common form of mitigation was effluent storage and discharge. Some had made changes for the purpose of mitigating nutrient regulation but the reasons for this ranged from:

- Improving the saleability
- Ordered by council to do so
- To be as compliant as absolutely possible – in the case of dairy conversions

Some had made changes for cross purposes i.e. for farm system efficiency with the “natural” outcome being that it is favourable when inputted into Overseer and therefore improves the nutrient leaching status of the property.

Many interviewees saw a change to their irrigation type as providing a good potential gain in their nutrient budget, i.e. where their farm had spray irrigation (e.g. rotorainer) they recognised that by replacing this with pivot irrigation they understood that there would be an improvement in their Overseer result. Some interviewees had gone a step further and installed variable rate irrigation, and/or soil moisture probes.

All of the interviewees in the Lower Selwyn district had completed some form of riparian planting and had plans to continue with this program. Two of the interviewees were sceptical about how useful this environmental measure was indicating that the benefits are difficult to understand from a pure water quality standpoint but they were happy that they had done it for the aesthetic appeal of the property as a result and the feel good factor. These lower Selwyn District farmers had also completed extensive drainage on their property which was not necessarily to mitigate regulation but due to the nature of their soils being heavy and poor draining.

4.2 Perception of Impact on Land Value to Heavier Soil Localities

There was considerable focus on the heavier soil catchments to the Lower Selwyn District when discussing nutrient regulation. There were four interviewees farming on those heavier soils in the Lower Selwyn District around Lake Ellesmere. They were generally comfortable that the nitrogen leaching limit of 15 kgN/ha/yr is an easy limit to farm within given the low leaching qualities of the heavier soils. For those interviewees trying to sell their property in this area they felt that the public (i.e. the buying public) had a generally poor perception of this locality due to the implications of nutrient regulations. However, this wasn't limited to potential purchasers; rather, was caused by the perception of professionals such as bankers, real estate agents, farm advisors and lawyers. Case study participants felt that this perception was irrational and that there was a generally poor understanding of the rules, and it was their impact on dairy farms in this locality that was creating this perception. One of the case studies was of a farm recently purchased in this locality. He believed he had taken advantage of this perception and corresponding uncertainty and purchased relatively well. He had looked at two other properties (case studies 4 and 5) and had put an offer on case study 5. He considered that each of these properties - being in the relatively sensitive lake area, within the phosphorus and cultural areas - should be discounted. This was not so much because of the rules, but because of their situation to Lake Ellesmere and the generally inferior nature of these properties.

For those case studies farming on the lighter soils further inland they had an opinion on the heavier soil locations. They preferred to farm on the lighter soils because of the difficulty of farming on the heavier soils in winter. They were circumspect about how the rules were going to impact on land values in that location, but generally indicated there would be an impact. One of the case studies had sold within the heavy soil locality not only to be on the lighter soils so that they could gain some scale, but also due to the nutrient rules.

Clearly there is a perception around the impact of the nutrient rules on land values in the heavy soil areas around Lake Ellesmere, and that perception is around the future saleability of this land as the rules come into effect. However, three of the four interviewees in this area considered there was definite advantage in farming in this location because:

- Low leaching soils
- Farming was a permitted activity at an N loss of 15kgN/ha/yr - and this was easily attainable
- Its location close to Christchurch City would always underpin values
- There was versatility in what they could farm on their heavy soils

While there appears to be an impact on the saleability relating to nutrient regulation to two of the case studies in this research it is noted that the economics of farming in a year of lower dairy pay-out creates a heightened sense of uncertainty in general. As found in the literature, in a climate of depressed commodity prices like that generally prevailing at the time of the study, the factors that impact on value are accentuated, and consequently the level of uncertainty is heightened.

4.3 The Negatives of Regulation

Each of the interviewees commented on the additional recoding and reporting that was required as a result of the new regulation. Half of the interviewees considered this recording and reporting was impacting negatively on their farm management and general enjoyment of farming. They were looking forward to getting out of farming altogether, and therefore avoiding the growing pain of additional

paperwork. This was not restricted to nutrient regulation, but included Health & Safety and compliance. They felt they were losing control of their farm.

4.4 How has Regulation Focused Farmers

All except one of the interviewees were focused on understanding the rules and doing what they needed to do to comply with the rules. Two of the interviewees verbalised this and said they were completely focused on how the rules impacted on them and were intent of doing whatever it took to make sure they remained within the rules. They felt their focus had been taken away from the real issue which is to improve water quality. At the same time they both considered that an incentivised system should be explored referencing the incentivised systems in Europe.

4.5 The Impact of Nutrient Regulation on Productivity, Profitability and Land Value

None of the interviewees felt that their productivity or profitability would be impacted negatively due to the nutrient regulation. Many of the interviewees had researched technology and systems to install and implement in order to help mitigate the nutrient regulation, and at the same time have found real benefits to their operations. Respondents were surprisingly reticent concerning how much all the mitigation measures had cost, and the impact of that cost and/or the return on that investment. Three of the interviewees had drawn the line on some measures of mitigation because they were under the nutrient limits now. They deliberated there was no benefit to their system of spending more capital on infrastructure or systems that could bring their N losses down further. One of the interviewees mentioned that he could spend a further \$1,000,000 of capital to improve and renew his existing infrastructure and improve his environmental footprint, but he had *“had enough of spending for no return”*.

The majority of interviewees felt that their land value would stay the same or increase in the future under the impending nutrient regulation. Two of the interviewees who had their farms on the market felt that the perception of the impact of nutrient rules on land values in their area was impacting on the saleability of their land. They had not lowered their expectations as a result maintaining that the perception was not based on anything real, that their farms were or could, with relatively small improvements, easily be within the nutrient limits, and that the farms were productively solid propositions.

4.6 Will the Face of Farming change in Selwyn?

Three of the interviewees (one being a corporate farming entity) had large multi farm operations and had the ability to ‘enterprise’ their holdings to better manage their nutrient losses so that where they had one farm that was leaching more than the regulated limits this could be offset by another landholding that was under the limits. They each saw this as creating a considerable advantage over farmers with one landholding and farm system.

One of the interviewees considered that, with the advent of increased regulation and with it elevated recording, reporting, mitigation and capital expense, farming in Selwyn was only now attractive to larger corporate models.

4.7 Factors Considered when Purchasing Farmland

The final question of the interview revealed an unexpected result. It is important to note that participants were not constrained in nominating the factors they considered relevant when purchasing farmland, i.e. they chose the factors they thought were most important. While there are a considerable number of variables considered when purchasing farm land, as discovered across this relatively small sample; location, water and soil stood out above all other factors as being considered most important. Within the context of this study ‘Nutrient Regulation’ rated relatively poorly, although the two participants operating larger enterprise operations ranked nutrient regulation as their number one consideration. Across the other six participants it either ranked poorly, or not at all.

Table 5 - Ranking of Factors considered most important when purchasing

Factor	CS-1	CS-2	CS-3	CS-4	CS-5	CS-6	CS-7	CS-8
Location	1	4	1	1	1	5		3
Water	2		2	2	2			
Soil	3	1	4	3			3	4
Nutrient	4	5				1	1	
Shape	5		3		4			
Presentation		2						
Irrigation		3					2	
Council				4				
Regulation/Compliance				5				2
Climate					3			
Topography					5		5	
Farming System						2		
Infrastructure						4		
Connectivity							4	
Opportunity								5
Productivity								1
Labour			4					

4.8 Quantitative Evidence

In as far as the quantitative evidence is concerned, the following observations can be made:

1. The dairy land sales in Selwyn over the last two years remain relatively high and correspond with the long term trend of dairy land values in Canterbury as demonstrated at Figure 3 – note both sets of data are analysed land value.
2. The nutrient rules around Lake Ellesmere are more onerous and might be reasonably expected to impact on land value to a greater extent than other areas. It is noted that one of the case studies in this research is located adjacent to Lake Ellesmere and is on the market at \$33,000/ha. This is lower than the sale located adjacent to Lake Ellesmere which sold at \$40,000/ha (analysed land value \$32,000/ha) but in keeping with lower prices paid for land adjoining the lake.
3. One of the sales nearer the lake is outside Phosphorous and Cultural Areas and was purchased by one of the Case Studies in this research. It is understood there were other factors impacting on the value of this land other than situation to the lake and nutrient regulation but the price is somewhat lower than other sales in Lower Selwyn and could indicate a lower value because of nutrient regulation although this is not definitive. It is noted that this sale was a private sale so did not undergo market process.

Overall there was no absolute evidence of land value being impacted by nutrient regulation from this market analysis. However, it should be noted that there was considerable difficulty in distinguishing nutrient regulation from all other factors impacting on land value when conducting an assessment across a large data series. It seems fairly evident that the single largest factor impacting land value even since regulation is most likely economics i.e. market forces. However, the synopsis is that each property sold had its own unique factors which could impact on sale - including amongst them nutrient regulation. Shape, soils, water, location, infrastructure, tenure, land class mix and compliance together with the associated productivity and profitability of the land where all factors impacting on land value.

Moreover, our analysis of Canterbury and National dairy land sales shows clear evidence of the impact of economics on land values especially through 2008-2009 during the Global Financial Crisis and again in 2011 -2013 when commodity prices were lower. Using long term analysis of land sales, indices and economic statistics, the researcher was not able to discern a trend related to nutrient regulation beyond economic variables which, in concert with the literature, has been traditionally established as the overruling factor in land value increases and decreases.

5 Conclusions & Further Research

5.1 Summary conclusion

This research did not find any conclusive evidence that land values were being significantly impacted by nutrient regulation. However, there were some subtleties around land transactions or lack thereof that could reasonably be perceived as evidence of an impact - but there are other subtleties that could also be contributing and accentuating the nutrient regulation factor.

The theory built from this research is that regulation, whether it is “correct” or not, is attempting to classify farm land based on its inherent, nature given qualities; soils, climate, contour. Farmers are being asked to farm the land within that classification. In cases where that classification does not fit, then impact on land value is likely - suggesting that where there is an intention to farm at an intensity above what suits the ethereal qualities of the land, then that farm operation is polluting. Farm within the limits created and land value will continue to be impacted by normal market forces. However, in this period where rules are being created, there is a level of uncertainty where those best informed will likely overturn opportunity. Those less informed will face complications and barriers because they have or are trying to farm at a level of intensity that does not suit the environment as determined by the rules. It is concluded that through this period of relative uncertainty there will likely be impact on land values for entities that are farming their resource at an intensity that impacts the environment and who are not applying technologies and better management systems to mitigate that environmental impact. On the flipside land values will be maintained or enhanced for farming entities where land is respected with regard to the rules and to its resource.

Furthermore, MGM will be a significant guide for farmers in Selwyn. It goes some way in providing a benchmark by which they farm the resource associated with their property under the farming system they choose to operate. Operating in tandem with this is Overseer which, despite its shortcomings, may be equipping farmers with a tool to measure their impact on the environment and technology in irrigation, effluent, infrastructure and management systems – thus, supporting farmers to farm their desired intensity within environmental limits. The MGM therefore provides farmers with a guide on what is acceptable for their resource under their system.

In summary:

- Dairy farmers in Selwyn are generally positive about their ability to farm within nutrient limits, using technology and management systems to mitigate, and maintain, if not, enhance their respective land values.
- The weight of negative perception around the impact nutrient regulation will have on dairy farms located close to Lake Ellesmere is to a degree impacting on the saleability of the farms in this locality. The degree of impact needs to be qualified, however there are other additional factors impacting at the same time – perhaps serving to accentuate the uncertainty around regulation.
- There are many tools available to farmers, both regulatory and technological, to help them better understand their farming resource and system and enable them to continue to farm productively and profitably in this environment of nutrient regulation, and consequently maintain or enhance land value.

5.2 Limitations and Further Research

In some respects this research is premature having regard to the stage at which the rules are in their rollout, particularly given that, as at date of writing, MGM has only been recently published and in process of being embraced. MGM helps to define GMP for a farms system, soils and climate and establish a base for the calculation of nitrogen and phosphorous limits that farmers need to be farming at by 1 January 2022. However, the rules and regulation have been developing over an extended period of time and as has been established, are reasonably well understood by irrigated dairy farmers in Selwyn. Consequently, perceptions have been formed for where the rules are at now, and where they are intended to head. So relative to each case study's circumstances, whether it was a farm purchase, a conversion, trying to sell, or just farming in the current environment, this study has obtained a snap shot in time of farmers perception of the impact of nutrient regulation on land value both now and of the future. However, this research is limited by what has occurred to this point in time and perception of the future is almost certain to continue dynamically in an ever changing regulatory landscape.

This research is limited in its sample size. Eight irrigated dairy farms and their farmers were the focus of this case study. This sample is small and as progress was made through the interviews it was found there were factors arising that would have been good to test across a larger sample.

The case studies in this research consist of irrigated dairy farms. Arable and pastoral farming, and indeed many other forms of farming in Selwyn are also impacted by these rules as well – and in some respects, possibly more so. In addition, the Central Plains Irrigation Scheme is establishing – stage one is complete and stage two is in design phase. As a consequence there are a raft of untested implications and potential impacts for landowners in this catchment.

Table 6 - Response Summary concerning the perceived impact of regulation

Response Summary: Is nutrient regulation having an impact on land values now / future?	
Case Study 1	<ul style="list-style-type: none"> Nutrient regulation was a large contributor to their decision to purchase: willing to pay a higher price for property with a low N Base-line. Regulation may soften as the argument around the rules gathers - confident in the ability of technology advances to lessen the need to reduce production and meet limits.
Case Study 2	<ul style="list-style-type: none"> Nutrient regulation played “very little” part in the decision process when purchasing the farm. Don’t feel that the value of their land would be impacted in the future by nutrient regulation and in fact could only see a positive impact because their N loss was relatively small
Case Study 3	<ul style="list-style-type: none"> The rules have had quite an impact. Perception of the rules has been prohibitive. People (prospective purchasers) have been concerned about resale. Considers his land value would decrease in the future and did not believe there was any opportunity out there with respect to the nutrient regulation.
Case Study 4	<ul style="list-style-type: none"> No impact on land values now because of technology and consideration of basic economics/valuation theory. Nutrient rules were “<i>a key thing to have your head around before you buy land now</i>”. Perceives there will be significant impact on land value in the future. Believes his property is more saleable due to good infrastructure that mitigates the rules.
Case Study 5	<ul style="list-style-type: none"> There are plus’s and minus’s wherever you farm: claims it would be easy for him to meet the limit of 15 kgN/ha/yr. Believes there is a lack of understanding of the rules. There wouldn’t be much of an impact in the future. If other regions like Ashburton are doing a similar thing then it will all be relative. Land values currently a little depressed due to the low prevailing dairy pay-out.
Case Study 6	<ul style="list-style-type: none"> No impact on land value at this point. Nothing is selling presently largely because there is a slump in dairy prices - limited benchmarks available. Not planning on doing any more to his property to mitigate nutrient regulation. Considers his land value will increase in the future because there is still some versatility in the cap.
Case Study 7	<ul style="list-style-type: none"> Doesn’t know if there has a huge impact because they were under dairy use through the baseline period so they have an allocation that is relatively high and therefore freedom to farm as they always have. In the future - would certainly be an impact on value, but difficult to know because they don’t know where they need to get to with regard to GMP (this will be determined by how quickly they can make changes to achieve the reductions required by 2022).
Case Study 8	<ul style="list-style-type: none"> The landscape for land purchase has completely changed in Canterbury. Rules definitely impacting land value, but the perception of land being impacted by the rules because of its proximity to the lake was irrational. Sees the nutrient regulation regime as an opportunity in the future. Understand the rules, then manipulate them to your advantage.

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