



Outline of Waikato Regional Council sheep and beef farming – grazing management practices research

Collaborative Stakeholder Group Healthy Rivers: Wai Ora Project

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Policy work stream report for discussion at CSG workshop 4

Disclaimer

This report has been prepared by Waikato Regional Council policy advisors for the use of Collaborative Stakeholder Group Healthy Rivers: Wai Ora Project as a reference document and as such does not constitute Council's policy.

1 Purpose

The purpose of this report is to assist the Collaborative Stakeholder Group in understanding the grazing management research commissioned by Waikato Regional Council (the council) to date on sheep and beef farming in Waikato¹.

The research summarised here seeks to provide a structured approach for understanding farmer decision making around winter grazing management practices. Having a detailed understanding about how practices and technologies align with the need, or choices, of farmers provides an indication of what practices are likely to be undertaken and by how many. This can inform the design of policy to increase the uptake of practices and technologies to achieve the policy objectives.

2 Report overview

This report provides a summary of three studies into sheep and beef grazing management. For more detailed information please refer to Davies, (2012) for the qualitative interviews, Versus Research Ltd and Reed, (2014 in press) for the quantitative telephone survey results and Kaine, (2014 in press) for the farm context analysis.

Similar research has been conducted on dairy enterprises. See WRC document number 2986745 provided at the end of to the CSG workshop number 2.

The next section contains a short description of the research. The findings on pugging management and waterlogging are reported to illustrate the findings from the research. The conclusions of this research are reported.

3 Approach

The purpose of this research was to understand the grazing management decisions of beef and sheep farmers' in the Waikato and Waipa River Catchment. Interviews were undertaken with farmers running a wide range of enterprises and livestock combinations with the main sample drawn from those that ran beef and or sheep. Those farmers providing dairy support through dairy heifer grazing or wintering dry dairy cows were considered to be part of the beef and sheep sector. The focus of the research was on the winter practices on farm that may help or exacerbate nutrient management.

Broadly speaking the research approach involves two stages. The first stage is to identify the elements in the farm system that influence the benefits from adopting a particular practice or technology. These elements form the farm context for the innovation. The second stage is to quantify the proportion of farmers in the population possessing the farm context for the practice or technology (Kaine, 2008). This proportion is an estimate of the population of potential adopters of the practice or technology (Kaine et al., 2011).

¹ This report is on a particular body of commissioned research. Similar research has been conducted on dairy enterprises. See Waikato Regional Council (2014) document number 2986745 provided at the end of to the CSG workshop number 2, to be presented at CSG meeting 3.

Phase 1 – Qualitative interviews

- Data was gathered in this stage through semi-structure interviews.
- The purpose of the interviews was to identify the variety of winter management practices that can be undertaken on farm and the farm context for particular practices. Results reported in Davies, (2012).

Phase 2 – Quantitative surveys and farm context analysis

- The quantitative study tests the key findings that emerged from the qualitative research using a statistically representative population.
- Data was gathered through a large scale telephone survey and the overall results compiled into a report.
- This was then analysed to statistically test the link between proneness to waterlogging and pugging and practices.
- Two reports have been produced; Versus Research Ltd and Reed, (2014 in press) and Kaine, (2014 in press).

3.1 Phase 1

Qualitative interviews

Understanding farmer decision-making: What grazing practices farmers are using, why they choose certain practices over others and why they may or may not have made changes to their system.

Between March and December 2009 in-depth interviews were conducted with 32 beef and sheep farmers in the Waikato region. Interviews were undertaken in the main sheep and beef areas in the region. Interviews were conducted with farmers running a wide range of enterprises and livestock combinations. Dairy support was also included in this study.

The purpose of this research was to understand the grazing management decisions of the beef and sheep farmers and relate that to nutrient management.

The following management practices of respondents are reported (Davies, 2012):

- Grazing practices
- Winter management practices including:
 - Wet soils management
 - Winter cropping management
- Riparian management
- Soil conservation and afforestation
- Nutrient management including:
 - Nutrient budgets, nutrient management plans, soil testing
 - Fertiliser application
- Feed supplements including:
 - Grown supplements
 - Purchased supplements
 - Feed system

3.2 Phase 2

Quantitative survey

Quantifying why farmers use certain practices: how many farmers are undertaking different practices and the reasons for using or not using them.

A telephone survey was undertaken with 450 sheep and beef farmers in the Waikato and Waipa River catchments between the 10th June and 21st July 2013. This study quantified and tested the findings from the qualitative study using a sample drawn from the wider beef and sheep farming population.

Broadly the research objectives of this quantitative study were to more fully understand how farmers managed different farming enterprises within the catchments, how farmers managed waterlogged soils and pugging through grazing and stock management, and what actions farmers undertook regarding riparian planting.

The Versus Research and Reed, (2014 in press) report covered:

- District council area, topography, soil type, effective farm area
- Livestock enterprise, the drivers for this choice of enterprise.
- Fertilisers and soils including:
 - fertiliser use and application (timing, location, and amount), soil testing
 - fertiliser management plans, nutrient budgets and nutrient management plans
- Winter cropping practices including:
 - topography of their winter cropping area, if they use cropping to fill a feed deficit or cropping for pasture renewal and if they graze crops to bare soil
- Managing waterlogged soils including:
 - frequency of waterlogging, proportion of farm that is at risk of waterlogging, timing and duration of waterlogging,
 - impacts of waterlogging on pasture and grazing, pasture composition and on fertiliser application
- Managing pugging including:
 - how prone farms are to pugging during winter
 - impact of pugging on pasture, grazing, pasture composition and soil structure
 - duration that stock are grazed on areas prone to pugging
- Use and management of sacrifice paddocks including:
 - use of the same sacrifice paddocks each winter, the location of the sacrifice paddock and the use of winter crop paddocks as sacrifice paddocks
- Management of the different stock class (bulls, dairy heifers, dairy cows, sheep, lambs, and beef cattle) including:
 - the proportion who run each stock type, number of each stock type on farm, the type of enterprise run and the management of waterlogging and pugging for each stock classes
- Management of property waterways
 - fencing of waterways, reasons for fencing or not fencing, riparian plantings over the last 5 years, reasons for riparian planting or not planting,
 - management of wetland, swamps or boggy areas, and the fencing or retirement of swamps or boggy areas
- Infrastructure decisions including;
 - installation of culverts or bridges for stock crossing, and reasons for installing culverts or bridges or reasons for not installing culverts or bridges
- Awareness of local groups and projects and any involvement
- Support needs of farmers to undertake environmental management actions

Farm context analysis

Statistically test some of the identified relationships:

- 1) link between frequency and extent of pugging and waterlogging and practices farmers use to manage sheep and beef over winter, and
- 2) to test if frequency and extent of pugging and waterlogging was a function of biophysical characteristics of the farm.

The influence of farm context on winter grazing practices of sheep and beef farmers in the Waikato and Waipa River catchments was investigated using data collected from a survey of 450 sheep and beef farmers (Versus Research and Reed, 2014 in press). The farming systems investigated included bull and beef cattle enterprises, sheep and lamb enterprises, and dairy cow and heifer grazing enterprises.

Kaine (2014 in press) has analysed the data specifically to test:

1. the link between frequency and extent of pugging and waterlogging and practices farmers use to manage stock over winter and
2. to test if frequency and extent of pugging and waterlogging was a function of biophysical characteristics of the farm.

4 Example of findings: waterlogging and pugging management

The following sections outline findings from each phase of the research on wet soil management and more specifically wet soils².

4.1 Phase 1 - Qualitative findings

Excerpts from Davies, 2012³ on wet soils management and pugging

Interviewees managed their pastures over winter to allow for slower grass growth and higher risk of pasture damage from pugging. In doing so they had to consider topography and soil and the need to provide sufficient feed to meet the growth and condition requirements of their stock. For example, the feed needed to meet the weight gain requirements of two or three year old bulls was different than that of dairy heifers or carry-over cows. The feed requirements of pregnant ewes meant that they were prioritised onto better pasture over the other sheep classes on farm.

4.1.1 Wet soils management

In general interviewees held favourable attitudes towards the management of pasture and soil damage over the winter months and were aware of the cost of pugging in terms of pasture condition (impaired growth and weed infiltration) as these quotes illustrate.

*“damage pasture more by pugging than by overgrazing. ...Grass doesn't grow in it properly, damaging roots of grass. Farm to minimise it, never get rid of it”
(interviewee 20)*

“don't want pugging...it can take 12 months for it to recover” (interviewee 30)

Most of the farmers interviewed reduced stock numbers prior to winter, and/or changed to lighter stock classes. Farmers deliberately chose a mix of age and livestock types that allowed them to reduce numbers by selling stock, or in the case of dairy heifer grazing returning stock, ahead of winter and in time to build up pasture for the winter. The availability of grown supplements was also a consideration in determining what stock to carry through winter.

For most interviewees, preparing the farm for winter meant setting up paddocks for the different livestock types and classes. This might involve strip grazing, break feeding, set stocking or rotational grazing and depended on the interviewees' overall objectives with respect to feed quantity and quality. A common practice was to shift heavier stock off the steeper country in favour of the lighter stock to avoid pugging and erosion damage. This meant that the sheep, lighter beef classes and older breeding cows or carry-over cows were put on the steeper areas as this quote illustrates:

“Pasture damage can be chronic in this country with older heavier cows, but with calves not lasting damage” (interviewee 4)

“big help keeping big cattle off steep country over winter” (interviewee 13)

² Section 3 details all the practices studied in each phase of the research. Refer also to full reports (Davies, 2012, Versus Research and Reed 2014, in press, Kaine 2014, in press), for full results.

³ 32 face to face, in-depth interviews were conducted with sheep and beef farmers

While this was common practice amongst interviewees, in this study one farmer was interviewed that could not put his heavier stock on the farm's flat area because this area has gley soil. This meant that lighter stock went on the flats and heavier stock on the hills.

Break feeding or strip grazing was commonly practiced among those with cattle and was applied across all age classes. However, not all interviewees with beef cattle favoured these practices. Some preferred less intensive grazing practices such as rotational grazing and set stocking, or stated that their property could not support break feeding.

Conversely one farmer held strong preferences against set stocking because he felt that break feeding was better for pasture quality.

A few interviewees mentioned that they used races to stand off some stock if they needed to manage wet soils, because of a rain event.

None of the interviewees mentioned having purpose-built stand off infrastructure such as a stand or loafing pad or a feed pad to reduce the amount of time stock were on paddocks in winter.

Some interviewees expressed the view that standing off was not required on a dry stock farm as beef and sheep were lighter than dairy cows and stocking rates in winter were lower.

4.1.2 Farms with free drainage

Around quarter of farmers (n=7) interviewed stated that they had no problems with pugging through the winter. These interviewees were all on free draining soils such as ash and pumice.

Apart from shifting lighter stock to steeper country, the most common strategies these interviewees used to avoid pugging were to speed up their grazing rotation or simply avoid grazing wetter paddocks. While some were in areas where heavy rain events were experienced these events were infrequent during the winter and stock could be moved to another paddock if necessary.

Two interviewees set stocked in mid-winter. Another also used break feeding when needed, but this was only in bad weather.

4.1.3 Farms with poor drainage

Almost a quarter of interviewees stated that pugging was a problem that had to be managed on their farms. Farms had mainly clay soils or had areas that were harder to manage. These farmers said that they were always watchful of weather and pasture conditions.

“Clay gets water on it, turns really wet ...stay off them [paddocks] as even a motorbike can get stuck” (interviewee 1)

“Winter wet through here. I have to monitor day to day, I keep an eye on forecast ... We go round whole farm every day” (interviewee 28)

The interviewees ran a number of strategies to manage their heavier stock through winter.

Most undertook strip grazing or break feeding to manage feed demand and pugging of heavier soils by cattle. Some needed to shift cattle every day to manage feed and pasture quality, while others shifted cattle onto a new break every 4-6 days. In very wet weather

those that shifted their cattle daily said they might need to shift their cattle twice in one day. Some interviewees who strip grazed their cattle, also back fenced to reduce trampling of pastures by cattle.

Strategies differed for farmers grazing bulls, who were generally reluctant to shift their bulls in winter and preferred to set stock; farmers with poor drainage said they shifted their bulls daily.

As with the other farmers, all moved lighter stock onto steeper areas. One farmer undertook set stocking and tried not to feed out, preferring to rely on all grass having de-stocked prior to winter. Some had swamp or peat areas which they were able to place cattle on to relieve their more water logged paddocks.

A number of farmers fed out supplements, such as silage and hay, to keep stock content so that they were less likely to “walk” which was seen as contributing to pugging and compaction. Supplements were fed-out usually on the 2nd or 3rd day of a break.

However, feeding-out in winter was a problem for some of these interviewees because the heavy machinery could damage the soil. Some did not feed-out at all, while others swapped from silage to hay because the silage wagon, being heavier than a quad bike and trailer, was more damaging to soils. This meant for some that they needed to lower stocking rates for winter in line with pasture growth.

“Feed out as little as possible. Cost related and makes a mess. Got to adjust stock accordingly” (interviewee 21)

Two interviewees used set stocking as a management strategy for their heavier bulls. One ran an open gate strategy while the other increased the paddock size relative to the number of bulls and moved them less often, in this way “*taking weight off the ground*”. Grazing rotation was reduced from 25-30 days in summer to 18 days in winter.

One farmer described the balance between maintaining pasture condition and holding cattle back to build feed for spring:

“bigger areas in nasty weather, and when get drier colder weather gave them more supplementary feed. During wet periods give more area and to compensate, when dry areas hold them up and feed supplements. When it's wet they're eating with 5 mouths, their hooves, they're wasting it” (interviewee 16)

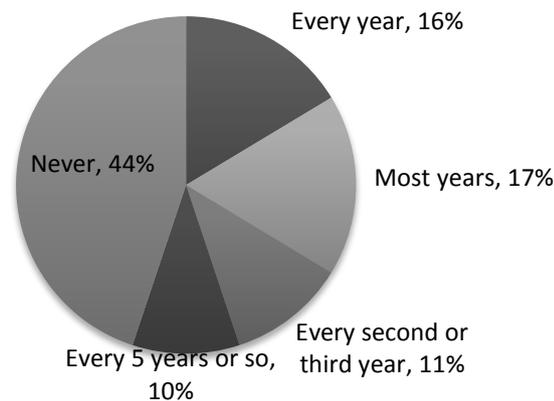
4.2 Phase 2 - Quantitative findings

Excerpts from Versus Research and Reed, 2014⁴

4.2.1 Waterlogging

Overall sixteen per cent (16%) of farmers stated that their farms were waterlogged every year, and 17% stated that they were waterlogged most years (Figure 1). Eleven per cent (11%) stated that their farms were waterlogged every second or third year, and 10% stated that they were waterlogged every five or so years. Forty-four per cent (44%) stated that their farms never became waterlogged.

Figure 1: Frequency of waterlogging



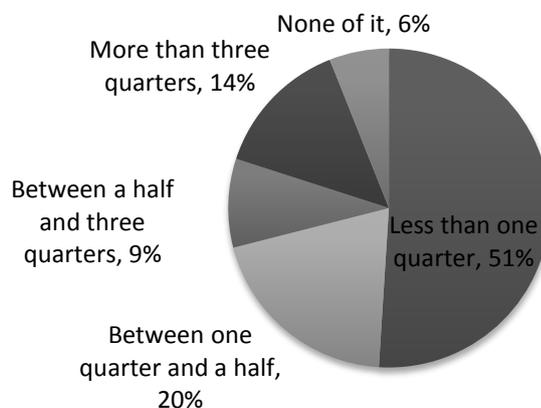
Base: All farmers, n=450

4.2.2 Proportion of farm at risk to waterlogging

Farmers who stated that they get waterlogged soils (56%) were asked what the proportion of their farm was at risk of getting waterlogged in most years (Figure 2). Of the farmers who get waterlogged soils 14% stated that more than three quarters of their farm became waterlogged most years, 9% stated that between half and three quarters of their farm became waterlogged, and 20% stated that between half and one quarter of their farm became waterlogged.

Just over half (51%) of farmers stated that less than one quarter of their farm became waterlogged, and 6% stated that none of their farm was waterlogged in most years.

Figure 2: Proportion of farm at risk of waterlogging



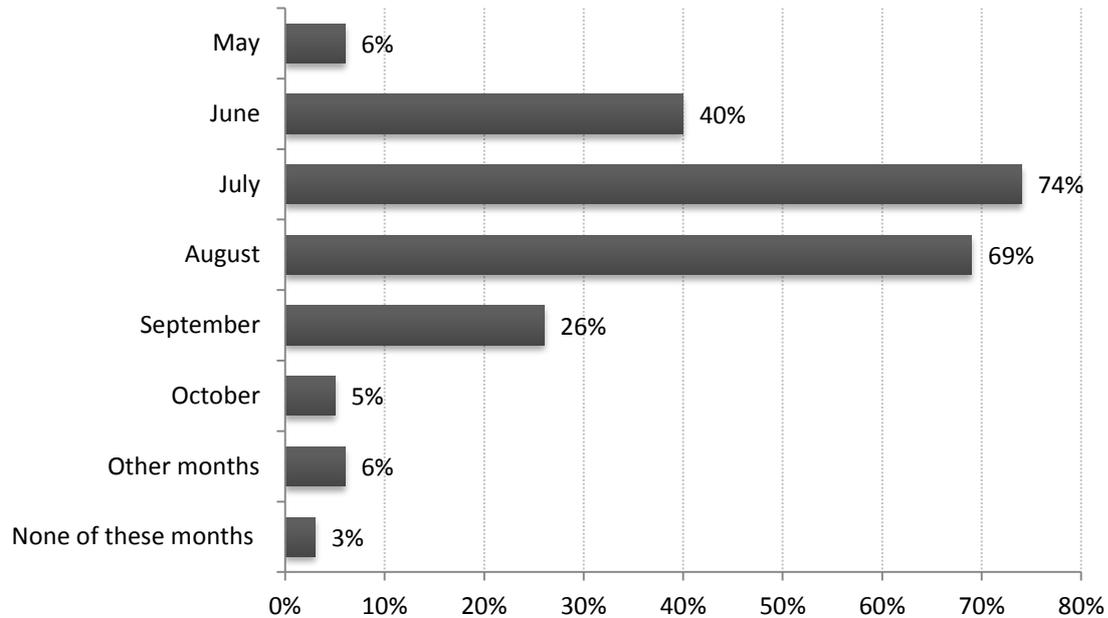
Base: Farmers who get waterlogged soils, n=250

⁴ 450 sheep and beef farmers were interviewed in large scale telephone survey.

4.2.3 Months that soils are waterlogged

Farmers who stated that they get waterlogged soils (56%) were asked in which months they experienced waterlogging (Figure 3). Of the farmers at risk of waterlogged soils, the majority experience waterlogged soils in July (74%) and August (69%). These months were followed by June (40%) and September (26%). All other months registered mentions of only 6% or fewer.

Figure 3: Months that soils are waterlogged

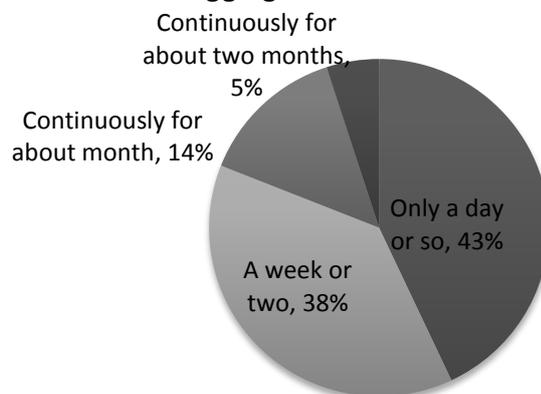


Base: Farmers who get waterlogged soils, n=250

4.2.4 Duration of waterlogging

Farmers who stated that they get waterlogged soils (56%) were asked to specify the duration of waterlogging on farm from options; only a day or so at a time, a week or two at a time, continuously for about a month or continuously for two months or more (Figure 4). The majority stated that their soils were waterlogged for a day or so (43%) or a week or two (38%). Only 14% stated that their soils were waterlogged continuously for about a month and 5% stated that they were waterlogged continuously for two months or more.

Figure 4: Duration of waterlogging

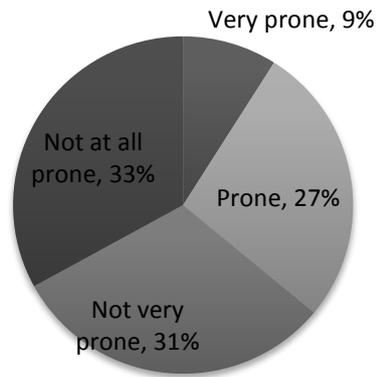


Base: Farmers who get waterlogged soils, n=250

4.2.5 Proneness to pugging

Farmers were asked overall how prone their farm was to pasture damage or pugging during winter. Thirty one per cent (31%) stated that their farm was not very prone and 33% stated that it was not at all prone. Twenty seven percent (27%) stated that their farm was prone to pugging or pasture damage over winter and nine per cent (9%) of all farmers stated that their farm was very prone.

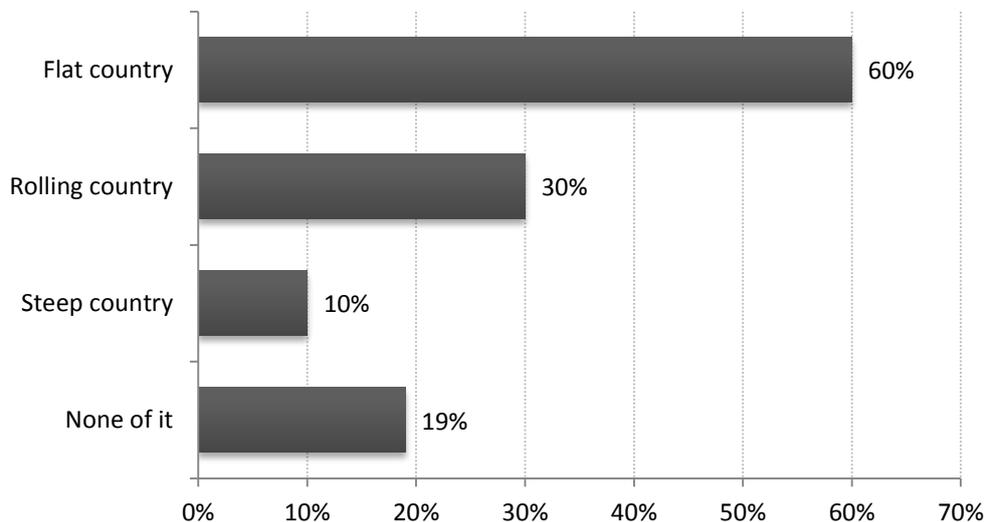
Figure 5: Proneness to pugging



Base: All farmers, n=450

Of the farmers that were not very prone, prone or very prone to pugging, 60% stated that their flat country is at risk of pugging, 30% stated that their rolling country was at risk of pugging, and a further 10% stated that their steep country was at risk of pugging. Nineteen per cent stated that none of these areas were at risk of pugging (Figure 6).

Figure 6: Areas at most risk of pugging⁵



Base: Farmers with farms that are prone to pugging, n=303

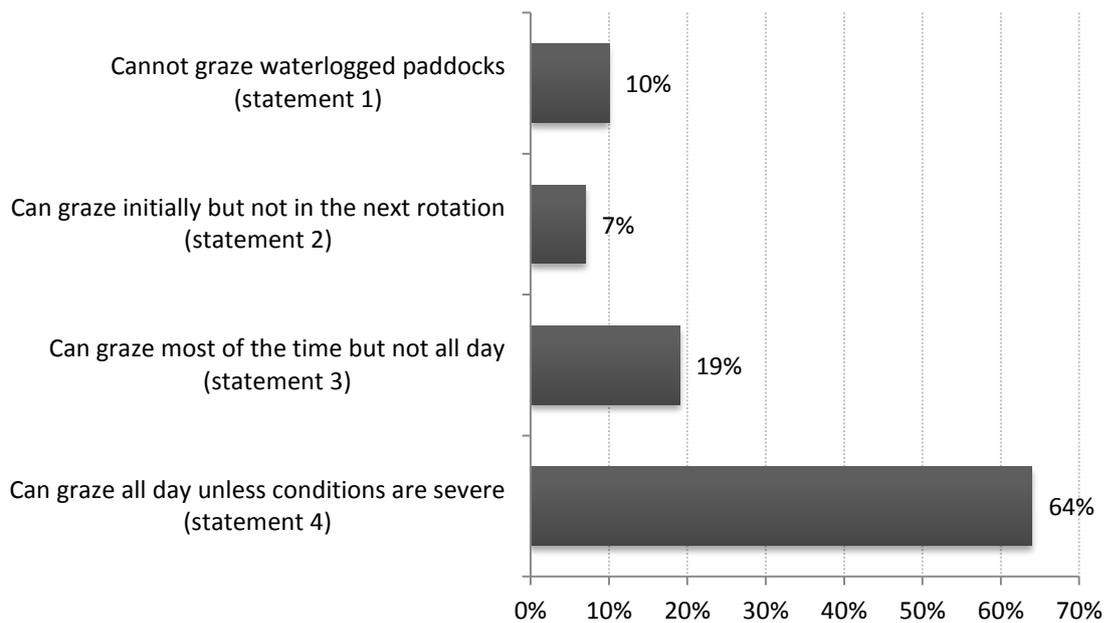
⁵ Survey question: Which areas on your farm are at risk of pugging? (Q43)

4.2.6 Duration of grazing on waterlogged paddocks

Farmers were asked to select one statement from a list of statements that best described how long they could graze waterlogged paddocks (Figure 7).

Sixty-four per cent (64%) of farmers who had farms that were prone to pugging, or who experienced waterlogged soils, stated that they were able to graze all day unless the conditions were severe, a further 19% stated that they could graze most of the time but for shorter durations. Seven per cent (7%) stated that they could graze waterlogged paddocks initially but would not be able to use these paddocks in the following rotation, while 10% stated that they could not graze waterlogged paddocks at all.

Figure 7: Duration of grazing on waterlogged paddocks



Base: Farmers with farms that are prone to pugging or who have waterlogged soils, n=331

4.3 Farm context findings

Excerpts from Kaine, 2014 in press

The 450 respondents to the Council survey were classified (Kaine 2014 in press) into farm context segments for managing stock in winter based on their assessments of:

- The proneness of their farm to pugging (see Figure 5), and
- The frequency with which they experience waterlogging (see Figure 1)

The profiles of the resulting farm context segments with respect to the proneness to waterlogging and pugging are summarised in table 1.

Farm context factors such as soil type, location, susceptibility to and extent of pugging and waterlogging, and management practices were significantly different across the six winter grazing contexts.

Overall, the results show that differences in the proneness and severity of pugging across the farm contexts are associated with differences in the extent and duration of waterlogging and pugging. Differences in proneness to waterlogging and pugging were associated with differences in soil type and drainage. Although the topography of farms was similar across the contexts, they differed in regard to soil types with farms that were more prone to waterlogging and pugging having a much greater proportion of clay-based soils, and a much smaller proportion of ash-based, than farms that were less prone to waterlogging and pugging.

The results confirm that the practices farmers use to manage sheep and beef over winter are driven by the frequency and extent of pugging and waterlogging that they experience over winter. The duration and frequency of pugging and waterlogging is primarily a function of biophysical characteristics of the farm that influence drainage (such as soil type and rainfall).

The study results indicate that there is extensive variety in the combinations of practices that farmers use to manage stock in winter, with the combination any one farmer uses being a function of the biophysical characteristics of their farm.

These results lead to the conclusion that the adoption of management practices for sheep and beef such as:

- grazing stock on larger areas, or on better or drier paddocks,
- changing rotation length,
- putting stock on steeper country or selling stock,
- feeding hay or silage and feeding purchased supplements

And are motivated by production benefits and these benefits arise from the biophysical characteristics of sheep and beef farms.

	Context 1 Pugging and frequent extensive waterlogging	Context 2 Some pugging and frequent waterlogging	Context 3 Some pugging	Context 4 Frequent waterlogging	Context 5 Infrequent waterlogging	Context 6 No waterlogging or pugging
Percentage of respondents	22%	8%	18%	12%	14%	26%
Proneness to pugging	Prone Very prone	Prone	Prone	Not prone	Not prone	Did not experience pugging
Proneness to waterlogging	Most years	Frequent - Every 2 or 3 years	Rarely if at all	Most years	Occasionally	
Extent of waterlogging	More than quarter of the farm	Up to quarter of area		Less than quarter of the area	Less than quarter of the area	
Continuity of waterlogging	Last for 2 weeks or more	Up to 2 weeks at a time		Usually lasts for a week or 2 or less	Only last of a day or 2 at a time	
Topography/soils/ Drainage	High proportion of farm: Rolling, clay and clay loam soils with poor to moderate drainage Small proportion of farm: Flat and steep, ash soils	High proportion: Rolling, clay and clay loam soils with poor to moderate drainage Small proportion: Steep, ash soils	Low proportion: Rolling, clay and clay loam soils with poor to moderate drainage High proportion: Flat, rolling and steep, ash soils	High proportion: Rolling, clay and clay loam with poor to moderate drainage High proportion: Rolling and steep, ash soils	Low proportion: Rolling country - Clay and clay loam soils with poor to moderate drainage High proportion: Rolling and steep, ash soils	Very low proportion: Rolling, clay and clay loam soils with poor to moderate drainage Very high proportion: Flat, rolling and steep, well drained ash soils
Mean average Rainfall	Relatively low	Relatively low	Relatively high	Close to average	Relatively high	Relatively high
Location in region	Waipa and Waikato	Waikato	Waipa and Waikato	Waipa and Waikato	Waipa, Waikato and Otorohanga,	Otorohanga, Taupo, Waipa and the Waikato

Table 1. Summary of Context segments for winter (adapted from Kaine 2014 in press)

4.4 Example

The following section outlines 2 example of farms that fall in a particular context, as described by Kaine (2014 in press), and how an example policy intervention may impact on the practices they employ in winter.

The farm in context 2 runs bulls, dairy heifers, beef cows and sheep (Table 2). In winter wet periods, to manage their bulls they use a sacrifice paddock⁶. To manage their dairy heifers they alter rotation length, move stock to better paddocks and or stand off their heifers. They use a range of practices to manage their beef cows including altering rotation length, move stock to better paddocks or steeper country, sell stock or feed out hay or silage. The main strategy for their sheep is to graze them on steeper country

The farm enterprise in context 6 runs bulls, dairy heifers and beef cows. To manage their bulls grazing over winter they feed out hay or silage. To manage their dairy heifers and beef cows they alter rotation length, for the beef stock they also feed out hay or silage.

The farm in context 2 put lighter stock classes on the steeper slopes to manage winter conditions. A policy that restricted their use of steeper country could have significant impact. This farmer may have to sell stock, or abandon breeding, sell stock earlier than planned, bring in more feed, or make greater use of sacrifice paddocks. The response option is not as simple as putting sheep somewhere else on the farm. If they can't use their steeper country the choices may be to sell stock in winter to avoid pugging or standing stock off. They would be choosing to invest in what could be expensive infrastructure or change their enterprises.

Livestock type and practices	Context 2 Wet (Some pugging and frequent waterlogging)	Context 6 Dry (No waterlogging or pugging)
Bulls		
Sacrifice paddock	X	
Hay/silage		X
Dairy Heifers		
Alter rotation	X	X
Move to better paddocks	X	
Stand off	X	
Beef cows		
Alter rotation	X	X
Move to better paddocks	X	
Move to steeper country	X	
Hay/silage	X	X
Sell stock	X	
Sheep		
Move to steeper country	X	

Table 2: Example of 2 farm enterprises and practices employed in winter.

⁶ A sacrifice paddock is a term commonly used for a paddock or part of a paddock that is used to hold stock in wet periods, with the acceptance by the farmer that it is better to have one small area of the farm where pasture is eaten down to bare soil and/or pugged than a larger area of the farm with some pugging damage. These paddocks are then later regrassed or cultivated for crops.

5 Summary

Achieving policy objectives depends, in part, on the extent to which the policy target groups make changes in choices of practice and technologies. Consequently, the impact of policy initiatives involves identifying what practices and technologies are being undertaken, by how many, and identify how to increase the uptake of desired practices and technologies.

The research described in this report is the building block for identifying how to change behaviour and increase the uptake of desired practices and technologies. A detailed understanding is needed of how choices of practice and technologies that achieve policy objectives align with the needs, or choices of sheep and beef farmers.

The use of the Kaine Framework (2008) has enabled the council to understand the winter grazing management practices and decisions of sheep and beef farmers in the Waikato Region. The Kaine Framework steps through a structured methodology. The council has used this to undertake two phases of research: qualitative interviews and a quantitative survey with farm context analysis.

The qualitative interviews elicit what practices and technologies farmers are currently undertaking, and why. The quantitative survey then tests the findings of the qualitative research by gathering data from a large sample of farmers that is representative of the population. Information on how many people are undertaking a practice or using a technology is known, as well as how many people share the same benefit or not adopting a practice of technology. Finally, the farm context analysis looks at the relationships between farm context factors and the use of a certain practices and statistically tests the relationships. The focus of the farm context analysis was to tested the link between frequency and extent of pugging and waterlogging and practices farmers use to manage sheep and beef over winter, and if this was a function of biophysical characteristics of the farm. This approach could be used to understand other winter grazing management practices.

The results of the research has revealed that farmer decision making is complex, highly involved and influenced by a range of factors such as fixed biophysical characteristics and associated management decisions, which can be hard to change (Kaine, 2014).

Undertaking this research enables policy decision makers to have a clear understanding of what winter grazing management practices are currently occurring in the sheep and beef industry in the Waikato Region.

The approach can be used to set priorities for, and design of, water resource management policies. This research approach forms part of a comprehensive, integrated approach to understanding behavioural responses of farmers to policy instruments.

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