Factors influencing standing off and wintering off dairy livestock in New Zealand

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Abstract. The winter management practices of dairy farmers in the Waikato are under scrutiny as dairying is a key contributor to declining water quality in the region. Proposals requiring farmers to change practices are under consideration. The influence of farm context on the winter grazing practices of dairy farmers in the Waikato was investigated. The results confirmed that the standing-off of dairy cattle in winter was driven by the severity of pugging that farmers experience over winter. Pugging severity was primarily a function of biophysical characteristics of the farm that influence drainage. The main factors influencing wintering-off were herd size, stocking rate, and proneness to pugging. The benefits from wintering-off and standing-off of dairy cattle arise from the biophysical characteristics of dairy farms, herd size and stocking rates. Farmers that use these practices are likely to suffer serious economic losses should they be compelled to change them.

Keywords: Adoption, compliance, practice change, NRM, Extension, farm context, farm systemsIntroduction

Policies to change the winter management practices of dairy farmers in the Waikato are under consideration by the Waikato Regional Council as dairying is considered a key contributor to declining water quality in the region (Ministry for the Environment 2009; Vant 2014). Consequently, the Council commissioned interviews with farmers (Davies and Topperwien 2011) followed by a survey of four hundred farmers (Versus and Davies 2012) to obtain information on farmers' winter grazing practices and management decisions.

Versus and Davies (2012) quantified the use of winter grazing practices by dairy farmers in the Waikato region including standing-off stock (taking stock of paddocks) and wintering-off (sending stock off the home farm for a period of time). They then identified differences in the use of these practices across districts, farm and herd size, stocking rates, soil types and demographics. While Versus and Davies (2012) concluded that contextual factors such as the severity of pugging did influence the practice of standing-off stock, it was unclear how the various contextual factors combined to influence the grazing practices of dairy farmers. How these contextual factors combine to influence farmers' grazing management in winter is important in enabling policy makers to assess the flexibility, if any, farmers may have in their choice of winter grazing practices, and the likely magnitude of costs to dairy farmers of changing winter grazing practices.

In this paper the data collected by Versus and Davies (2012) is re-analysed to show more clearly how factors in the farm context such as proneness to pugging, extent of pugging and soil type combine to influence farmers' choices in regard to wintering-off and standing-off livestock.

The influence of these factors was analysed by (1) classifying farmers into farm context segments for standing off stock based on farmer's assessments of the proneness of their farm to pugging, and the extent of their farm that was pugged in a normal winter; and (2) classifying farmers into a second set of farm context segments for wintering off stock based on the size of their herd and their stocking rate.

In the next section the classification of farmers into farm context segments for standing off is described. This is followed by an analysis of the differences among segments in management practices. The differences in the factors that influence farmers' decisions to stand-off and winter-off are then investigated and discussed. The classification of farmers into farm context segments for wintering-off is described. The policy implications of the results are discussed briefly in the final section.

Farm context segments for standing off

Respondents to the Versus and Davies (2012) survey of dairy farmers were classified into farm context segments for standing off stock in winter based on farmers' assessments of:

- The proneness of their farm to pugging, and
- The extent of their farm that was pugged in a normal winter.

Proneness to pugging was rated by respondents on a four-point scale from not at all prone to very prone (Versus and Davies 2012, 11).

The extent of the farm subject to pugging in a normal winter was elicited as a percentage of the farm area (including trough areas and laneways) and graded into three categories; less than 5% typically pugged, 5% to 10% typically pugged, more than 10% typically pugged (Versus and Davies 2012, 12). The proportion of the farm that was subject to pugging was assumed to be zero for those farmers that reported their farms were not at all prone to pugging.

Respondents were classified into farm context segments using SPSS (IBM 2012). The classification method and measure of dissimilarity employed were Wards and squared Euclidean distance, respectively (Aldenderfer and Blashfield 1984). Examination of the agglomeration schedule indicated a substantial increase in the agglomeration coefficient at the formation of five segments; consequently a six-segment solution (see Figure 1) was selected for analysis (Aldenderfer and Blashfield 1984, 55-57).

The profiles of the farm context segments with respect to the proneness and extent of pugging are summarised in Table 1. There were statistically significant differences across the segments in terms of location, topography, drainage and soil type. The characteristics of the contexts in terms of farm infrastructure and grazing practices during winter are summarised in Table 2. Only the results of overall significance tests are reported. The results of post-hoc and pairwise tests are available on request from the author.

Tables 1 and 2 reveal that differences in the proneness to and extent of pugging across the farm contexts are associated with differences in the kinds of infrastructure, such as feed pads and loafing pads on farms, and in the grazing practices used. The frequency of wintering off was not significantly different, statistically speaking, across the farm contexts. This is to be expected as the main reasons for wintering off were to manage pasture production (Versus and Davies 2012). Each of the contexts is now described.

Farm context one: Prone to extensive pugging

Context one farms are prone or very prone to extensive pugging with, on average, approximately a quarter of the area of their area prone to pugging in winter. Farms in this context have a flat topography and the soils are mainly clays or loams that have poor to moderate drainage. They were concentrated in districts in the north of the region. Most farmers with this context stand off stock for more than 12 hours a day for at least ten days in winter. Most have to stand off stock for up to a month, some for even longer. Consequently, a relatively high proportion of these farms have feed pads, purpose built loafing pads, wintering barns or a herd home, and have sacrifice paddocks over winter. Feed management and other factors also influence investment in feed pads, loafing pads, wintering barns and herd homes.

Farm context two: Very prone to some pugging

Context two farms are very prone to pugging over a relatively small area. The farms in this context have a flat or flat to rolling topography and the soils are mainly clays and loams that have poor to moderate drainage. Farms with this context are concentrated in districts in the north of the region, like those with context one. As was the case with the farmers with context one, most farmers with context two stand off stock for more than 12 hours a day for at least ten days in winter. Most have to stand off stock for up to a month, some for even longer. Similar to the farms in context one, a relatively high proportion of the farms in context two have feed pads, purpose built loafing pads, wintering barns or a herd home, and have sacrifice paddocks over winter.

Farm context three: Prone to some pugging

Context three farms are prone to pugging over a relatively small area, with approximately 7% of the area of these farms being prone to pugging in winter. They have a flat to rolling topography and the soils are mainly ash and loams that have good drainage. These farms are spread throughout the region. Similar to the farms in contexts one and two, a relatively high proportion of the farms in context three have feed pads, purpose built loafing pads, and have sacrifice paddocks over winter. Unlike farmers with contexts one and two, most farmers in context three stand off stock for less than a month in winter.

Farm context four: Prone to a little pugging

Farms with context four are prone to pugging over a very small area. The farms in this context have a flat to rolling or rolling topography and the soils are mainly ash and loams that have good drainage. Farms with this context are spread throughout the region. While a relatively high proportion of the farms in this context have feed pads the proportion with wintering barns or a herd home, or purpose built loafing pads is relatively low. Most farmers in context four stand off stock of for less than a month in winter.

Figure 1. Farm context tree for standing-off

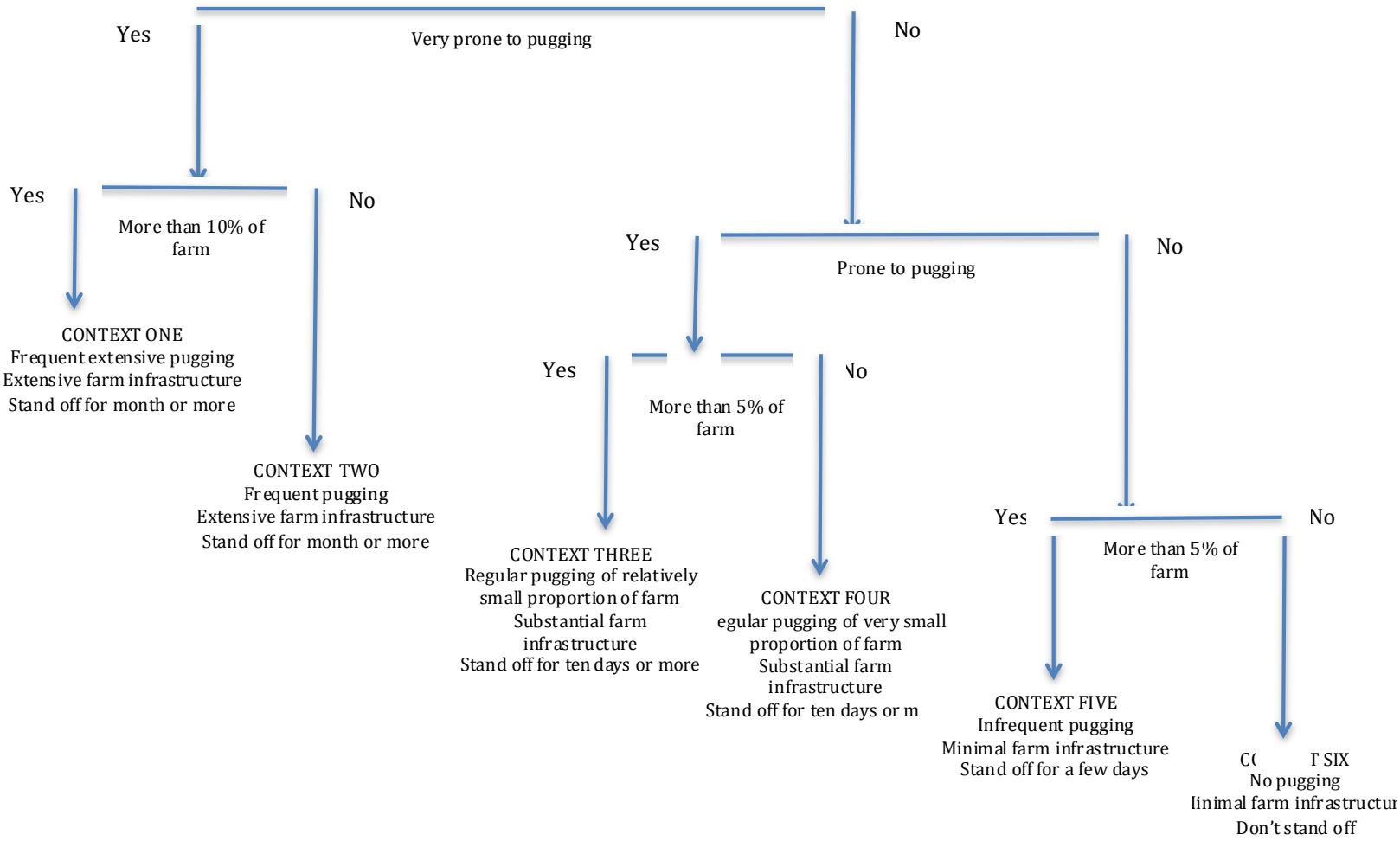


Table 1. Farm context segments for standing off

	Context 1 Prone to extensive pugging	Context 2 Very prone to some pugging	Context 3 Prone to some pugging	Context 4 Prone to a little pugging	Context 5 Some occasional pugging	Context 6 Not prone to any pugging
% of sample	11	17	22	14	14	22
Proneness to pugging*						
Very prone	55	100	-	-	-	-
Prone	38	-	100	100	-	-
Not very prone	7	-	-	-	100	83
Not at all prone						
Extent of pugging*						
Less than 5%	-	33	-	100	-	100
5% to 10%	-	67	100	-	100	-
More than 10%	100	-	-	-	-	-
Average % of farm pugged in winter*	24.2 (15-60)	5.3 (0-10)	6.8 (5-10)	1.5 (0-4)	7.0 (5-10)	1.6 (0-4)

Notes: * Denotes statistically significant differences across contexts. Values are percentage of respondents in each context except where otherwise indicated. Values in parentheses are ranges

Table 2. Farm context, standing off and infrastructure

	Context 1 Prone to extensive pugging	Context 2 Very prone to some pugging	Context 3 Prone to some pugging	Context 4 Prone to a little pugging	Context 5 Some occasional pugging	Context 6 Not prone to any pugging
Do standoff (1)*	88	95	84	88	74	53
Standoff for: (2)*						
Less than 10 days	11	11	17	23	62	44
10-29 days	60	58	71	67	32	47
30-59 days	16	25	9	5	6	2
60-89 days	8	5	1	2	-	2
Infrastructure:						
Feed pad*	21	33	24	35	15	17
Standoff or loafing pad*	43	27	29	18	15	9
Wintering barn or herd home*	10	10	4	6	4	0
Sacrifice paddock*	33	30	29	16	27	15
Only sheds and races*	33	24	27	37	48	62

Notes: * Denotes statistically significant differences across contexts. (1) Values are percentage of respondents in each context. Values may not sum to percentage in context that stand off because of rounding errors. (2) Values are percentage of respondents that stand off in each context. Values may not sum to 100 because of rounding errors

Farm context five: Some occasional pugging

Farms with context five are a little prone to pugging over a relatively small area. They have a flat to rolling or rolling topography and the soils are mainly ash, peat and loams that have mixed to good drainage. These farms are spread throughout the region, although there is a relatively high proportion in the southern districts of the region. Unlike the farms in the preceding contexts, a relatively low proportion of context five farms have feed pads and purpose built loafing pads, though a relatively high proportion use sacrifice paddocks. Most farmers in context five stand off stock for less than ten days in winter.

Farm context six: Not prone to any pugging

Context six farms are not prone to pugging at all. These farms have a flat to rolling or rolling topography and the soils are mainly ash, pumice and loam that have good drainage. These farms, like those in context five, are spread throughout the region, although there is a relatively high proportion in the southern districts of the region. A relatively low proportion of the farms in context six have feed pads, purpose build loafing pads, and have sacrifice paddocks over winter. Most farmers either do not stand-off stock or stand-off stock for less than ten days in winter.

Standing off and wintering off

Versus and Davies (2012) found the main reason for wintering-off dairy cattle was to manage pasture production and that only a small proportion of farmers wintered-off to prevent pugging. This suggests that the factors that influence the decision to winter-off dairy cattle are different to those that influence the decision to stand off dairy cattle, though there is some overlap. This suggestion was tested by using discriminant analysis (Klecka 1980) to identify the factors in the farm systems that were associated with standing-off and wintering-off dairy cattle.

The results of the analyses are summarised in Table 3. Based on their correlation with the discriminating function the main factors influencing standing-off stock were proneness to pugging and the extent of pugging, together with stocking rate. This is consistent with the results reported earlier and confirms that farmers' decisions to stand-off cattle are primarily influenced by the biophysical characteristics of their properties that relate to pugging and, to a lesser extent, the intensity with which they farm.

In contrast, the main factors influencing wintering-off were herd size, stocking rate, and proneness to pugging. Other factors such as location, soil type and extent of pugging were not significantly related to wintering-off. These results indicate that farmers' decisions to winter-off cattle are primarily influenced by the intensity of their farm systems and, to a lesser extent, the biophysical characteristics of their properties in relation to drainage. This is consistent with the reasons given by farmers for wintering-off stock (Davies and Topperwien 2011).

Farm context segments for wintering off

Given the results presented in the preceding section respondents to the Versus and Davies (2012) survey were classified into farm context segments for wintering off based on their herd size and stocking rate. As before, respondents were classified into farm context segments using SPSS (IBM 2012) and the classification method and measure of dissimilarity employed were Wards and squared Euclidean distance, respectively (Aldenderfer and Blashfield 1984). Examination of the agglomeration schedule indicated a substantial increase in the agglomeration coefficient at the formation of five segments; consequently a six-segment solution (see Figure 2) was selected for analysis (Aldenderfer and Blashfield 1984).

The profiles of the farm context segments with respect to the herd size and stocking rate are summarised in Table 4. There were no statistically significant differences across the contexts in terms of contour, drainage and main soil type. The characteristics of the contexts in terms of farm infrastructure and grazing practices during winter are summarised in Table 5. Each of the contexts for wintering off is described in detail below.

Farm context one: small farms with limited wintering off

Context one farmers have relatively small herds and have medium stocking rates. Less than a third (28%) of these farmers winter off their stock in June. Most also stand off stock in winter but usually for less than a month. A relatively low proportion of these farms have feed pads. A relatively high proportion of farms in this context have only sheds and laneways.

Farm context two: small farms with wintering off

Context two farmers have relatively small herds but have relatively high stocking rates. Slightly more than a third (38%)of them winter off their stock in June and July. Most of these farmers also stand off stock in winter, usually for ten days or more. A relatively high proportion of the farms have feed pads.

Farm context three: medium farms with limited wintering off

Farmers with context three have medium-sized herds but have relatively low stocking rates. Approximately a quarter (24%) of these farmers winter off their stock in June. Most of them also stand off stock for up to a month in winter. A relatively low proportion of the farms in this context have feed pads.

Farm context four: medium farms with wintering off

Farmers with context four have medium-sized herds but have relatively high stocking rates. A third (33%) of these farmers winter off their stock in June. Most farmers also stand off stock in winter, usually for ten days or more. A relatively high proportion of the farms in this context have feed pads, loafing pads or standoff pads, and winter crops.

Farm context five: large farms with wintering off

Context five farmers have large herds and have medium stocking rates. Almost half (44%) of these farmers winter off stock in June and July and most also stand off stock in winter for up to a month. A relatively high proportion of the farms had feed pads, loafing pads or stand off pads, and winter crops.

Table 3. Factors influencing standing off and wintering off

	Standing off*	Wintering off*
Goodness-of-fit statistics:		
Wilks' Lambda	0.87	0.95
Chi-square	50.8 (p<0.01)	18.6 (p<0.01)
Correlation coefficients:		
Herd size	-	0.82
Stocking rate	-0.39	0.65
Proneness to pugging	0.94	-0.38
Pugging severity	-0.41	-
Classification statistics:		
Correct prediction %	69	59

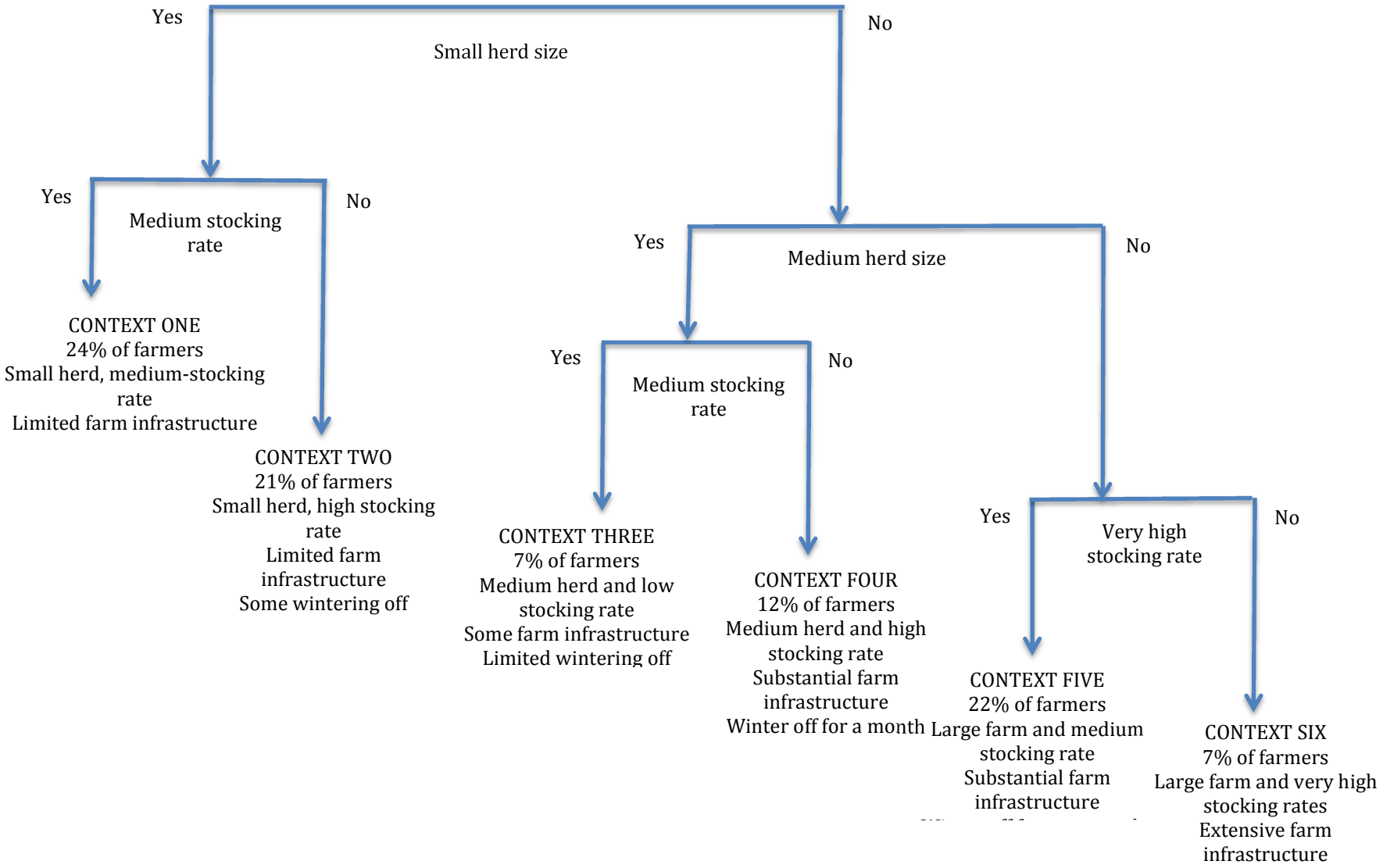
Notes: * Denotes statistically significant differences across contexts.
Correlations less than 0.3 in absolute value are not reported.

Table 4. Farm context segments for wintering off

	Context 1 Small farms with limited wintering off	Context 2 Small farms with wintering off	Context 3 Medium farms with limited wintering off	Context 4 Medium farms with wintering off	Context 5 Large farms with wintering off	Context 6 Large farms with extended wintering off
% of sample	24	21	16	12	22	7
Herd size*						
100-200	52	34	45	-	-	-
201-300	48	66	36	-	-	-
301-400	-	-	19	100	-	26
401-500	-	-	-	-	44	26
>500	-	-	-	-	56	48
Stocking rate*						
Less than 2.5	-	-	100	-	16	-
2.5 to 2.99	100	-	-	52	40	-
3.0 to 3.49	-	73	-	48	44	-
3.5 or more	-	27	-	-	-	100
Average farm size*	75.9 (35-120)	68.7 (34-100)	111.9 (41-340)	118.3 (94-156)	216.6 (126-776)	142.1 (73-350)

Notes: * Denotes statistically significant differences across contexts. Values are percentage of respondents in each context except where otherwise indicated. Values in parentheses are ranges

Figure 2. Farm context tree for standing-off



Farm context six: large farms with extended wintering off

Farmers with context six had large herds and had very high stocking rates. Approximately half (48%) per cent of these farmers winter off stock in June and July and most also stand off stock in winter for up to a month. A very high proportion of the farms had feed pads and loafing pads.

These results confirm the findings from the discriminant analysis. They indicate that wintering-off and standing-off in the dairy industry are motivated by different sets of factors in the farm system, though there is some overlap between the sets. They highlight the extensive variety in the combinations of practices that farmers use to manage stock in winter. They also highlight how the combination of practices any one farmer uses is a function of the biophysical characteristics of farms such as size, soil type and topography as well as management strategies such as stocking rates.

Table 5. Farm context, wintering off and infrastructure

	Context 1 Small farms with limited wintering off	Context 2 Small farms with wintering off	Context 3 Medium farms with limited wintering off	Context 4 Medium farms with wintering off	Context 5 Large farms with wintering off	Context 6 Large farms with extended wintering off
Do winter off (1)*	28	38	24	33	44	48
Winter off in: (2)						
May	18	26	46	52	30	46
June	75	76	88	76	84	85
July*	36	76	54	45	68	69
August*	14	39	8	24	23	23
Winter off for: (2)*						
Less than 10 days	35	30	42	19	16	4
10-29 days	54	56	44	50	66	74
30-59 days	7	6	11	22	13	13
60-89 days	3	5	2	3	-	9
Every day	-	3	-	6	4	-
Infrastructure:						
Feed pad*	10	27	10	27	33	59
Standoff or loafing pad*	17	18	19	23	24	44
Wintering barn or herd home*	3	6	2	10	3	7
Sacrifice paddock*	25	24	31	29	26	15
Only sheds and races*	6	7	7	10	20	7

Notes: * Denotes statistically significant differences across contexts. Values are percentage of respondents in each context. (1) Chi-square=10.5, p=0.06

Discussion

The results indicate that wintering off and standing off in the dairy industry are motivated by different sets of factors in the farm system, though there is overlap between these sets, and there are likely to be subtle interactions between farm infrastructure, standing off, and wintering off. The practice of standing-off dairy cattle in winter is driven by the proneness to, and extent of pugging that farmers experience on their properties over winter, which is primarily a function of biophysical characteristics of the farm such as soil type, rainfall, and farm topography that influence drainage. Wintering-off, though influenced by proneness to pugging, is primarily a function of high-level strategic farm decisions, herd size and stocking rate.

This confirms the adoption of wintering-off and standing-off is motivated by production benefits and these benefits arise from the biophysical characteristics of dairy farms, herd size and stocking rates. Being biophysical or strategic, these contextual factors cannot be easily or inexpensively modified, consequently both wintering-off, and to a lesser degree, standing-off are intrinsically 'sticky' practices (Szulanski 1996; Ogawa 1998); farmers will resist being compelled to adopt, modify or abandon, them.

Considering wintering-off, the results presented here indicate that this practice is most likely to offer a net benefit, a relative advantage (Rogers 1995), when farmers have large herds and high stocking rates. See Kaine et al. (2005), Kaine (2008) and Kaine & Bewsell (2008) for explanations as to how relative advantage may be inferred from an analysis of farm context. Farmers in these circumstances will be strongly motivated to resist abandoning the practice because to do so would severely impair their capacity to pursue a high stocking rate strategy. Wintering-off appears less likely to offer a net benefit to farmers with low stocking rates and smaller herds. Farmers in these circumstances will be strongly motivated to resist being forced to adopt the practice because to do so would add substantially to their costs with little prospect of improving their profitability.

In these circumstances the role for extension to promote compliance appears problematic. Furthermore, the rate of non-compliance and degree of opposition to a policy compelling adoption of wintering-off, or prohibiting the practice, is likely to be quite insensitive to the provision of incentives. This may be the case even where incentives represent a substantial proportion of the cost of changing practice.

Considering standing-off, the results presented here indicate that the magnitude of the relative advantage this practice offers depends on the severity of pugging farmers' experience. Consequently, the severity of pugging farmers' experience will determine the intensity with which they will resist a policy compelling standing-off in winter to minimise nutrient losses. Standing-off is unlikely to offer a substantial net benefit to farmers that experience limited, occasional pugging. Farmers in these circumstances will be strongly motivated to resist being forced to adopt the practice, especially if they are also required to invest in expensive infrastructure, because to do so would increase their costs with little prospect of improving their profitability.

In these circumstances, the role for extension to promote compliance appears limited. Furthermore, the rate of non-compliance and degree of opposition to a policy compelling adoption of standing-off is likely to be insensitive to the provision of incentives for infrastructure unless they represent a substantial proportion of relevant costs.

The results reported here suggest that dairy farmers may well seek to block, modify or actively seek to delay implementation of a policy mandating the standing-off and wintering off of cattle. They will also seek ways to appear to comply with the letter of the policy while avoiding complying with its intent (Kaine and Higson 2006).

Conclusion

The results presented here confirm that the practice of standing-off dairy cattle in winter is driven by the proneness and extent of pugging that farmers experience over winter. The proneness and extent of pugging is primarily a function of biophysical characteristics of the farm that influence drainage (such as soil type, rainfall, and farm topography). Discretionary management decisions do not appear to have any influence on stand-off practice, except for stocking rate which appears to have some small influence. Wintering-off is primarly driven by high level strategic decisions, stocking rate and herd size, with proneness to pugging having a small influence.

The results indicate that wintering-off and standing-off in the dairy industry are motivated by different, but overlapping, sets of factors in the farm system, and there are likely to be subtle interactions between farm infrastructure, standing-off, and wintering-off.

This study confirms the adoption of wintering-off and standing-off is motivated by production benefits and these benefits arise from the biophysical characteristics of dairy farms, herd size and stocking rates. Being biophysical or strategic, these contextual factors cannot be easily or inexpensively modified. Consequently, wintering-off, and to a lesser degree, standing-off are intrinsically 'sticky' practices (Szulanski 1996; Ogawa 1998); farmers will resist being compelled to adopt, modify or abandon, them.

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