Lambs and landscapes

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Abstract

Hill country farmers face major challenges to provide the physical environment and climatic conditions for maximum survival of multiple-born lambs. Farmers and scientists together investigated the opportunities for improved lamb survival on seven high-producing (scanning percentage 150-220%) North Island hill country farms. For 3 years, each of the participating farmers monitored lamb survival to docking on their farms. Five paddock attributes (e.g. slope, hazards, disturbance, wetness and wind) were quantified, weighted and summed to provide a paddock score. When all the lamb docking data (2005-2008) were pooled, the relationship between paddock score (slope +hazards +disturbance +wetness +wind) and lamb survival to docking was not significant ($y = - 0.983x + 181$, $R^2 = 0.186$). This was in part due to the mild conditions that prevailed during spring each year. Despite the poor relationships, the land assessment tool (LAT) developed provides a stepwise basis for examining how different paddocks tend to affect lamb survival to docking and why the performance might vary from year to year.

Keywords: lamb survival, physical environment, land assessment tool

Introduction

Lambing percentage of New Zealand's sheep flock has been improving annually (Agriculture and Forestry in New Zealand 2003). Top performing sheep farmers are now consistently achieving well in excess of 150% survival to weaning. Ram selection, improved nutrition and overall animal management (e.g. disease control, mid pregnancy shearing) and technologies (scanning) have driven this increase. The use of pregnancy scanning has also enabled farmers to identify the efficiency of their lambing programmes.

On hill country, there is limited access to easy contoured land protected from the extremes of climate. As the proportion of the breeding ewe flock bearing twins and triplets increases with scanning percentages over 150%, there are not enough paddocks for set stocking on ideal lambing country. Knight *et al.*, (1988) showed with twin bearing ewes that, as slope increased above 30°, lamb mortality rates increased exponentially due to lambs slipping from the birth site. With that knowledge available,

the practice of spreading ewes out across the whole farm just prior to lambing becomes less and less of an option, as the proportion of the farm suitable for lambing (flat and easy) decreases. Knowingly shedding out multiple bearing ewes onto hill country and accepting high mortality rates is neither good business, nor does it represent responsible management. With an eye to ongoing profitability of hill country farming and to future market access we need to develop a suite of tools to lift lamb survival.

We investigated what the opportunities are for improving lamb survival on seven sheep farms in North Island hill country with scanning percentages ranging from 150-220%. The effect of different landscape and environmental features (e.g. slope, hazards, wetness, etc) on lamb survival from multiple bearing ewes was quantified and the potential for improving lambing survival by a change in management explored.

Method

On-farm study

For 3 years (2005-08), each of seven participating farmers recorded lamb and ewe numbers at docking on three separate blocks on their farm. Farms are located from the foot hills of the Ruahine Range near Dannevirke to Herbertville on the East Coast. The farms ranged from typically summer moist to summer dry hill country environments with a range in dominant aspect and altitudes. Treatment blocks were picked to represent areas of the farm that were viewed as "good", "average" or "poor" for lamb survival from multiple bearing ewes. Blocks were stocked 4 to 14 days prior to lambing with twin bearing ewes of the same age, breed and mean lambing date. Ewes had been mated to the same group of rams and grazed together up to set stocking before lambing. Lamb losses were calculated from the difference between the actual scanning percentage (200%) and the number of lambs present at docking. Ewe deaths were calculated from the difference between ewes set stocked and present at docking (Table 1).

Development of the land assessment tool

The paddocks used by each farmer in the group had a range of aspects, shelter, slope, evenness, wetness and potential disturbance, all factors influencing lamb survival.

Table 1 Examples of the type of data collected from each lambing block.

	Airstrip/Yard	Hora Tai Tumu
Data logger #	14	5
Dam breed	Texel/Romney	Composite
Sire breed 1	Texel/Romney	Kelso/Terminal
Lambing date	25 August 2006	5 September 2006
Scanning percentage	151	200
Date shorn	Feb	NA
Nitrogen date #1		24 August 2006
Nitrogen rate (kg/ha)		20
Androvax	Y	N
Toxovax	Y	HGT
Campy	Y	HGT
5 in 1	Y	Y
Trace elements (Cu, Se, I)	Y	N
Pre-lamb drench	Nilvax	Lightest ewes
Last udder check		1 February 2006
Animal data		
No. of ewes	200	166
Age structure	2th, MA	MA
Ewe condition score at set stock	3	2.5
Number single foetuses		
Number twin foetuses	400	332
Number triplet foetuses		
Potential number of lambs	400	332
Animal performance		
Number of lambs at docking	299	274
Number of wet ewes at docking	176	153
Number of dry ewes at docking	8	8
Number of ewes removed at docking	8	8
Number of ewes dead by docking	7	5
Number of ewes not accounted for	9	0
% of dead ewes	3.5	3.0
% Lambs lost due to ewe deaths	3.5	3.0
Paddock docking % (ewes at set stocking)	150	165
% Lambs dead per lamb scanned (ewes set stocked)	25.3	17.5
% Lambs dead per lamb scanned (ewes alive at docking)	22.5	14.9
Ewe condition score at docking	3	2.3

Table 2 Criteria and recording sheet for making a visual assessment of a lambing paddock.

Farm name

Paddock name

Slope % of paddock area with slope >26º

Hazards % of paddock area affected by:
   Fences on narrow ridges
   Fences across steep slopes (x 2 weighting)
   Bluffs & dropouts
   Waterways & Drains
   Steep land on sides of water courses (x 2 weighting)
   Ponds/dams, lakes and swamps

Disturbance Major = 5, none = 1

Wetness Well, imperfectly or poorly drained
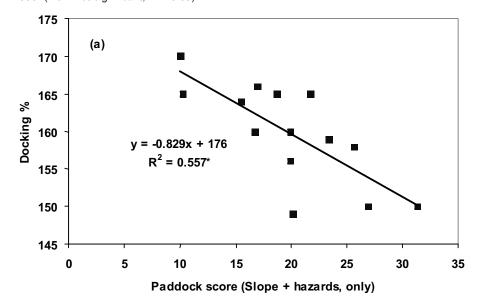
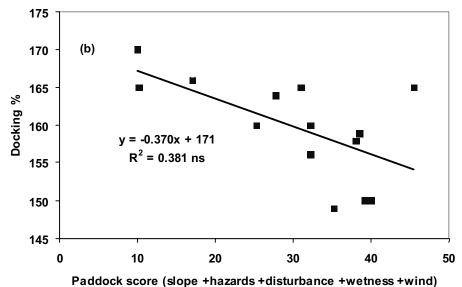**Land class** Flat, rolling, hill or steep

Shelter
   % of paddock area with vegetation shelter
   'Killer' wind (e.g. southerly)
   % of paddock area with landscape/aspect protection from killer wind

Figure 1 Relationship between (a) paddock score with only slope and hazards included and lamb survival to docking on the participating farms in 2006 and (b) paddock score with all the factors included (slope +hazards +disturbance +wetness +wind) and lamb survival to docking on the participating farms in 2006. (n.s.= not significant, * P<0.05).

(a)

$$y = -0.829x + 176$$
$$R^2 = 0.557*$$

Docking %

Paddock score (Slope + hazards, only)

(b)

$$y = -0.370x + 171$$
$$R^2 = 0.381 \text{ ns}$$

Docking %

Paddock score (slope +hazards +disturbance +wetness +wind)

The criteria listed below to characterise and score each paddock, was developed with the farmer group over the first 2 years of the study.

1. *Slope* Percentage of the paddock area with slope > 26º
2. *Hazards* Percentage of the paddock area affected by:
   - Fences located on narrow ridge tops (weighting x1)
   - Fences across slopes >26º (weighting x2)
   - Bluffs and dropouts (weighting x1)
   - Waterways and drains (weighting x1)
   - Land >26º on both sides of water courses (weighting x2)

   - Ponds/dams, lakes and swamps (weighting x1).
3. *Disturbance* Level of disturbance that sheep are exposed to (beside major road = 5, remote = 1).
4. *Wetness* Categorise the paddock as 'well drained', 'imperfectly drained' or 'poorly drained'.
5. *Land class* Categorise the paddock as 'flat', 'rolling', 'hill' or 'steep'. Estimate the percentage of the paddock that has physical protection from the main wind direction that causes lamb losses.
6. *Shelter* Estimate the percentage of the paddock area

that has shelter by way of vegetation, excluding shelter (e.g. rushes) in wet areas.

The data collected on each of the factors listed in Table 2 were incorporated into a spreadsheet in a stepwise manner with the features present each year (e.g. slope, hazards and level of disturbance) entered first, followed by those factors influenced by the weather conditions that prevail in an average year (e.g. wetness and wind). Each of the attributes (e.g. slope, wetness, etc) were then given a weighting based on their estimated impact on lamb survival, with those that killed lambs x10 and those that reduced lamb survival x5.

The 2006 data, the most complete data set of the 3 years, was used to compare the relationship between the physical features (slope + hazards) and lamb survival to docking and all five paddock features (slope +hazards +disturbance +wetness +wind) with lamb survival to docking (Fig. 1). There were missing data from farms in 2005 and 2007, limiting analysis to a combination for the 3 years.

Wind chill factor

In spring 2006, air temperature recordings were taken from lambing blocks (Fig. 2). On each farm, a temperature data logger was stapled to the top of a fence post in the designated trial paddocks. The data loggers were then capped with a block of wood to ensure consistency of measurement across lambing blocks. From these data, the wind chill factor (CF) was
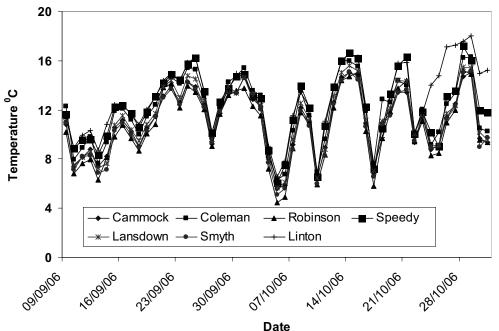
calculated from the equation of Donnelly (1984):

$CF = (11.7 + 3.1*\sqrt{wind})*(40-temp) + 481 + 418*(1-exponential (-0.04*rain))$ where CF = KJ/m^2/h, wind = m/s, temperature = ºC and rainfall = mm/day, using temperature data collected every 2 hours from 9 September to 1 November 2006 from each paddock. Dannevirke meteorological data from same period recorded a mean rainfall in 24 hours (mm/day) of 2.9 mm/day with a min and max of 0 and 27 mm/day and wind runs (km/24 hours) of 2.66 and min and max of 0.5 and 7.5 m/s. The minimum temperature recorded each day on each lambing block was used with the Dannevirke meteorological data for each day to calculate the chill factor to identify the number of days with the chill factor greater than 1171 KJ/m^2/h. Since the rainfall and wind runs were from only one site, the chill factor comparisons for each lambing block on each farm were based on temperature differences only (Fig. 2).

Return on investment from increasing lamb survival

A simple excel spreadsheet was used to calculate the breakeven point (using a nominated return on investment) from an investment into changes in the physical environment (e.g. realigning fences, and or adding shelter and improving drainage) for the purpose of improving lamb survival to docking. The model farm for this exercise covered 400 ha and carried 2200 MA ewes. Average ewe pregnancy scanning was 165%,

Figure 2 Air temperatures during lambing on a selection of the paddocks on the participating farms in spring 2006.

with 1500 multiple bearing ewes. Average lambing percentage was 129% (2835 lambs), a 22% lamb wastage from scanning.

Results and Discussion

Relationship between paddock features and lamb survival

The process of scoring the features of each of the three lambing blocks on each farm was conducted in the field with the participating farmers. It proved to be one of the benefits of the project. The process of assessing the lambing paddocks, using the criteria set out in Table 2, created the opportunity to systematically examine why different paddocks tend to perform better or worse in terms of lamb survival to docking and why the performance might vary from year to year.

Visual assessment of the significance by area of various paddock features (e.g. the percentage of a paddock that has slope >26%, or the percentage of a paddock that is protected from the 'killer wind' by way of contour/aspect) was sometimes quite difficult. There may be a role here to aid assessment through the use of technologies (e.g. terrain models, 3-D visualisations) in the future.

The relationship between lamb survival to docking in 2006 and, respectively, the physical features (slope + hazards) of the paddock, and the combined features that contributed to the paddock score (slope + hazards + disturbance + wetness + wind), are presented in Figures 1a and 1b. As the paddock score increased, the suitability of that paddock for lambing declined. Adding wetness and a wind chill factor in 2006, however, weakened the relationship (Fig. 1b). This may be due in part to the mild climatic conditions that prevailed across the participating farms in 2006, despite significant altitude (sea level to 550 m above sea level) and distance separation (70 km). The number of days in spring when the calculated wind chill factor could have caused hypothermia varied from only 4 to 10 days across the participating farms that year. In fact, a feature of the 3 years (2005-2008) that lambing data were collected was the favourable weather conditions that prevailed each spring, although ewes endured the wettest winter in 30 years in 2006 and ewe condition was compromised in spring 2007 by dry conditions that prevailed throughout much of the previous summer and autumn. Had "average" weather conditions prevailed, the paddocks with the higher scores could be expected to have lower docking percentages.

When all the lamb docking data (2005-2008) were pooled, the relationship between the paddock score (slope + hazards +disturbance + wetness + wind) and lambs docked was poor and not significant ($y = -0.983x + 181$; $R^2 = 0.186$). Three factors are likely to have influenced this result. First we used 'average'

weather data in three mild springs so lamb losses due to wetness and wind chill were probably lower, even in paddocks with a poor history of lamb survival. Secondly, most farms did not scan for triplets, so actual lamb losses may have been higher than calculated on some paddocks since we used 200% scanning. Finally, for any paddock score, docking percent varied by at least 20%. Increasing the number of paddocks in the study would have helped strengthen the relationship especially with mild spring conditions. Only environmental factors are examined here.

Land assessment tool

The land assessment tool (LAT) developed in this study provides a stepwise basis for separating the effect of physical environment (i.e. slope and hazards) from the impacts of the weather conditions (i.e. wetness and wind) prevailing over a particular lambing. For example, is there merit in re-aligning fences to remove hazards, employing temporary fencing to remove steep faces, planting shelter trees or lambing on the safest country (identified by the LAT approach) for improved lamb survival? The same question can be asked of shedding out ewes and lambs immediately after lambing as McMillan & Knight (1985) found no effect of slope on lamb survival when the ewes and lambs were transferred to 36-40° slopes 24 hours after birth of the lambs on flatter, more favourable terrain.

Returns from lamb survival

To achieve a 25% return on investment (ROI) for every $10,000 invested in improving the lambing environment, the lamb wastage rate must decrease by 2% (to 20%) on the model 400 ha farm carrying 2200 MA ewes. This is assuming an average lamb value at weaning of $1.30/kg live weight and corresponds to a lambing percentage of 132% (plus 3%). $10,000 was used as an investment figure as it represents a significant investment to be made in addressing environmental and management factors. It is sufficient to perhaps undertake either 1 km of conventional fencing, 2 km of drainage, or 500 spaced plantings. Whilst not accounting for the cost of capital, the farmer could expect to recoup the investment made over 4 years (based on a nominal ROI of 25%). Using the paddock score and lamb docking percentage relationship in 2006 (Fig. 1a), by reducing the paddock score by 10 (as a result of the improvements made), we could expect an increase in lamb survival of approximately 10%. This provides one example of how the LAT can be utilised by farmers to prioritise on-farm development and investment decisions. The LAT can also be used in a diagnostic mode, assisting for example in identifying paddocks with low scores, but with below average lambing percentages.

Conclusions

A landscape assessment tool has been developed that allows farmers to objectively assess the risk of lambing multiple bearing ewes in particular paddocks on their farms. By qualifying the physical characteristics of a paddock, farmers are able to adopt alternative management plans or alter the environment to improve lamb survival and hence farm profitability. Increasing the survival of lambs from multiple bearing ewes will increase returns and addresses, at the same time, animal welfare issues that have the potential to cause major difficulties (trade barriers) in affluent overseas markets.

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