Controlling pasture quality on hill country – key decisions and techniques

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Abstract

The control of pasture quality over spring is central to the achievement of high levels of animal performance on hill country. Despite this, little is known about how farmers actually manage pasture quality. This paper describes how a high performing hill country farmer manages pasture quality on his sheep country over spring. The study highlights that to control pasture quality on sheep country requires farmers to make important strategic and tactical decisions. Strategic decisions should be made that result in a system that matches feed supply with pasture growth over the spring and maintains high grazing pressure so that average pasture cover levels do not exceed 4.0 cm or 1200 kg DM/ha and seedhead development is minimised. Key decisions in this area include choice of lambing date, stocking rate, sheep performance levels, pasture cover at set-stocking, stock purchase and sale dates, shearing policy and weaning date. Equally important are the tactical decisions designed to minimise within- and between-block variation in pasture cover levels about the 1200 kg DM/ha (4.0 cm) target during mid- to late-spring. Key tactical decision areas include: (1) ensuring the correct distribution of pasture cover at set-stocking, (2) setting stocking rate and pasture cover levels at set-stocking for the different sheep mobs that best match feed demand to pasture growth, (3) integrating cattle to help control the steeper contour sheep paddocks through spring and (4) using fortnightly monitoring and micro-budgeting to better match feed demand with feed supply.

Additional key words: strategic, tactical, management, farmer knowledge

Introduction

Pasture quality is an important determinant of animal performance on hill country (Sheath et al., 1984; Lambert et al., 2000; Litherland and Lambert, 2000). Central to the maintenance of pasture quality is the control of the spring surplus (Sheath et al., 1984). Poor pasture management over spring can result in low utilisation and high pasture cover levels that consequently lead to high levels of dead matter and reproductive stem and low pasture quality (Hodgson, 1984; Francis and Smethan, 1985; Litherland et al., 2002). This in turn will influence liveweight gain, milk and fibre production and the health and reproductive performance of livestock (Lambert and Litherland, 2000). Failure to control pasture over spring can also result in poor pasture

regrowth during summer and autumn (Korte, 1982; McDonald, 1984) and reversion to inferior pasture species (Sheath et al., 1984). Analysis by Webby and Sheath (2000) using the simulation model Stockpol showed that improving pasture quality on a sheep farm is worth $53 - $148/ha.

Much has been written about pasture quality (Sheath et al., 1984; Francis and Smetham, 1985; Butler et al., 1987; Lambert and Litherland, 2000; Webby and Sheath, 2000) and decision-support models have been developed to help farmers incorporate pasture quality into their decision-making (Woodward et al., 2000). However, despite the importance of spring pasture management to the control of pasture quality on hill country, little is known, with the exception of the recent work by

Lambert *et al.* (2000), about how farmers manage this period of the year. Anecdotal evidence suggests that high performing farmers use a plethora of techniques to manage pasture quality over the spring. Through use of rigorous qualitative analysis techniques to describe the management decisions made by a high performing hill country farmer, this paper seeks to capture in a form that can be passed on to other farmers, those decisions critical to the maintenance of pasture quality over spring. This paper describes the management decisions made by a high performing hill country farmer that were critical to the maintenance of pasture quality on his sheep country over spring.

Method

A single-case study design (Yin, 1993) was used to investigate the decision-making processes used by a hill country farmer who achieved levels of physical and financial performance that were consistently in the top 10 % for his land class. Farm management consultants were used to select this "expert" farmer. Semi-structured interviews and field observations (Gray, 2001) were used to collect data on the case farmer's decisions over two years. Interviews were transcribed verbatim to minimise bias (Denzin, 1989) and then the transcripts were analysed using qualitative data analysis (Dey, 1993; Miles and Huberman 1994). A model of the case farmer's decision-making processes was derived from the data, verified and then compared with the literature.

Results and Discussion

The case farmer operates a 657 ha semi-finishing, summer-wet, hill country property south-east of Pahiatua. The farm comprises 30 ha of flats, 50 ha of rolling, but cultivatable land, 120 ha of uncultivable easy hills and 457 ha of steep hill country. It is classified as a summer-wet semi-finishing farm because of its steeper contour and average rainfall of 1500 mm per annum. The farm has Olsen P levels

between 15-25 with soil pH between 5.4 – 5.9. Estimates suggest the farm grows around 9500 kg DM/ha/yr and stock consume 8000 kg DM/ha/yr. In 2002/03 the property wintered 3775 ewes, 1215 ewe hoggets, 203 R1yr bulls and 365 R2yr bulls at an overall stocking rate of 11.8 su/ha. Sheep comprise 61 % of the total stock units run on the property. The farm has achieved lambing percentages of 140 %, 132 %, 153 %, 146 % and 139 % over the last five years. Physical and financial performance for the year prior to the study is summarised in Table 1. Pasture quality measures for late spring are high and summarised in Table 2.

To ensure high feed quality on his sheep country over spring, the case farmer aims to maintain pastures in an actively growing vegetative state. This is achieved by keeping average pasture cover at or below 4.0 cm sward height or 1200 kg DM/ha (based on a winter calibration[1]) (Figure 1) from set-stocking (early September) to weaning (early January). At this sward height, animal performance is optimised whilst seedhead formation is minimised. Farmers in a study by Lambert *et al.* (2000) also stated that keeping pastures short during spring delayed the decline in pasture quality, however, no average pasture cover levels were specified. Hodgson and Maxwell (1983) advocated maintaining pastures at 1200 – 1500 kg DM/ha during late spring to maximise lamb growth per hectare on perennial ryegrass, white clover pastures in Great Britain. New Zealand studies of singleton-, twin- and triplet-bearing/rearing ewes (Parker and McCutcheon, 1992; Morris *et al.*, 1993; Morris *et al.*, 2003) have shown that lamb growth rates over lactation can be optimised at sward heights of no more than 4.0 cm. In their study, Morris *et al.*, (2003) estimated that the average herbage mass on their 4.0 cm sward height treatment over spring was 1174 ± 67 kg DM/ha. Theoretically, increase in pasture ME value from 10.5

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[1] The farmer does not adjust his pasture height calibration for season.

MJ/kgDM to 12 MJ/kgDM will improve growth rates of lambs from 140 g/day to 180 g/day (Matthew, 2004).

Table 1. A comparison of the case farmer's physical and financial performance to district data[1] for the 2001/02 year.

Performance measure	Case farm	District average	Top 10%
Net production/ha (kg CW)	304	243	290
Lambing %	153.4%	128.6%	133%
Wool/ssu (kg/ssu)	5.1	5.4	5.5
Wool/ha (kg/ha)[2]	56	55	67
Stock units/ha	11.1	10.3	12.1
Revenue/sheep su	$86.06	$81.78	$89.15
Revenue/cattle su	$116.25	$73.60	$117.46
Gross farm revenue/su	$98.97	$80.68	$96.13
Gross farm revenue/ha	$1,094	$833	$1,159
Standard expenses/su	$32.03	$43.12	$37.24
Standard expenses/ha	$354	$445	$449
Economic farm surplus/su	$63.18	$33.45	$52.76
Economic farm surplus/ha	$698	$345	$636
Return on capital	14.6%	7.9%	9.9%

[1] Data obtained from Baker & Associate's Farm Analysis Bureau.
[2] Wool/ssu multiplied by stocking rate.

Table 2. Average pasture quality measures (and range) for late spring on the case farm.

Month	November		December	
% Crude protein	21.3	(17.8 - 27.2)	19.8	(13.9 – 24.1)
% OMD	82.1	(79.1 - >85)	80.8	(77.3 – 84.5)
ME (MJ/kg DM)	11.5	(10.8 – 12.3)	11.2	(10.8 – 11.6)

The case farmer maintains average pasture cover at or below 4.0 cm or 1200 kg DM/ha (Figure 1) during spring by ensuring a high feed demand that matches pasture growth (Figure 2). The case farmer has designed a high stocking rate (11.8 su/ha), high performance (140 – 150 % lambing), later lambing (20th September) sheep system to best match feed demand with spring pasture growth. The manipulation of summer-autumn stock sales, the application of autumn nitrogen (25 kg N/ha) and later lambing allow the case farmer to carry a high stocking rate through winter. The case farmer stressed the importance of a high lambing percentage in ensuring high spring feed demand. Feed demand is further increased through hogget lambing (October 1st) and the purchase of 300 yearling cattle of which a proportion are run on the sheep country. Stock sales (cattle, cull ewes and hoggets) and weaning date are delayed to maintain grazing pressure until the sward returns to a vegetative state. Similarly, ewes and lambs are not shorn in the spring so that grazing pressure is maintained while the sward is in a reproductive state.
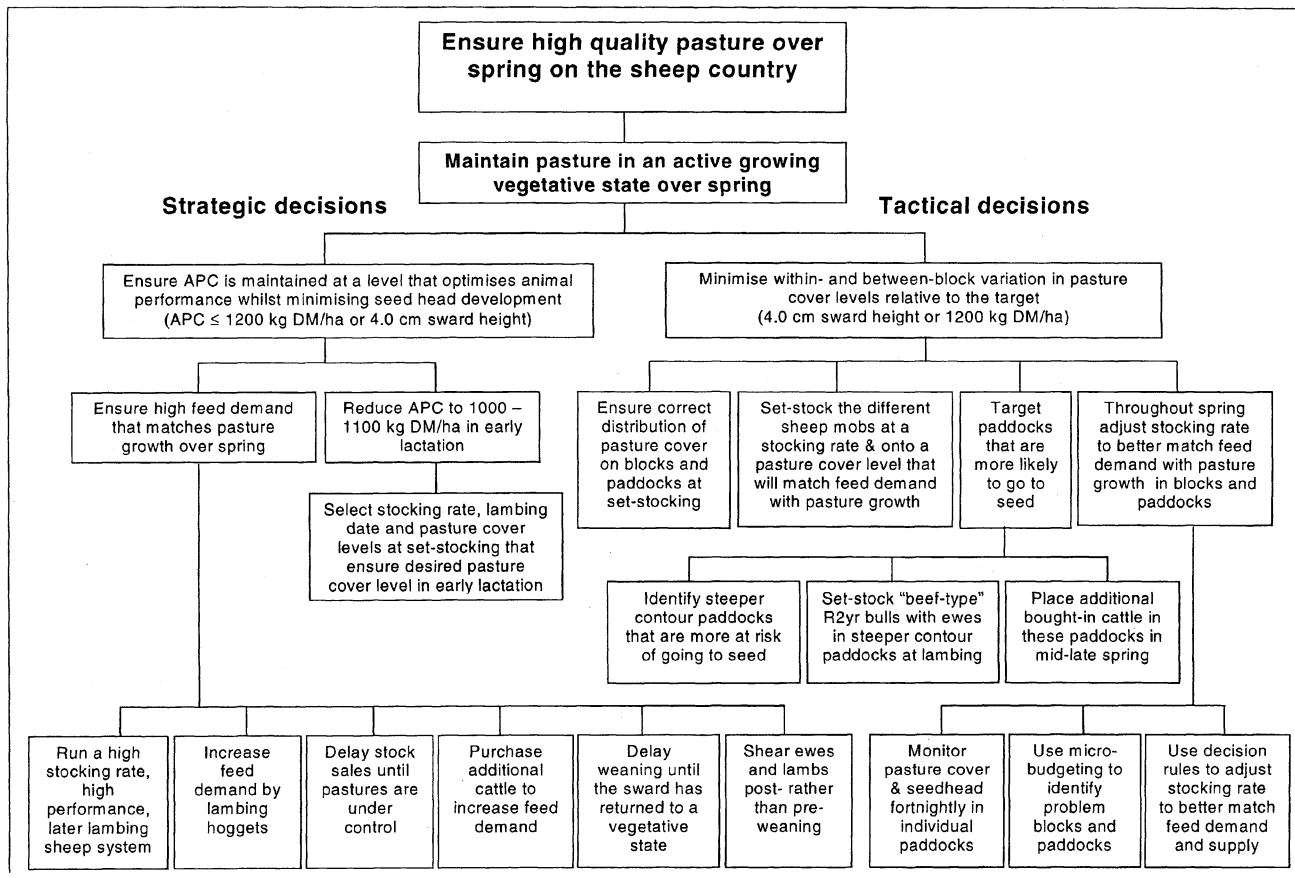
Figure 1. Methods used by the case farmer to ensure high quality pasture over spring. APC = annual pasture cover

Trial work (Francis and Smetham, 1985) and modelling studies (Bircham, 1983; Gray, 1987) have shown the importance of matching feed demand to pasture growth on hill country to control pasture quality. Similarly, Lambert *et al.*, (2000) reported that farmers manipulate whole-farm feed demand throughout the year to match pasture growth and control pasture quality. Bircham (1983) suggested the adoption of more prolific sheep breeds and Gray (1987) advocated the development of a high performing sheep system to better match feed demand to pasture growth on hill country. Farmers have also adopted these strategies to control pasture quality (Lambert *et al.*, 2000). Nitrogen has long been advocated as a means of improving hill country winter stocking rates (Lambert and Clark, 1986) and later lambing has been recommended to better match pasture growth to feed demand during lactation (Bircham, 1983). Later weaning and the manipulation of cattle sales and purchases have also been advocated to better match feed supply and demand (Bircham, 1983). Again, such strategies have been adopted by farmers to control pasture quality on hill country (Lambert *et al.*, 2000).
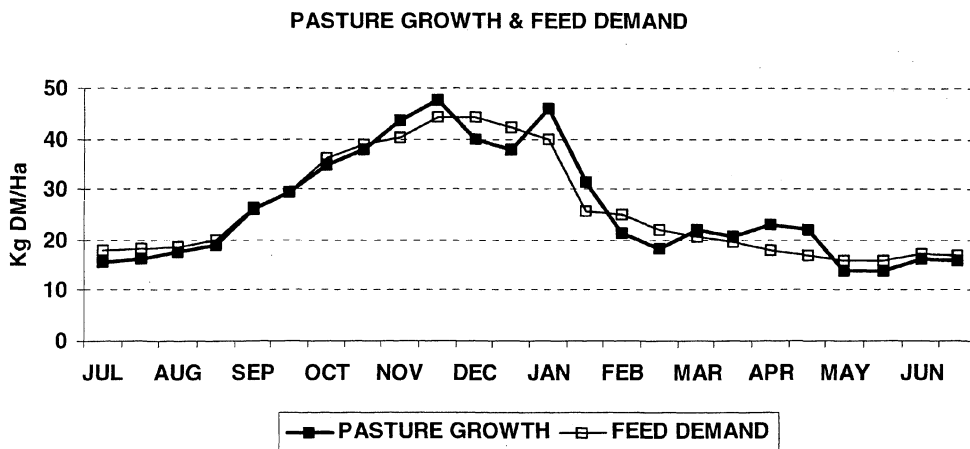
PASTURE GROWTH & FEED DEMAND

Figure 2. Pasture growth and feed demand.

The case farmer also aims to reduce average pasture cover to a target level of 1000 – 1100 kg DM/ha in early lactation to ensure that it does not exceed 4.0 cm or 1200 kg DM/ha in mid- to late-spring (Figure 1). To do this the case farmer selects an average pasture cover level at set-stocking, and a stocking rate and lambing date (20th September) that has a feed demand pattern relative to pasture growth that will reduce average pasture cover to the desired level in early lactation. These pasture cover targets are designed to ensure that the sheep are adequately fed in early lactation whilst minimising future pasture quality problems in late spring. Lambing late, just before spring pasture growth rates increase rapidly, allows the farmer to reduce average pasture cover to 1000 – 1100 kg DM/ha without deleterious effects to animal performance. In a modelling study, Bircham (1983) showed that maintaining pasture cover above 1000 kg DM/ha was critical for ensuring

that pasture growth, pasture intake and liveweight gain of ewes and lambs were not restricted over spring. Korte (1982) demonstrated that hard grazing in spring produced more green leaf and less dead matter over the summer.

Decisions such as the choice of stocking rate, lambing date, sales policy and stock performance levels are strategic in nature. However, the case farmer makes a range of tactical decisions that are important to maintaining pasture quality on the sheep country (Figure 1). The primary aim of these tactical decisions is to minimise within- and between-block variation in pasture cover levels in relation to the target of 4.0 cm sward height or 1200 kg DM/ha (Figure 1). This is achieved by firstly ensuring that there is the correct distribution of pasture cover on the different blocks (e.g. triplet-, twin-, and single-bearing ewes, late lambing ewes, dry hoggets, lambing hoggets) within the sheep country at set-stocking. Failure to achieve this will result in a deterioration in pasture quality in some blocks whilst stock in other areas will be underfed during the spring. The case farmer monitors the distribution of feed on the farm during the winter and makes some estimate, given likely pasture growth rates, of the distribution of feed at set-stocking. This is then compared to the planned distribution and stock rotations are manipulated to ensure the desired feed distribution is achieved. This process is repeated every 2 – 4 weeks and then more frequently as set-stocking approaches.

Also, the case farmer minimises within-block and between-block variation in pasture cover levels by set-stocking the different sheep mobs (e.g. triplet-, twin- and single-bearing ewes, late ewes, lambing hoggets, dry hoggets) at a stocking rate and onto a pasture cover level that will match feed demand with pasture growth. Adjustments are made primarily on the basis of lambing date and bearing rank (Table 3). Further refinements to stocking rate are made to allow for differences in paddock pasture cover levels and productivity. Korte's (1982) research showed that set-stocking or fast rotations were the best method for controlling reproductive growth in spring. With further research in the intervening years, it is now understood that set-stocking or a fast rotation maximises animal intake and reduces the impact of spring-surplus growth. Although the case farmer set-stocks his multiple-bearing ewes on easier contour paddocks, this is undertaken to enhance lamb survival rather than for pasture quality reasons.

Table 3. Pasture cover levels and stocking rate for ewes of different bearing rank.

Ewe Bearing rank	Pasture Cover at Set-stocking (kg DM/ha)	Stocking rate (head/ha)
Triplet-bearing ewes[2]	1300	2.2
Triplet-bearing ewes[3]	1300	6.5
Twin-bearing ewes	1100 - 1200	9.5
Single-bearing ewes	1000	11.0
Late ewes – single-bearing	1000	11.5
Late ewes – twin-bearing	1000	10.0
In-lamb hoggets	1200	11.5
Dry hoggets	1000	15.5

[2] These ewes are on the cattle block until docking, after which they join the triplet bearing ewes on the sheep block which is then stocked at 9.0 ewes/ha.
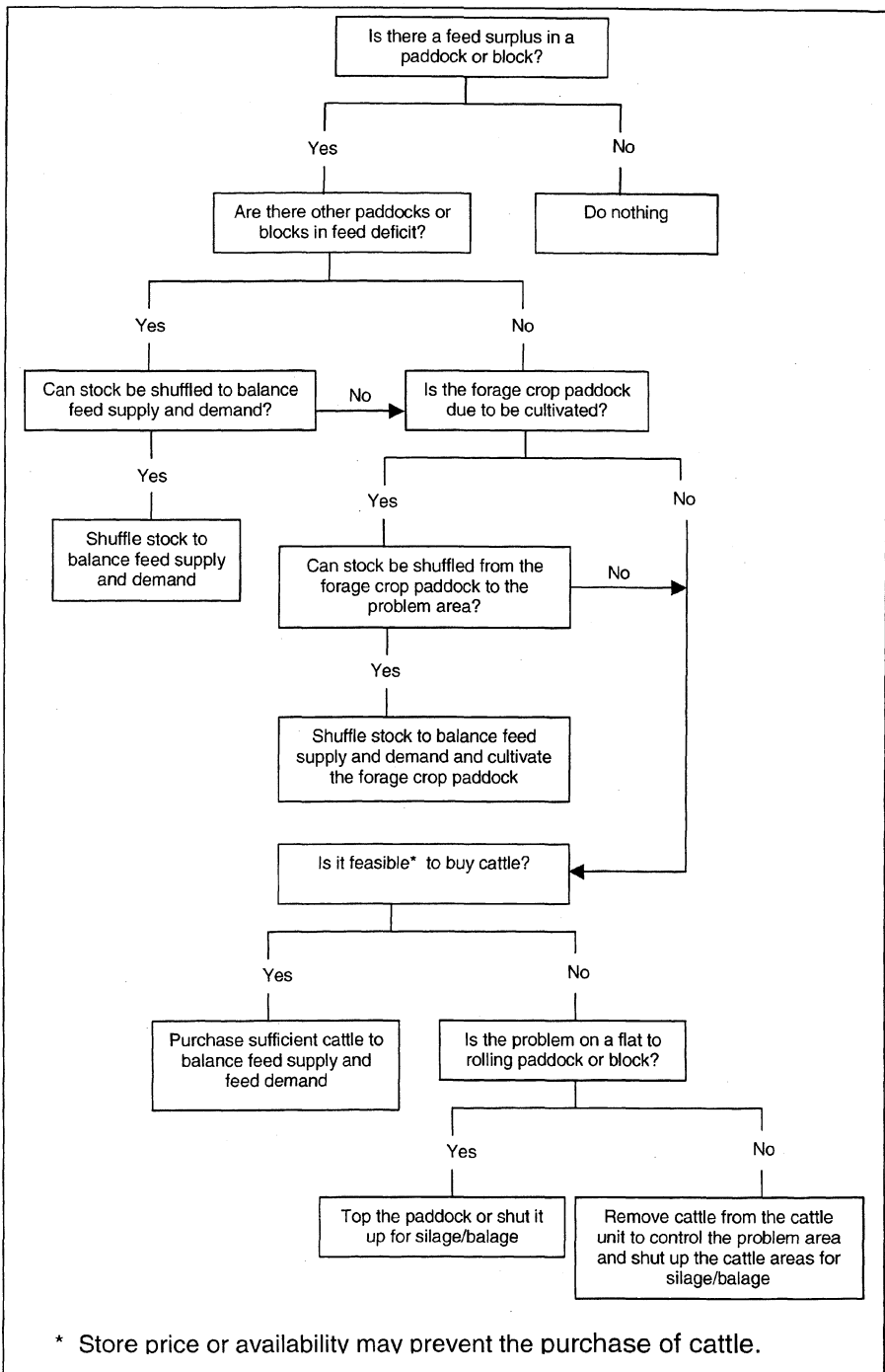[3] These ewes are on the sheep block.

Figure 3 : Decisions tree for pasture quality control for individual paddocks

Within- and between-block variation is also minimised by targeting paddocks that are more likely to go to seed (Figure 1). These are normally the steeper contour paddocks and they are controlled by set-stocking older cattle with the ewes (Figure 1). These cattle graze the bottom of slopes and the longer and poorer quality pasture that is avoided by sheep. During mid to late spring, feed demand in these paddocks is further increased through the introduction of additional bought-in cattle. Sheath *et al.*, (1984) advocated the preferential control of steeper hill country over the late spring because pasture on this class of land deteriorated more quickly than that on less steep country. Suckling (1975) reported that a major benefit of cattle was the improvement in pasture quality over late spring and Cazacarra and Petit (1995) demonstrated that older cattle are less selective grazers than younger cattle. McCall (1994) also discussed the benefits of cattle on hill country and concluded that their major benefits were through improving clover content, reducing selectivity and increasing grazing pressure. The farmers in Lambert *et al.*,'s (2000) study emphasised the importance of integrating sheep and cattle to control pasture quality.

The primary means by which the case farmer minimises within- and between-block variation in pasture cover levels (Figure 1) is through the tactical use of a micro-budgeting approach (Gray *et al.*, 2003). The case farmer monitors pasture cover levels and seedhead development in each paddock on the sheep block at fortnightly intervals. This frequency of monitoring is used because of the high variability of pasture growth rates over the spring. Pasture cover is estimated visually because time constraints[4] prohibit the use of a rising plate meter. Pasture cover information is used in conjunction with a "micro-

budgeting" technique (Gray *et al.*, 2003) to forecast the likely match between feed demand and pasture growth in each paddock on the sheep block over the next two weeks. The case farmer uses a set of decision rules (Figure 3) to determine what to do if the micro-budget forecasts a likely feed surplus in a paddock or block of paddocks. Other studies have reported the importance of the timing of decisions in relation to pasture quality and the role of monitoring and planning in this process (Lambert *et al.*, 2000), but little detail is provided on how this is achieved.

Summary and conclusions

The study highlights that to control pasture quality on hilly sheep pasture requires farmers to make important strategic and tactical decisions. Strategic decisions should be made that result in a system that matches feed supply with pasture growth over the spring and maintains high grazing pressure so that average pasture cover levels do not exceed 4.0 cm sward height or 1200 kg DM/ha and seedhead development is minimised. Key decisions in this area include choice of lambing date, stocking rate, sheep performance levels, pasture cover at set-stocking, and stock purchase and sale dates, shearing policy and weaning date. Equally important are the tactical decisions designed to minimise within- and between-block variation in pasture cover levels about the 4.0 cm sward height or 1200 kg DM/ha target during mid to late spring. Key decision areas include: ensuring the correct distribution of pasture cover within- and between-blocks at set-stocking, setting stocking rate and pasture cover levels for the different sheep mobs at set-stocking that best match feed demand to pasture growth, and using cattle to help control the steeper contour sheep paddocks through the spring. Central to the control of pasture quality through the spring is frequent monitoring and the use of micro-budgets and associated decision rules to

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[4] Estimates by the authors suggest that to formally plate meter the case farm would take 1 - 2 days.

better match feed demand and pasture growth at the paddock and block level.

This study highlights that the control of pasture quality on hill country is complex and that there is no straight forward solution. Farmers have to make a range of important decisions both at the strategic and tactical levels to ensure they maintain pasture quality. The strategic decisions made by the case farmer are similar to those proposed in the literature. Similarly, decision support tools such as Stockpol (Webby and Sheath, 2000) can help farmers make better strategic decisions in relation to pasture control. However, tactical decisions are equally important, particularly given the variation in pasture growth rates experienced on hill country during the spring. This topic has had limited research and few decision support tools exist that can help farmers in this area.

Acknowledgement

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