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The impact of lamb growth rate pre- and post-weaning on farm profitability in three geo-climatic regions

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Abstract

Sheep and beef farmers target an increase in lamb growth rates as a means of increasing on-farm profit. Increasing any performance parameter invariably increases feed demand, resulting in either a need to increase feed supply or reduce feed demand in some other area of the farm system, therefore potentially affecting profit. A whole-farm-system model was used to assess the impact of increasing lamb weaning weight and post-weaning growth rate on farm profit and enterprise selection of three farms from three regions (Otago, Gisborne and Northland). Farm profit did not always increase with an increase in weaning weight or post-weaning growth rate. Farm profit was highest in the cool temperate region when weaning weight was at the base weight (27 kg) and post-weaning growth rate was 75 g/d greater than current. Farm profit was highest in the dry temperate region when weaning weight was 32 kg (6 kg above the base weight) and post-weaning growth rate was 50 g/d greater than the base growth profile. In the warm, temperate region, farm profit was highest at the two extremes, the highest weaning weight (30.6 kg) and post-weaning growth rate profile (100 g/d greater than the base profile) and at the lowest weaning weight (24.6 kg) and post-weaning growth rate profile (50 g/d less than the base profile). This demonstrates the interactions and trade-offs between feed supply and lamb growth rate on farm, and highlights that increasing lamb liveweight gain does not necessarily equate to increased profit.

Keywords: lamb; growth rate; farm profitability; farm system

Introduction

The profitability of a farm system is intrinsically tied to the efficiency at which the base farm resources are used to create saleable product. Farmers can increase the volume of saleable product by a variety of means in an attempt to increase farm profit. However, determining the impact of any single factor on profitability is difficult (Morel and Kenyon 2006). In a situation where feed supply is fixed, increasing performance in one area may reduce performance in another, with potentially unknown effects on profit.

Increasing the performance of the lamb flock through faster pre- and post-weaning growth rates is generally encouraged, as lamb growth rate is perceived to be related to farm productivity and profit (McIvor and Aspin 2001). This drive to increase lamb growth rates is derived from three main factors. First, higher schedule prices occur earlier in the season, encouraging farmers to finish lambs as quickly as possible to achieve higher premiums; second lambs that are grown faster are more efficient at using the resource, as more energy goes towards growth rather than maintenance (Brown 1990); and finally, over recent decades, increased carcass weights have been encouraged by rising market premiums for heavier carcasses (Cocks and Brown 2005). Continuing to increase liveweight gain may not necessarily result in improved profitability at the whole-farm level. At a fixed feed supply, farmers have to decide where the "best bang for their buck" is, as they cannot always increase animal performance at all levels.

A farm-systems analysis was carried out on three current farming operations to assess the impact of changes in pre- and post-weaning lamb growth rates on farm profitability and farm enterprise selection.

Methods

A farm-systems analysis was used to investigate the potential impacts of increasing lamb liveweight gain pre- and post-weaning on both the profitability and livestock configuration of farm systems. The data from three sheep and beef Landcorp Farming Ltd properties in three distinct New Zealand geo-climatic regions were used (cool, moist temperate (Otago, 1280 ha), warm, dry temperate (Gisborne, 3136 ha) and warm, wet temperate (Northland, 1159 ha)). Whole farm scenarios of variability in pre- and post-weaning lamb growth rates were investigated using a response surface approach.

Farm-system analyses were performed using INFORM (Integrated Farm Optimisation and Resource allocation Model) (Rendel et al. 2013), a linear programming model that maximises EBITDA (Earnings before interest, tax, depreciation and amortization), by optimising resources over a one-year timeframe. INFORM is a single-year steady-state model. The model solves the complicated process of managing pasture cover by suggesting the sale and purchase of prime or store livestock and the number and species of capital stock to use. It can chose from a range of sheep and beef enterprises, both breeding and finishing or any combination of these. It selects the most profitable option according to the inputted performance levels and feed supply. INFORM can utilise a number of land-management units and operates in fortnightly time steps. A land-management unit is considered to be an area of land on the farm that has similar physical characteristics such as pasture growth.

Lamb weaning weight for each model was increased in 1-kg increments up to 6 kg from the current farm performance, termed as the "base" values (Table 1). For

Table 1 Lamb weaning weights (kg) for three sheep and beef Landcorp farms modelled in Otago, Gisborne and Northland and seven 1-kg incremental theoretical variations on weaning weight that were modelled to assess the impact on farm profit.

	Otago	Gisborne	Northland
Base weight (kg)	27.0	26.0	24.6
+1 kg	28.0	27.0	25.6
+2 kg	29.0	28.0	26.6
+3 kg	30.0	29.0	27.6
+4 kg	31.0	30.0	28.6
+5 kg	32.0	31.0	29.6
+6 kg	33.0	32.0	30.6

each of these 1-kg increments in lamb weaning weights, seven post-weaning lamb growth rates were also used creating a total of 49 models for each farm modelled. Post-weaning growth rates were adjusted in 25 g/d increments with two growth rates below and four above the currently achieved profile (base). Incremental changes in growth rates were applied evenly across the fortnightly periods within the models using the same base growth profile as experienced on the current farms in 2014-15. This resulted in minimum growth rates of 0, 40, and -30 g/d and maximum growth rates of 305, 220, 330 g/d for the Otago, Gisborne and Northland farms respectively, in any single fortnightly period.

Base farm and animal production parameters and costs are presented in Table 2 and were based on data provided by Landcorp Farming Ltd. (Due to space requirements not all parameters are reported). Pasture growth rates (Figure 1) were also taken from the provided data, while pasture quality (Figure 1) was based on the profiles from Litherland et al. (2002).

A fortnightly price schedule for a 12-month period was developed for prime lamb and beef using the 2014 data from www.interest.co.nz (Interest 2015a, Interest 2015b, Interest 2015c). Separate schedules were developed for the North and South Island using the published pricing. Adjustment factors for fortnightly pricing across the year for all carcass grades were assumed to be the same as those for the prime carcass grades (Y lamb and P2 Steer), also obtained from www.interest.co.nz.

Table 2 Effective area and number of land management units per farm, per enterprise (includes costs associated with livestock recording, professional services, stationary, office supplies and subscriptions, and communications and travel), hectare (includes costs associated with dogs and horses, weed and pest control, amenity planting and shelter belt maintenance, pasture maintenance, urea, lime and fertiliser application, freight, farm stores, repairs and maintenance, rates and other financial costs) and animal costs (includes costs associated with animal health, breeding, shearing, salaries, casual wages, ACC levies, electricity and vehicle fuel), and animal reproductive performance parameters for the three sheep and beef Landcorp farms modelled in Otago, Gisborne and Northland.

Parameter	Otago	Gisborne	Northland
Area (ha)	1280	3136	1159
Number of Land Management Units	2	2	3
Per enterprise cost ($)	15889.60	22937.70	12104.80
Per hectare cost ($)	164.53	169.00	233.86
Per ewe cost ($)	26.79	22.50	37.58
Per lamb cost ($)	11.48	7.05	10.10
Per cow cost ($)	36.34	26.33	32.47
Per finishing cost ($)	26.24	26.33	39.67
Ewe pregnancy scanning %	179	177	171
Lambing date	08-Oct	12-Sep	17-Aug
Lamb weaning %	142	142	135
Lamb death rate post-weaning (%)	2	2	5
Calving date	07-Oct	16-Oct	12-Sep
Calf weaning %	84	81	90
R1yr death rate (%)	1	1	3

Results

Increasing lamb weaning weight on the Otago farm did not increase farm EBITDA (Figure 2a), with the highest weaning weight for any given post-weaning growth rate having the lowest farm EBITDA. Increasing post-weaning growth rate resulted in increased EBITDA for any given weaning weight. However the highest post-weaning growth rate did not return the highest EBTIDA. The most profitable combination was a lamb weaning weight of 29 kg with a post-weaning growth rate that was 75 g/d higher than the base. Increasing lamb weaning weight led to decreased numbers of breeding ewes and store lambs bought while increasing the number of breeding cows. It is important to note that the model controls the number of animals selected to maximise profit including capital stock and the number of store stock brought and sold. Lamb post-weaning growth rates lower than current growth rates resulted in the model selecting an all-cattle system. Lamb post-weaning growth rates higher than the current resulted in more capital ewes at the expense of cattle and purchased store lambs.

On the Gisborne farm, increasing lamb weaning weight above the base weight of 26 kg increased EBITDA (Figure 2b) but did not alter the number of breeding ewes or cows. Decreasing post-weaning lamb growth rates from the base resulted in all lambs being sold store rather than prime and the model switching to a cattle-dominated system, with the exception being when the lamb weaning weight was at its highest (32 kg). Increasing post-weaning lamb growth rates by +25 to +75 g/d from the base dramatically increased EBITDA. Breeding ewe numbers also increased with increasing post-weaning lamb growth rates, while breeding cow numbers declined. The number of store lambs purchased increased significantly with increasing post-weaning lamb growth rates, resulting in more lambs being sold prime as opposed to store. When post-weaning

Figure 1 Pasture growth rates for developed and undeveloped hill country land management units and pasture quality for the three sheep and beef Landcorp farms modelled in Otago (a), Gisborne (b) and Northland (c).

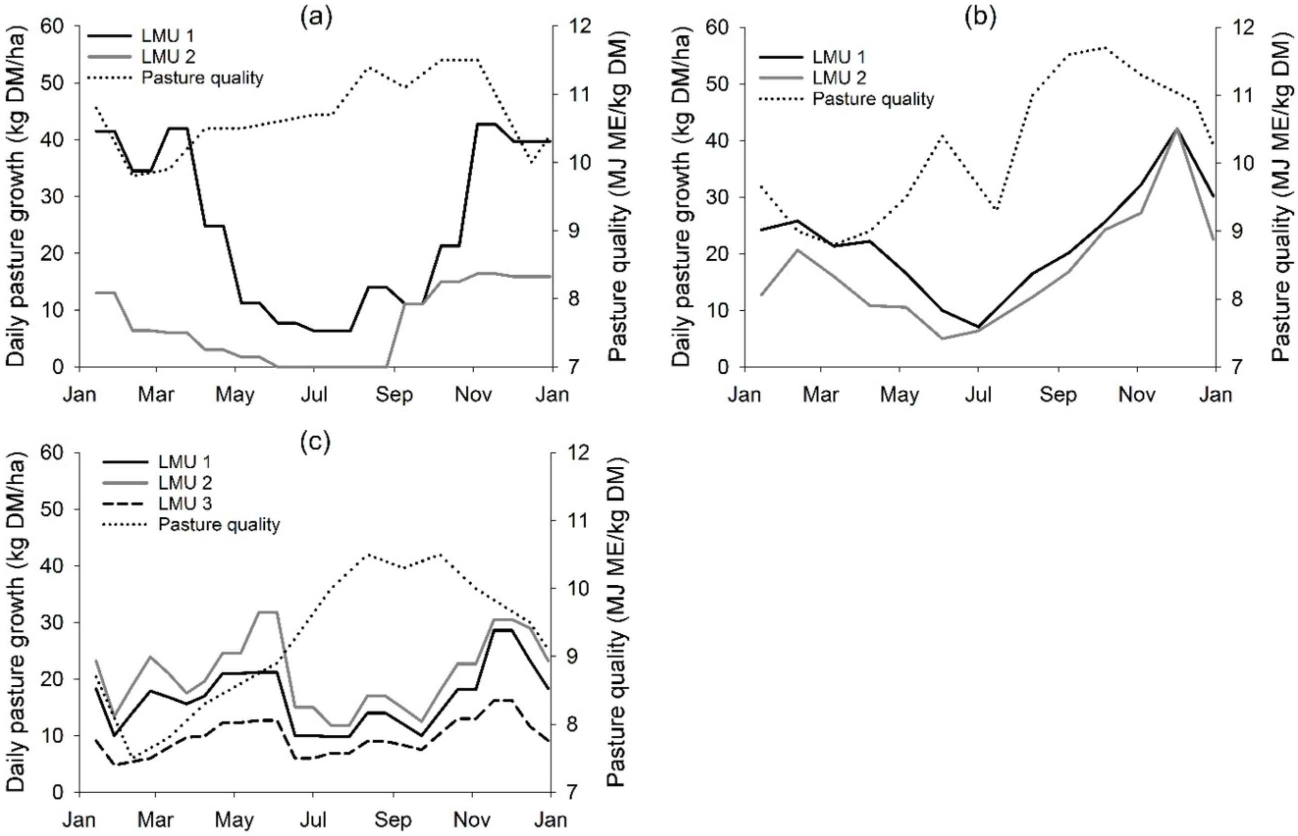
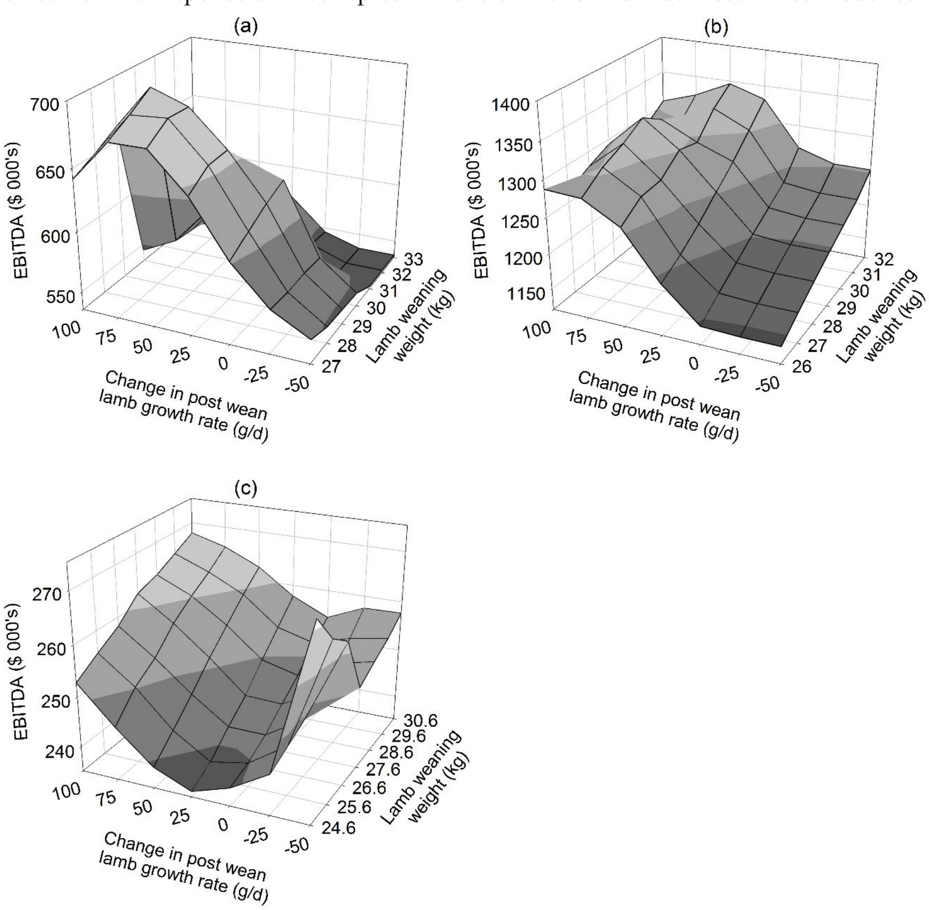


Figure 2 Effect of lamb pre- and post-weaning growth rates on farm earnings before interest, taxation, depreciation and amortization (EBITDA) for the three sheep and beef Landcorp farms modelled in Otago (a), Gisborne (b) and Northland (c). Each corner of each cell on the response surface represents one of the 49 individual scenarios modelled for each farm.



lamb growth rates were high, the model determined that all of the lighter home-bred lambs should be sold at weaning into the store market, and heavier store lambs purchased to finish for slaughter.

The highest EBITDA on the Northland farm occurred when both the lamb weaning weight and the post-weaning lamb growth rates were at the lowest values. At these values the model reduced breeding ewe and cow numbers significantly and purchased a large number of store lambs. This increased the efficiency of the system by diverting feed resources used for maintenance of capital livestock to growth of finishing animals. At low weaning weights and post-weaning growth rates, EBITDA was very sensitive to changes in these parameters. An increase of 25 g/d from -50 g/d resulted in EBITDA dropping significantly by approximately $30,000 when lamb weaning weight was 24.6 kg. At post-weaning lamb growth rates at or above the base, EBITDA increased incrementally with increasing lamb weaning weight. High weaning weights were also associated with lower breeding ewe numbers and higher numbers of lambs sold store.

Discussion

The outcomes reported here are the optimised results for each scenario producing the maximum profit. Theoretically, there could be many other variations to these systems that result in profit that is lower by only a small increment, but these are never shown or known. What we have demonstrated here is the trend in profit with changing pre- and post-weaning lamb growth rate at a fixed feed supply and we have discussed the resulting enterprise changes to achieve these profit margins.

What must also be taken into consideration is that the response surfaces demonstrated here are the results of the model that operates as a complex physical system (restricted to physical parameters only). In reality, farming systems are complex adaptive systems whereby the farmers learn and adapt their behaviour according to prior experiences.

Profitability was driven primarily by enterprise selection, based on feed demand and supply profiles. When pre- and post-weaning lamb growth rates were high, and feed supply was not adequate to support this, the models switched to enterprises with less demand during these periods. For example, in the cool moist temperate (Otago) scenario, when weaning weight increased beyond 30 kg and post-weaning growth rate was at or above 75g/d above the base, the system switched to a cow breeding dominated system by decreasing ewe numbers as feed demand was lower during the summer and autumn, with the majority of calves being sold store. In an optimised system where the feed supply is fixed, the extra energy required to increase liveweight gain must be substituted from another area. In this case the model compensates for the increased liveweight gains of the lambs by adjusting capital stock numbers or altering enterprise configurations. This changes the proportion of the total feed supply being feed to growing stock rather than capital stock. In reality many farmers have a buffer of feed built into their systems as they cannot afford to run an optimised system where all grown feed is consumed every fortnight as they do not know what the “future may hold”. In good seasons this allows for faster growth rate by having more feed on hand, conversely in poorer seasons if stocking rate has not been adjusted growth rate or some other livestock performance parameter will be reduced.

The purchasing of store lambs plays a significant role in both the cool moist temperate (Otago) and warm dry temperate (Gisborne) models, but we have our reservations that this may being driven by the price differential between store and prime stock in the model rather than the feed profiles. However, in situations in which the feed profile fits store lamb demands and the cost of finishing lambs is relatively low, store lambs are purchased in large quantities (cool moist temperate and warm dry temperate) at the expense of cattle and capital sheep. This reduces the need to plant crops for winter feed and releases funds to purchase lambs for the short term. Flexibility in stocking policies, such as using store animals, has been shown to improve farm profitability in dryland farming previously (Gicheha et al. 2014).

This modelling exercise clearly demonstrates that “bigger is not necessarily better” and matching animal performance and, hence, demand with pasture performance and supply, is much more important for increasing farm profitability than improving animal performance *per se.*

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