Endless shades of green – calculating the economic thresholds between farming and forestry

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Abstract

Land use options have been evaluated to explore at which point it become economically worthwhile to plant pastoral land in trees by considering the relative returns between production forestry and pastoral options in the Hawke's Bay. The work indicates that land carrying less than 6.5 stock units/ha (su ha^{-1}) would produce higher returns in production forestry. If carbon is included at \$25 t^{-1} then the breakeven is closer to 13 su ha^{-1} for the first rotation. This would mean that Land Use Capability (LUC) class VI and the better class VII is more viable in the long term for pastoral production than for production forestry. A high-resolution land inventory with an updated legend, reflecting more modern livestock (and possibly forestry) stocking and production systems, would assist land managers allocating land between the farming, forestry (and even permanent planting) as they seek to maximise their earnings before interest and tax (EBIT).

Introduction

AgFirst were asked to provide a view on the place of forestry on pastoral land and an overview of the economic advantages of planting production forestry on behalf of the Hawke's Bay Regional Investment Company. We analysed a series of farm case studies in the Hawke's Bay region focusing on the relationships between land quality, forage type and financial returns from pastoral farming and forestry. In particular, we have broadly classified land more suited to forestry rather than remaining in pastoral production systems.

Case studies

Case Study 1 considered the impact of land and forage type on production levels presented as kilograms of meat and wool per hectare. Case Study 2 focused on the relationship between land quality and returns from pastoral farming compared with forestry. In Case Study 3, the learnings from the first two studies are applied in a practical demonstration. The last study is a desktop analysis looking at the possible effects of retiring land on farm revenues. The work was carried out in July/August 2019 using Farmax software (www.farmax.co.nz).

Sheep graze intensively farmed flats

Case Study 1: Impact of land and forage type

The case study farm was divided into three land classes based on slope (steep hill, easy hill and flats) and two additional areas on flats planted in specialist legume forage (lucerne and plantain/clover). By considering the effect of land class and forage type feed supply, an estimate of their impact on meat and wool production levels could be obtained (Figure 1).

On this farm, steep hill comprised 30% of the land area, easy hill 48% and flats 22%. While the steep hill units made up 30% of the land area, they only provided about 17% of the feed supply and 12% of the meat and wool production, reflecting the lower quality of this land class. By contrast the easy hill units provided nearly a proportionate amount of feed supply (48%) to land area, but a lower level of meat and wool (43%). The flats and legumes by comparison demonstrated their higher quality by providing higher feed supply (32%) and meat and wool (46%) compared to the percentage of land area (22%).

Converting this to earnings before income and tax (EBIT) shows that better quality land gives significantly higher farming returns (Figure 2). The flats return ~\$1,000 ha^{-1} yr^{-1} more than the steep hill and ~\$650 ha^{-1} yr- more than the easy hills.

Higher quality land not only produces more dry matter and is able to carry more stock units, but typically produces feed of a higher quality.

Higher feed quality enables more profitable livestock enterprises to be employed, such as finishing stock versus breeding stock. Increasing the metabolisable energy of feed by utilising enhanced pasture mixes, such as lucerne and plantain/clover, will improve livestock feed conversion efficiency and livestock business returns.

Currently, simple dry matter production, or stocking rate, is generally used as a guideline for land use decisions. However, whole-farm modelling that includes the response in animal performance to the land types/feed type will provide more accurate guidance.

Case Study 2: Impact of land quality on stocking rates

This case study focuses on the relationship between land quality and comparing financial returns from sheep and beef, and from forestry. Stocking rate is used as a proxy for land quality.

The forestry scenario used here assumes a pruned production forestry regime with a net stumpage of \$35,000/ha converted to an annuity. Two options for carbon were considered:

- No carbon
- Including carbon credits at a value of \$25/tonne, selling the first 17 years of carbon during the first rotation.

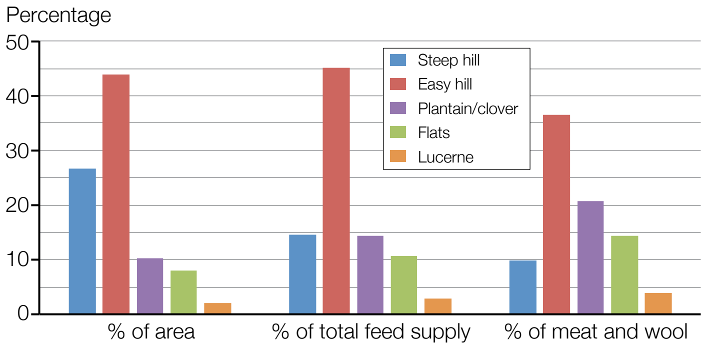

Figure 1: Contribution of land class and forage type to feed supply and meat and wool production

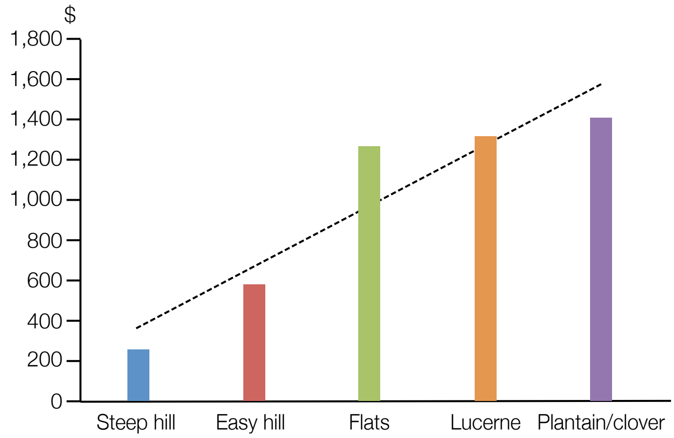

Figure 2: EBIT for pastoral farming as income \$/ha/yr

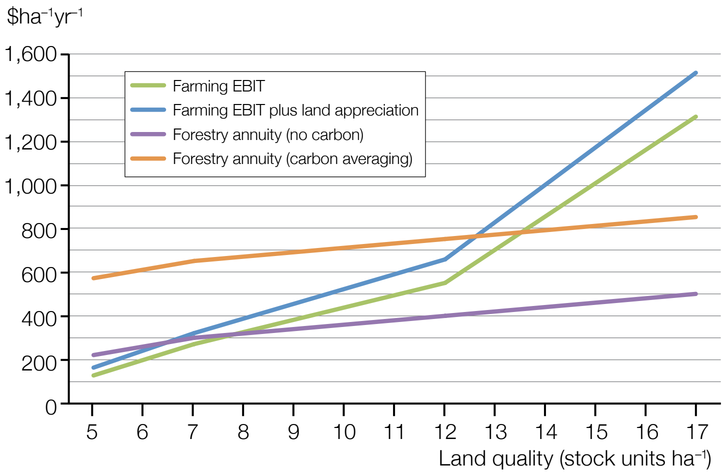

Figure 3: Farming EBIT compared with predicted forestry annuity with changes in land quality

The calculations of the forestry economics accounted for a reduction in the value of greenfields land to cutover forest ready for the second rotation. The market for cutover forest is relatively moderate with a range of \$2,000 to \$3,000/ha, and reflects the significant carbon revenue that can be earnt on the first rotation but not on subsequent rotations.

The expected earnings for land quality (as su/ha) are shown in Figure 3, along with forestry options with and without carbon. The breakeven point where forestry without carbon becomes financially viable is around 7.5 su ha^{-1} or a return of $300/ha.

The impact of adding land appreciation at 1% per year is shown by the blue line in Figure 3. Historically, clear pastoral land has increased in value at a rate greater than inflation. Often that rate of gain has averaged 2-3% p.a. There is a general expectation that the rate of real appreciation of land is likely to be slower in the future. However, the analysis has allowed for some land appreciation to be considered as a sensitivity around the option of retaining land in farming. Including land appreciation reduces the breakeven point for forestry without carbon from 7.5 su ha^{-1} to 6.5 su ha^{-1}.

When carbon is included in the first forestry rotation, the annual income breakeven point for livestock increases to around $750/ha or 12 su ha^{-1}. In this example, if stocking potential of the land is greater than 12 su ha^{-1} it should remain in pastoral farming, even accounting for the one-off benefits of carbon. (A key assumption was that whilst easier contour land would increase the forestry stumpage, the forestry returns are not as sensitive to this land quality as the livestock returns are.)

Case Study 3: A practical demonstration

A 2,100 ha coastal property with 1,250 ha currently in pastoral farming was reviewed. The farmed portion was estimated to be producing an average EBIT of around $300/ha. This was determined using a combination of benchmarking and farm simulation modelling, assuming current performance levels and expected medium-term prices. The property owners were advised that if forestry returns were presented as a discounted annual cash flow, then $300/ha would be the expected forestry income. Based on averages, the net farm revenue from pastoral land use and forestry appeared to be very similar.

Very simply, the most difficult half of the property in pastoral farming could be considered for forestry or, potentially, land retirement. This assumes that forestry returns are less sensitive to land quality, and that livestock returns could not be improved.

Alternatively, AgFirst believed that implementing farm management strategies that increased productivity on the cultivatable parts of the farm, along with a targeted livestock policy, had the potential to increase the EBIT to $538,000/year, or $430/ha. However, moving beyond looking at averages and identifying the profit contribution of the most difficult land, it was discovered that (even with improved policies) approximately 500 ha of land would still return an EBIT below $300/ha. Removing this land from pastoral use and focusing on the best 750 ha could increase the EBIT of the now smaller pastoral farm to $395,000/year, or just over $525/ha (see Table 1).

Table 1: EBIT summary

	Ha in pasture	EBIT per ha	Total EBIT
Current farm area & performance	1,250	$300	$375,000
All pasture – best practice performance	1,250	$430	$537,500
Best 750 ha @ improved performance	750	$525	$393,750

Identifying the profit contribution of different land classes

The farm had kept records of pasture covers, livestock tallies and performance within the Farmax system. Using this, it was possible to determine that potential pasture growth rates on this farm averaged 6.5 tDM/ha/yr. The farm had also been mapped into four farm production classes with further overlays of steepness and environmental risk, giving us seven land groupings. We allocated potential pasture production to ensure that the seven land class units produced the same weighted average as the total that has been recorded.

The most difficult land class was steep and erosion-prone and accounted for 132 ha. It was assumed that this block of land had the potential to produce four tonnes of low-value dry matter per hectare annually and that this would be utilised by breeding ewes and beef breeding cows. AgFirst modelled the farm as it is today and then again with the reduced land area. As well as scaling back livestock numbers, we also modelled changes to livestock policy and per head performance.

A summary of the modelled results for the steep and erosion-prone land is outlined in Table 2. The results suggest that, due to the low carrying capacity combined with the impact on animal performance, this land is generating a gross income less than $400/ha.

Even with optimistic product prices, this land class is not going to bridge the gap in returns between a net profit of $87/ha for livestock and the assumed $300/ha for forestry.

The second most difficult land class consisted of 368 ha of land and was estimated to have a potential pasture production of 5.35 tDM/ha/yr capable of carrying stock unit equivalents of 7.3/ha and generating an EBIT of $352/ha. The potential financial effects of retiring this land from grazing is shown in Table 3.

The forecast net profit for this 368 ha is estimated at $294/ha after allowance for interest on livestock capital. This is very close to the guideline breakeven figure of $300/ha for forestry. A decision on whether to retire this land class from grazing or not should be made on the basis of other factors relating to the objectives of the business. These might include:

- Environmental concerns
- Carbon capture and storage

- Ability to attract premiums in the marketplace
- Viability of scale of the residual operation
- Impact on staff
- Impact on land asset value
- Expectations of future demands for products

Whole-farm modelling approach

A whole-farm modelling approach is more sensitive to the impacts of feed quality on animal performance than simply trying to create a partial budget for the land being considered for land use change. This method also makes it possible to take into account grazing that is assumed to be available under pine trees that are three to 10 years old.

Overall, this farm would be able to generate a very similar EBIT from concentrating on the most productive 750 ha compared to the currently more extensively farmed 1,250 ha. The additional 500 ha in forestry would produce significant carbon income and eventually timber returns. Also, total nitrogen loss was expected to be reduced by 8% and phosphate loss was modelled to be reduced by 43% over the total property.

It must be noted that some of the strategies used to increase productivity would be expected to result in an increased nitrogen loss per hectare on some of the cultivated land and the use of high legume content pastures. However, the net benefits from improving the good land and allocating more difficult pastoral land to forestry would result in both financial and environmental benefits overall.

This case study identifies the opportunity to maintain cash flow income through a focus on applying more productive/profitable systems on the better land and freeing up more difficult land that can be allocated to longer-term forestry investment. The environmental benefits of such an approach can be significant, and the recommended methodology for analysis is to carry out whole-farm modelling with and without the land in question and compare the difference between the two models.

Table 2: Financial summary of the effect of retiring the most difficult land class from grazing

Financial summary: Retiring land from grazing				
Area retired from grazing (ha)		132		
Stock unit reduction			723	
Stock units per ha			5.5	
	Total	**$/ha**	**$/SU**	**c/kgDM eaten**
Income reduction ($)	51,680	392	71.48	13.0
Farm working expenses ($)	34,044	258	47.09	
EBIT ($)	17,636	134	24.39	
Interest on livestock capital ($)	6,099	46	8.44	
Net Profit ($)	**11,537**	**87**	**15.96**	**2.9**

Farm working expenses are estimated at $47/su or $258/ha

Table 3: Financial summary of the effect of retiring the second most difficult land class land from grazing

Financial summary: Retiring land from grazing				
Area retired from grazing (ha)		368		
Stock unit reduction			2,686	
Stock units per ha			7.3	
	Total	**$/ha**	**$/SU**	**c/kgDM eaten**
Income reduction ($)	255,216	694	95.02	17.3
Farm working expenses ($)	125,531	341	46.74	
EBIT ($)	129,685	352	48.28	
Interest on livestock capital ($)	21,483	58	8.00	
Net Profit ($)	**108,202**	**294**	**40.28**	**7.3**

Farm working expenses are estimated at $47/su or $258/ha

We believe that to fully assess the benefits or otherwise of a forestry investment, a whole-farm approach to the economic returns is necessary rather than using a gross margin approach. The whole-farm approach recognises the different land inventories that exist on a farm and how their dynamic interaction affects the production system choice and consequently the farm outputs.

Case Study 4: Remaining primarily a pastoral farm

Not every landowner wishes to branch out into forestry, but this should not preclude retiring land for ecosystem benefits. A desktop study was done on a 1,245 ha property in a northern Hawke's Bay sub-catchment that the owners wanted to remain primarily pastoral. This property has a mix of LUC class VII e9 (525 ha) and VI e11 (720 ha) and is carrying 11,200 su (9.0 su ha^{-1}). Across the whole farm, an average of 6,300 kgDM/ha/yr was grown. By retiring 310 ha of steep land with an annual dry matter growth of 3,850 kg/ha^{-1}/yr^{-1} (supporting 5.5 su ha^{-1}), the remaining land could theoretically grow 7,100 kg/ha^{-1}/yr^{-1} of dry matter with a stocking rate of 10.1 su ha^{-1}.

A 9% increase in gross return per stocking unit would be necessary to obtain the same Gross Farm Income (GFI) from the reduced area. This is considered feasible given the landowners would be farming only the more productive country. If the farm operating expenses were held at the current level, then the resulting surplus remains the same. It would be expected that there would be some reductions in working expenses that would be related to pastoral activities. The retired 310 ha would, on the basis of a study carried out for Beef+ Lamb NZ (Harrison & Bruce, 2019), return an NPV of between $2,600,000 to $2,900,000 under the carbon forestry regime. No calculations were made in this exercise on the resulting reduction in sediment losses from such a land use change.

Conclusions

As a broad guideline, we suggest that land on the East Coast of the North Island that has a carrying capability of less than 7.0 su/ha may be considered as potentially attractive for forestry. Farms, or parts of farms, that can produce EBIT levels greater than $300/ha should probably mostly remain in livestock production. By balancing farming and forestry, overall business viability is significantly improved.

Farms earning less than $300/ha, but with a desire to stay fundamentally in pastoral farming (such as in the northern Hawke's Bay case study), have the capacity to maintain current farm financial returns and have a forestry programme running concurrently, adding to the whole-farm long-term environmental and financial viability.

Classifying land at a farm paddock scale using LUC classification systems that take into account base soil structure, soil classification, slope, erosion risk and climate (plus other limiting factors) helps landowners identify the scale and location of poor and high-performing land. The current LUC regional scale of 1:50,000 gives an overall district picture, but the resolution is not high enough for practical farm use. A high-resolution land inventory with an updated legend reflecting more modern livestock (and possibly forestry) stocking and production systems would be a major leap forward in best land use identification, and would assist land managers in their decision-making in identifying those parcels of land where the EBIT justifies the land use decisions made.

Landowners and managers in the case studies commented on how having a forestry rotation in their farming business augmented cashflow, helping through the lean pastoral years (either caused by drought or fluctuating prices), and strengthens farm viability. They also commented that it removed some stress by not having to continually rely on the sale of protein as the major source of business income.

The whole-farm sustainability discussion must also take into consideration the increase in ecosystems and better management of land resources, to which the 'right tree in the right place' is the logical solution.

We believe that regional councils have a key role in assisting farmers to make the best long-term land use decisions for their farming businesses. Integrating land best suited to forestry and land best suited to pastoral systems at an individual on-farm scale will lead to more sustainable and resilient farming businesses and rural communities.

Reference

Harrison, E. and Bruce, H. 2019. *Socio-Economic Impacts of Large-Scale Afforestation on Rural Communities in the Wairoa District.* BakerAg (NZ) Limited, Masterton for Beef + Lamb NZ. Available at: https://beeflambnz.com/sites/default/files/Wairoa%20Afforestation_FINAL.pdf

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