The added value of value-add

Gina Lucci, Wei Yang, Stewart Ledgard, Grant Rennie, Geoff Mercer and Michael Wang

The economic and environmental opportunities of delivering "Pasture-fed" "Carbon neutral" and "Organic" red meat and dairy products in New Zealand

It is difficult to find an agricultural publication that does not promote or reiterate the mantra that adding value to our agricultural outputs is the key to a prosperous future. It has been shown that there are product characteristics, beyond what can be seen or tasted, that consumers will pay a premium for. Examples of such value-add attributes are country of origin, animal welfare standards, and organic certification.

Initiatives like *Taste Pure Nature* aim to position New Zealand beef and lamb as premium products due to their clean, natural production. Although a higher price might be demanded in the shop, it is not certain what proportion of the added value will reach the farmer. Who realises the financial benefits and what changes to agricultural systems are needed to deliver that added value are uncertain.

Delivering new, higher value product specifications will require changes on farm and we need to be sure that these changes enhance, rather than damage our environmental credentials. Therefore, the *Credence Attributes on Farm* project (https://ourlandandwater.nz/incentives-for-change/credence-attributes/), funded by Our Land and Water National Science Challenge, has combined research on both environment and economics to better understand if it's possible to get both high-value and low environmental footprint agricultural products.

We have modelled dairy, and sheep and beef systems to deliver "pasture-fed" or "carbon neutral" products; and dairy farming systems to deliver "organic" products in two contrasting conditions: the Waikato and Southland. What have we found?

Consumer willingness to pay

Firstly, we conducted a meta-analysis[1] of 94 studies of consumers' willingness to pay a price premium for dairy and red meat products. This work showed that, on average, consumers would pay 36% more for organic, 25% more for grass-based and 24% more for "environmentally friendly" products. In addition, it was found that beef and dairy products were associated with a higher price premium compared to lamb. Thus, the potential for increased payment is there for products that go beyond standard farming practices.

On-farm changes to deliver added value

Irrespective if we consider pasture-fed, organic or carbon neutral (C-neutral) attributes, there are multiple ways of configuring farm management to deliver products that meet those standards. We modelled 3 – 4 different scenarios for each attribute but here we present the ones where the level of production (i.e. kg product/ha) was most like the conventional base system.

This was achieved though actions such as replacing or eliminating feed and fertiliser inputs, and changing lactation length and pasture intake, depending on the attributes.

For the sheep and beef scenarios, changes to fertiliser application and elimination of crops had little effect since fertiliser rates are already low, and cropping was only on 5% of the farm.

[1] Yang, W. and Renwick, A. (2019), Consumer Willingness to Pay Price Premiums for Credence Attributes of Livestock Products – A Meta-Analysis. J Agric Econ.

Economic impacts

For the dairy scenarios, delivering the added-value attributes resulted in a reduction in overall milk production by 10 to 20 %, except for the C-neutral scenario where production levels were kept the same (Table 1).

Without any premium added, the profitability, estimated as Economic Farm Surplus, was reduced by up to 38% or at a similar profitability. When a premium is added to the price paid by consumers the story changes. The estimated return to the farmer was greatest for the organic and pasture-fed dairy products (36–67%). C-neutral products were less profitable, but still greater than the base scenarios (11–25%).

For the sheep and beef scenarios (Table 2), production and profitability were little changed by the changes made to the system.

Table 1: Dairy. *Base scenarios and the percentage change from delivering value-added scenarios. Base "WKO" are scenarios run on an average dairy farm system 3 in the Waikato region; "STH" are scenarios run on an average dairy farm system 3 in the Southland region. Changes of <5% are represented as –.*

	Base		*C-Neutral*		*Pasture-fed*		*Organic*	
	WKO	STH	WKO	STH	WKO	STH	WKO	STH
Milk production (kg MS/ha)	1,030	1,068	-	-	-17%	-10%	-20%	-14%
Farm Profit, without premium[A] ($/ha)	942	1,306	-9%	+8%	-	-	-24%	-38%
Farm Profit + premium – costs[B]	-	-	+11%	+25%	+36%	+49%	+42%	+67%
Nitrogen losses (kg N/ha/y)	37	24	-41%	-42%	-5%	-	-24%	-17%
GHG emission (kg CO_2 eq./ha/y)	12,368	11,546	-19%	-11%	-23%	-9%	-37%	-23%
C-footprint (kg CO_2 eq./kg MS/y)	10.3	9.3	-17%	-11%	-7%	-	-20%	-11%

[A] *Economic Farm Surplus @$6/kg MS (i.e. no premium and no accreditation costs)*

[B] *Accreditation costs for Organic & Pasture-fed & C-neutral; and costs to offset GHG emissions (C-neutral only)*

Table 2: Sheep and beef *scenarios based on an average Class 4 North Island hill farm (Base) and the percentage change from delivering value-added scenarios.*

	Base	*Pasture-fed*	*C-Neutral*
Total product (kg product/ha)	348	-5%	-6%
EBIT Profit ($/ha)[A]	100	-5%	+19%
Nitrogen losses (kg N/ha/y)	18	-11%	-17%
GHG emission (kg CO_2 eq./ha/y)	4,708	-5%	-8%
C-footprint:			
kg CO_2eq. /kg beef LW	12.8	-	-
kg CO_2eq. /kg sheep LW	8.2	-	-
kg CO_2eq. /kg wool	27	-	-

[A] *Earnings Before Interest and Tax (i.e. no premium and no accreditation costs)*

Environmental impacts

In terms of nitrogen (N) leaching and carbon footprint, C-Neutral and organic delivered the biggest environmental gains from dairy products (Table 1). C-neutral dairy had the greatest potential to reduce N leaching losses by just over 40% and reducing the C-footprint by up to 17%. Configuring to organic dairy also had a big impact on N leaching by reducing 17 to 24% over the conventional system, and reducing the C-footprint by up to 20%. Nitrogen leaching from pasture-fed dairy was only reduced by up to 5%, and C-footprint by up to 7%. Similarly, for beef production, the greatest environmental gains (though small) were from the C-neutral scenario (Table 2).

Considerations and conclusions

The pasture-fed products required more nitrogen fertiliser to grow more grass to offset the elimination of crops and supplements from the system. Therefore, the estimated environmental gains were small.

While the C-neutral system greatly decreased N losses, it also relied on imported feed to maintain production, and this feed needs to come from somewhere. Off-farm feed production effects were included in carbon footprint calculations, but not in N leaching estimates which are only from the farm.

Delivering organic and pasture-fed attributes comes with a greater risk from drought or unseasonal weather, limiting feed options and increasing costs substantially during a 'bad' year. Conventional systems have more options to meet feed shortages that are not available to producers that have committed to an organic or pasture-fed specification.

From this analysis, the added value that offers the greatest potential to deliver both greater returns to the farmer and the greatest environmental benefits is organic dairy. However, it is not going to be the answer for everyone.

Information

This is a brief synopsis of the findings of this project, not all of which have been peer-reviewed at the time of writing. For more information on this project, including upcoming publications, data and underlying assumptions, please contact Gina.Lucci@agresearch.co.nz. This project was funded by Our Land and Water National Science Challenge (contract #A23987) and AgResearch Strategic Science Investment Fund (contract #A22715). We would also like to thank our advisory group for their input and feedback on this project.

..a few METHODS

Dairy farm systems were based on surveyed averages for Waikato and in Southland (Dairy Base), while the sheep and beef farm was based on an average Class 4 North Island hill farm (Beef + Lamb NZ). The base and "attribute farms" were modelled in FARMAX and OVERSEER® Nutrient Budgets. Environmental impact assessment of the C-footprint of products was modelled using emission factors from the NZ GHG Inventory and background GHG emissions were calculated using LCA methods[2], e.g. accounting for fuel use and production and use of fertilisers.

Pasture-fed, carbon neutral and organic attributes were identified at a multi-stakeholder workshop attended by farmers and rural professionals. Organic attributes are relatively well-defined; but pasture-fed or carbon neutral are not. In this project we defined pasture-fed as an outdoor system, with no crops fed, however pasture silage is acceptable (homegrown or bought in [NZ only]). Carbon neutral is considered at the farm scale and excludes soil carbon and what occurs outside the farm gate. The modelling approach for C-neutral was to reduce biological GHG emissions as far as practical without affecting milk production, then payment to offset the remaining carbon equivalent ($25 NZD per ton CO_2-equivalent).

The return of the premium to the farm was estimated considering the interaction of businesses along the value chain, each taking their share, and what was left over was the farm share of the premium price. This also took into account accreditation fees for the value-add attributes and the cost of offsetting carbon for the C-neutral scenarios.

[2] Ledgard, S. F., Wei, S., Wang, X., Falconer, S., Zhang, N., Zhang, X. and Ma, L. 2019. Nitrogen and carbon footprints of dairy farm systems in China and New Zealand, as influenced by productivity, feed sources and mitigations. Agricultural Water Management 213: 155-163