Greenhouse Gas Emission Reduction Case Study
Puketoi
Otago Sheep, Beef and Arable Farm

Overview

Puketoi Station is a sheep and beef farm in the Māniatoto, consisting of 2,885 hectares in total, of which 2,737 hectares are effective. It is owned and managed by the Crutchley and Hagen families. Of the effective area, 1,300 hectares is hill/high country, and 1,437 hectares flat, including 475 hectares of irrigated land.

From 2019, total stock numbers have reduced slightly, while average stocking rate has remained much the same. At the same time, the area in arable crops has increased. The result has been a 5.3% reduction in biological greenhouse gases emitted in 2023 compared with 2019. ETS forestry recently planted as shelterbelts provide some offsetting, giving a net 7% reduction compared to 2019.

Table 1: Puketoi Station Physical Parameters

	2019	2022	2023
Effective ha	2,797	2,737	2,737
Breeding ewes	7,100	6,590	6,601
Breeding cows	160	163	145
Total Stock Units	15,191	13,860	14,877
SU/ha	5.4	5.1	5.5
Arable crop (ha)	32	40	59

What changes have been made?

The key decisions were around 2 factors; reducing capital breeding stock slightly, offset by finishing more stock, especially buying in store lambs for finishing, and increasing the area in arable cropping. In addition, some land has been taken out of production in order to plant up riparian strips and establish a wetland. In many respects the efficiency of the farm system has improved, resulting in a reduction in GHG emissions, while maintaining the financial sustainability of the business.

Why were the changes made?

As a result of the increasing focus on greenhouse gases in the agricultural sector in the past 15 years, in 2019, Emma attended the Massey University GHG Course and the level of their emissions was highlighted. The farm team have also always had a focus on per animal production, rather than driving for more animals to derive output. They set out to alter the system to reduce emissions while retaining profitability and meeting the broader family goals.

GHG modelling method

The farm was modelled in OverseerFM for the 3 years being analysed.

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What have been the impacts of the changes?

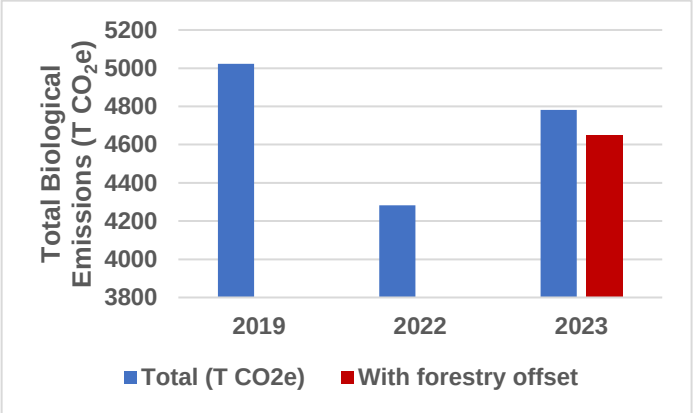

Figure 1 Puketoi total biological emissions (methane and nitrous oxide) since 2019

Figures 1 & 2 show the emissions and emissions by gas. This shows a decrease in total emissions and nitrous oxide emissions and a very small reduction in methane albeit they increased between 2022 and 2023 due to an increase in stock numbers. Less capital stock was off-set by more trade lambs. More detail on the emissions is presented in Table 2 below.

Table 2: Total GHG emissions by gas

	2019	2022	2023	% Change 2023 vs 2019
Methane (Total T CO_2e)	4,114	3,652	3,944	-4%
Methane (Tonnes CH_4)	165	146	158	-4%
Nitrous oxide (Total T CO_2e)	909	630	814	-10%
Total Tonnes CO_2e*	5,487	5,131	5,444	-1%
Total Tonnes CO_2e*/ha	1.90	1.78	1.89	-1%

*Includes CO_2 emissions

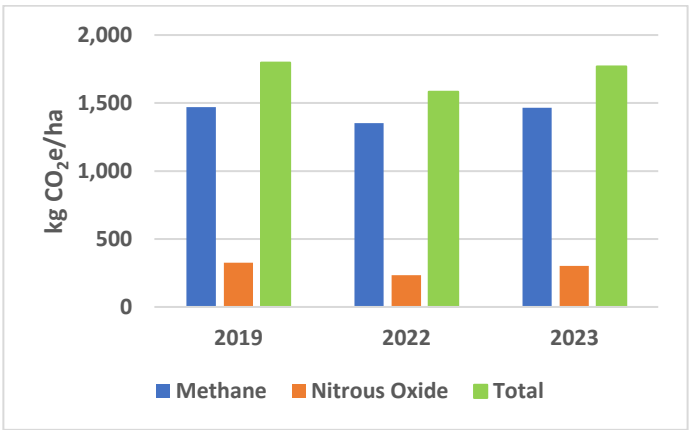

Figure 2: GHG Emissions by Gas (kg CO_2e/effective ha)

Emma and Kyle report that the changes made have meant it is easier to maintain ewes in good condition all year round and creating flexibility reduces the pressure on the family business. Financial performance has stayed relatively similar (in real terms).

They have been striving for improved lambing percentage, and still think this will come, but various disruptions (beyond their control) since 2019 have hampered this.

The overall environmental footprint has always been a focus, but lowering greenhouse gases has also reduced nutrient losses. It has also provided greater resilience to market changes as a result of increased flexibility in the system. It has enabled them to focus on resilience for the business in relation to water, biodiversity, adaptation to climate change, climate change policy and labour as well as animal welfare. The changes have also enabled retirement of lesser productive areas, much of which they are planting with trees (exotic and native).

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What changes were made on Puketoi that reduced emissions?

- Decreased winter crop area by 28.8% from 184ha to 131ha and a reduction in N applied to crops from 59kgN/ha to 27kgN/ha – decreased nitrous oxide emissions.
- Decreased total stock units by 1.5% from 15,191 to 14,962 and increased total liveweight sold (kg/ha grazed) – decreased methane emissions.
- Decreased total beef RSU by 17% - decreased methane emissions.

What process did they go through to make the changes?

The initial changes were made knowing they needed to build more resilience in the farm system and following the impacts of covid creating uncertainty across the supply chain. The focus was to reduce stocking areas, knowing they could get better performance with less stock. This was based on multi-generational knowledge and incorporating that into the farm system. They knew it made sense to make changes that aligned with these values. They utilised a couple of external consultants (as they had the time, capacity and expertise) to support some of the changes.

The shift to more arable also aligned with the resources they had and market demand. The growth in arable has been done over the past 20-years with careful consideration of the appropriate crops, as many are not suited in this extreme climate. They have also done it gradually to ensure there is a market for what they are producing. They have converted most of their border dyke irrigation to centre pivot. This was primarily done for water use efficiency and water quality management, but also supported changes made to the farm system.

What other changes are planned?

Keen to move to more arable. To do this they would need to know there were markets at the end of it, and would also need to have processes in place to manage climate risk to be able to make that shift confidently.

Stock numbers are about right now; the continued effort in the system will be in driving per animal performance. They would look to reduce stock numbers further if that supported reduced emissions

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and retained profitability. Low methane genetics will also be explored for the maternal flock.

The timing of sale of trade lambs has an influence on emissions (lambs held longer increase emissions). The trade lamb policy could be adapted to reduce emissions further.

Puketoi is also interested in being part of the solution to support greater resilience and sustainability in the local food network. They are members of their local catchment group working to be part of collective solutions to tackling challenges like climate change and local food networks.

What would drive or constrain these changes?

Being a profitable business is vital to support their ability to change. Regulatory uncertainty is a constraint. The extreme climate, market access and development for arable is also a constraint to doing more of that. Climate change in terms of greater unpredictability also creates challenges. All change takes time which is also limited when trying to also prioritise family time. Water security for climate adaptation is key, but this is under regulatory pressure at present.

What are they doing to ensure climate resilience for Puketoi?

- Use a terminal sire over 40% of their ewes to provide flexibility with lamb sales.
- Beef cows are used across all land types (including irrigated) as a tool for managing feed quality.
- Integration of wide shelter belts (which are in the ETS).
- Riparian areas are retired and planted with natives.
- Produce a lot of their own seed on-farm (clover, ryegrass and lucerne).
- Direct-drill except when incorporating straw.
- 90% of irrigated area of the farm is spray-irrigated (more efficient water use than previous border-dyke).
- Use lucerne to help finish lambs faster and provide greater flexibility with lambs.

What advice do they have for other farmers?

- It is important to know what problem you are trying to fix and know what the options are to do it. Often the solution to the problem is counter-intuitive to what you think. For example, reducing stocking rate may seem counter-productive, but with increased per animal performance you can be better off. Similarly farming to the carrying capacity of the land rather than chasing a particular policy.
- Be aware that as per head production increases, emissions may also increase so there is a need for constant adjustment.
- Modelling options can help de-risk making changes and give you confidence to make them.
- Important to reflect on what you've got and be grateful for that. That helps with a mindset of supporting and nurturing what you have.
- Consider everything through a lens of opportunity, rather than a challenge or a threat.
- Think across the multiple challenges that are being faced regardless of policy incentives its important to focus on solutions that can tick off multiple challenges. For example, shelter is also sequestration, or riparian quality can support water quality and biodiversity outcomes.

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