Lowering emissions need not compromise profitability

Practical solutions to reduce on-farm emissions

Why: To uncover measurable differences in emissions – nitrogen (N), phosphorus (P) and greenhouse gases (GHGs) – among similar farms by examining what successful farmers are already doing.

Where: Pairs of farms from four regions – Waikato, Manawatu, Canterbury and Southland.

Who: Sarah Hawkins and Chris Lewis (Baker Ag NZ), Jeremy Savage (MRB), Clint Gulliver (AgFirst), Farmax and eight de-identified farmers.

What:

- Farms can have low GHG emissions and nutrient losses while remaining profitable. Reducing emissions (absolute emissions) doesn't need to compromise profitability (economic farm surplus/ha).
- There is no clear relationship between GHGs, profit and nutrient losses being dependent on a particular farm's soils, climate and location.
- Farmers need to find the sweet spot for the farm system for the location regarding profit and environmental effects. Changes in a GHG price or how it is measured (gross emissions or emissions intensity) will shift that sweet spot.
- That optimal farm system will likely change over time as environmental requirements change.

More: ourlandandwater.nz/outputs/emissions-reduction-report

Learning from farmers who have successfully lowered their greenhouse gas emissions shows it's possible to find the sweet spot that benefits both balance sheet and environment.

New Zealand farms can be profitable and have low greenhouse gas (GHG) emissions and nutrient losses.

New research led by Sarah Hawkins, agribusiness consultant for BakerAg NZ, used a 'learning from farmers' approach to provide answers to questions farmers had been asking for some time.

"Reducing absolute emissions doesn't need to compromise profitability," says Hawkins. She compared the performance of pairs of farms from four regions – Waikato, Manawatu, Canterbury and Southland – in a study funded by the Our Land and Water Rural Professionals Fund in 2023.

"In response to farmer enquiries about greenhouse gas emissions, our hypothesis was that significant and measurable differences in emissions (nitrogen, phosphorus and greenhouse gases) exist among similar farms," she says. "We aimed to uncover these differences by examining what successful farmers are already doing."

Anonymous farmers' thoughts

The eight farms were selected from the Dairy Systems Monitoring (DSM) database. They were paired based on having similar locations and soils, with differences in GHG emissions and minimal variations in profitability. The dataset used was from the 2022/23 season.

Pairing farms in the same regions was important to ensure the information was relevant, Hawkins

Jersey cows

says. “In many ways the research is not telling us anything we didn’t already know, but it identifies some key drivers which can help reduce emissions without compromising the profitability of the farm.

“Some farms already achieve low greenhouse gas emissions while remaining profitable, but the methods employed by those successful farmers have not been thoroughly investigated. This lack of investigation leaves many farmers without the necessary knowledge about how to improve their existing farming systems. This study aimed to address this deficiency.”

The exact location and identity of the farms in the research is anonymous, but some of the farmers who took part agreed to share their thoughts on its value.

One farmer says the research had shown ways in which improvements could be made on his farm to further lower emissions. Its value to the wider industry was that it compared like with like in the farms it focused on, making it easier for farmers to relate to.

Another farmer believes the report would stimulate discussion within the dairy industry and encourage farmers to question their current farming practices in relation to their impacts on the environment.

“I hope the research will prompt others to look closely at their systems and ways in which they can improve their impacts. It’s independent, with no agenda pushed,” he says.

Another farmer involved in the study says the research demonstrated that there was more than one way to achieve reductions in emissions while remaining profitable.

Change is inevitable

New Zealand farmers will have no choice but to reduce their environmental footprint, says Hawkins, but she believes we are not yet fully prepared for what is to come.

“In North America and European barn farms they know exactly what’s going on with feed, greenhouse gas emissions and production. A different level of understanding is required for New Zealand’s biological grass-based systems. Farmers have to estimate how much animals are consuming, as they are not measuring each day what they eat.”

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As a major contributor to climate change, GHGs have triggered international initiatives such as the Paris Agreement, which sets out what different countries around the world have committed to achieving regarding emission reductions.

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"Not only are countries committing to these international agreements, but so are financial institutions and international companies, though using their own metrics. Many banks have joined the Net Zero Banking Alliance (NZBA), committing to net-zero financed emissions by 2050. Major players, like Danone and Nestle, are making commitments to achieve net-zero emissions by 2050."

There is a justifiable concern among farmers that reducing stock numbers (if this was the only solution) would result in a fall in profitability. "Some farmers are overwhelmed by the pressures to change. However, change is inevitable and if the New Zealand dairy industry doesn't meet new targets, some customers may not accept its products."

Knowing your numbers

Knowing what farm's GHG emissions are and where they came from is the first step towards reducing them.

"Knowing your numbers highlights whether or not the farm is producing a low emission product, the status of nitrogen leaching and what can be done to make changes. Without knowing current numbers, farmers can't progress forward," says Hawkins.

The study used Farmax and OverseerFM, but Hawkins says the final model for New Zealand's GHG accounting system is yet to be defined. Modelling systems used to predict GHG emissions and nutrient leaching need to take into account new research.

"Nothing is 100% certain in biological farming. Most of us operate on the 80/20 rule. However, models like OverseerFM and Farmax need 100% proof that something works before incorporating it into their models. But farmers need to be able to model the potential impacts changes in farm management may have on the environment now," one farmer says.

The research also raised the question of where the farm boundary should be when calculating emissions. "Do farmers need to account for all support land, young stock and wintering, or is it just the milking platform?" asks Hawkins. "What will be the measure for greenhouse gas accounting – emissions/ha or emissions/kg of product? The two measures have different drivers and will result in different outcomes for farmers and processors."

Hawkins believes that devising a GHG accounting system that is fair and equitable would not be easy. "Farmers are getting conflicting messages about what is required of them – and how. Our research highlights that some management practices can reduce gross emissions and improve emissions intensity – but not all do."

The study also found that there was potential for conflict between market drivers and government policy. International legislation required emission reductions measured at a gross level. Markets and processing companies tended towards requiring reduction in emissions intensity (fewer emissions per unit of product).

While corporations were targeting emissions intensity, it should not be at the cost of increasing total emissions. The global goal was to reduce emissions and minimise the impact of climate change on global warming. "The only way this will happen is to reduce total global emissions, hence government targets," says Hawkins.

The main levers to reduce GHGs that are reflected in the models were feed conversion efficiency, dry matter intake, nitrogen (N) fertiliser use and stocking rate. The major ways to reduce GHGs include:

- **Reducing fertiliser N**, as well as imported supplement. Reducing these will directly reduce GHG emissions and N loss to water, but will also indirectly reduce dry matter available for intake.
- **Improving feed conversion efficiency** through management, livestock performance and reducing feed and livestock wastage on-farm.

Table 1: Waikato farms' GHG comparison

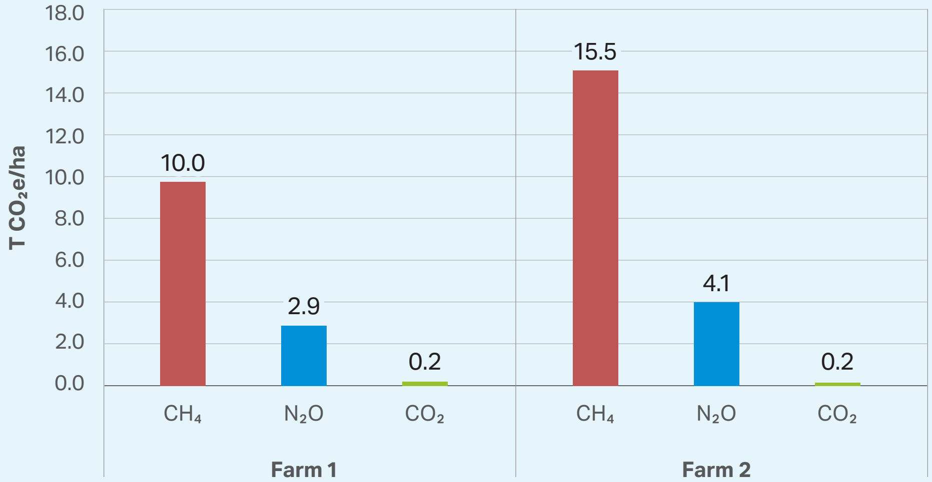
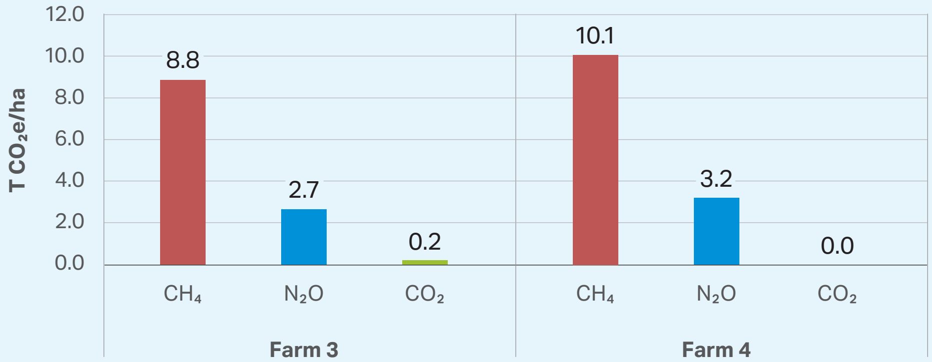


Table 2: Manawatu farms' GHG comparison



- **Targeting the sweet spot** for on-farm performance (physical, financial and environmental) – this is a factor of a farm's physical attributes, system design and management.

Comparing two Waikato farms

Both Waikato farms are located near Morrinsville and supply Tatua. The farms have similar soils, with mostly gley, poorly drained soils. The remaining soils are volcanic-free draining soils on Farm 1 and imperfectly drained brown soils on Farm 2.

The Waikato case study showed that a 41% increase in stocking rate (Farm 2 versus Farm 1) led to a similar increase in profitability and a 69% increase in GHG emissions (**Table 1**).

Intensification increases gross emissions, but can improve emissions intensity. As feed conversion efficiency improves, emissions intensity reduces.

Nitrate loss to water was not necessarily a function only of fertiliser N, stocking rate or surplus N. The efficiency of feed conversion can also be a factor, as is soil type. Differences in soil types explain much of the difference in N losses to water.

Comparing two Manawatu farms

The two Manawatu farms (**Table 2**) are located on the plains between the Manawatu and the Rangitikei rivers. The soils are a mix of sedimentary gley soils and recent sandy soils. Farm 3 has a mix of gley and sand soils, while Farm 4 has only the heavier gley soils.

Table 3: Canterbury farms' GHG comparison

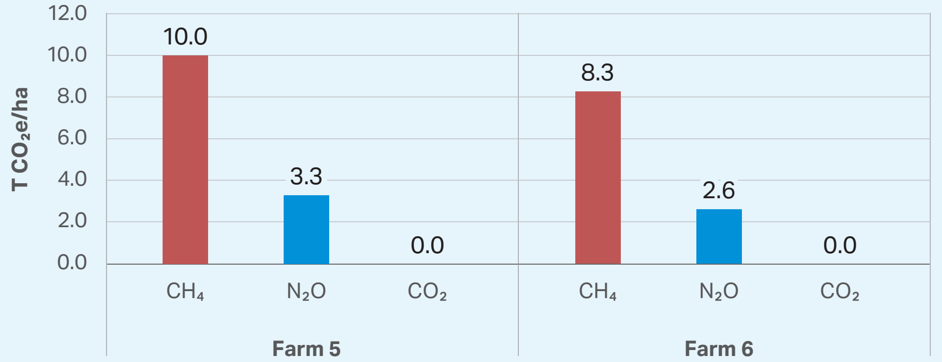
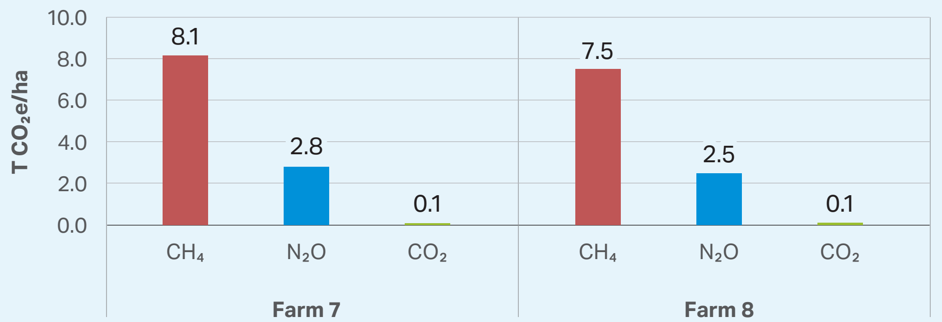


Table 4: Southland farms' GHG comparison



Given the economic farm surplus per kgCO_2e emitted, neither farm has strong economic resilience to compensate for an emissions charge.

Farm 4 is more at risk than Farm 3 once a farm-level emissions tax is implemented, as the current system has both high emissions and a lower profitability system. It is feasible for Farm 4 to lower their stocking rate and improve feed conversion efficiency. In doing this it can reduce emissions and improve operating profit.

Comparing two Canterbury farms

Both Canterbury farms (**Table 3**) are fully irrigated, highly productive farms located on the Canterbury plains. The soils are very similar, with mostly shallow free-draining Lismore soils, although Farm 6 has a small proportion of the farm with deeper moderately well-drained soils. The farms are a similar scale, with 210-235 ha effective area, and peak milking of 730-750 cows.

Finding the optimal balance of stocking rate, milk production, feed efficiencies and financial control will be important for each farm to ensure they can optimise the system for profit, GHG and nutrient losses.

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Comparing two Southland farms

The two Southland farms (**Table 4**) run different systems. Farm 7 is mostly self-contained with 90% of in-calf cows wintered on-farm. Most young stock are on-farm from birth to milking. Farm 8 is run as a classic milking platform, with no young stock on after weaning. About half of in-calf cows are wintered on-farm.

Both farms have room to improve. Farm 7 can look to improve feed conversion efficiency, which will lower gross emissions and emissions/kgMS – and may well lower working expenses further. Farm 7 shows that for a self-contained farm system emissions intensity appears to be poor. When looking solely at milking stock, the performance can be good.

Farm 8 has good feed conversion efficiency and low wastage (feed and fertiliser on-farm), but a higher cost operating system. Farm 8 earns more profit per kgCO_2e and so is more resilient and able to manage a GHG tax. However, a further improvement in profitability or reduction in emissions will help the farm business.

Hawkins says when looking at the self-contained Farm 7 unit, the gross emissions and emissions intensity at face value was greater than a milking platform only. "This is due to the higher 'maintenance cost' of emissions produced by non-milking animals.

"However, there cannot be a dairy farm without young stock coming through – these costs exist for all dairy businesses. The issue is whether emissions are accounted for by farm or by business entity."

Hawkins says that in time there would be a single approved model to calculate GHG emissions. "With that there will presumably be clear guidelines on how to calculate those emissions. This will deal with the uncertainty of the farm boundary and how off-farm grazing and imported supplement are factored in."

Elaine Fisher for the Our Land and Water National Science Challenge