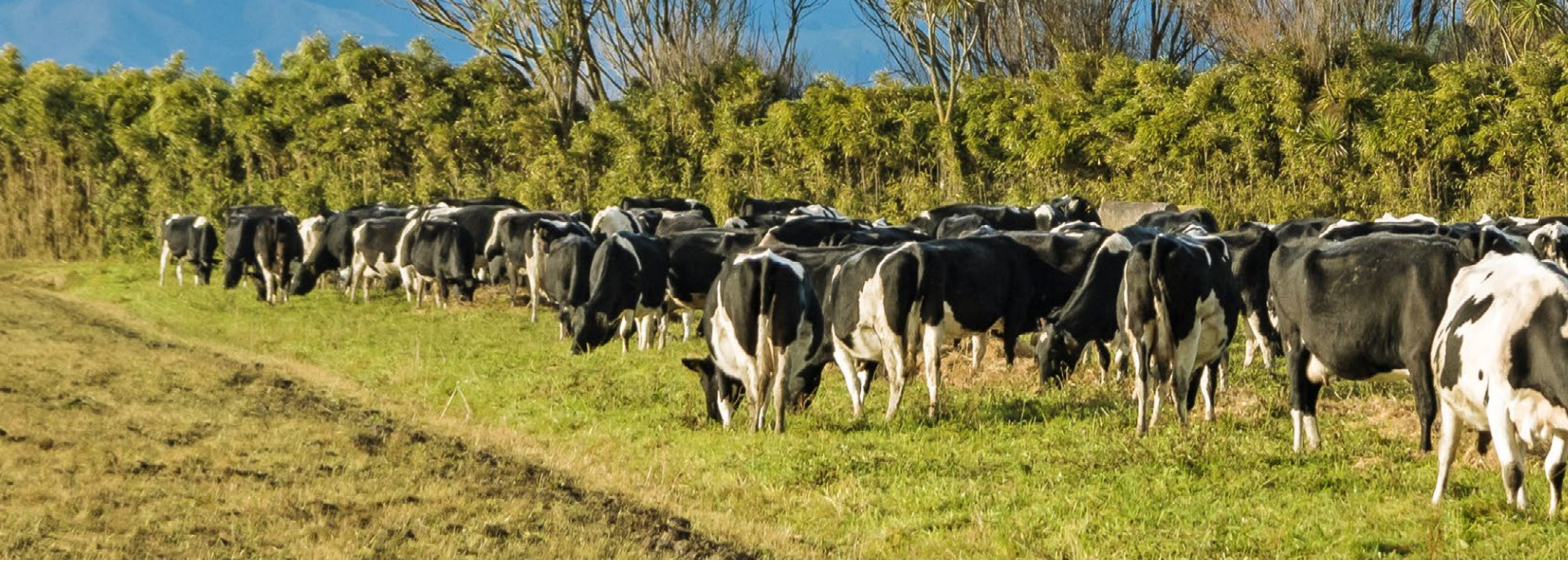


Sizing up the emissions footprint on low and high input dairy systems

Can a go-ahead dairy farmer really reduce total greenhouse gas (GHG) emissions and still flourish? Is there scope in today's challenging economic environment for farmers to post production gains and pare back nutrient loss at the same time?

In 2009, an SLMACC study into low emission intensity, high production dairy farming identified a set of promising GHG mitigation options.

Some of these options would be threaded into the design of Pastoral 21 (P21), a research venture based on dairy farms in four regions. Launched in 2007, this innovative collaboration, among other things, investigated the practicality, economic returns and impacts on water of "increased efficiency" systems.

In 2013, SLMACC and the New Zealand Agricultural Greenhouse Gas Research Centre jointly supported a second study to assess the effect of the Canterbury P21 systems on emissions of the GHGs methane (CH_4) and nitrous oxide (N_2O).

A team of nine from AgResearch, Lincoln University and DairyNZ worked to verify the mitigation options modelled in the initial SLMACC study. They did this by comparing the study's results with the estimated CH_4 and N_2O footprint of the P21 systems, the group of small but wholly functional farmlets tested over three to four seasons.

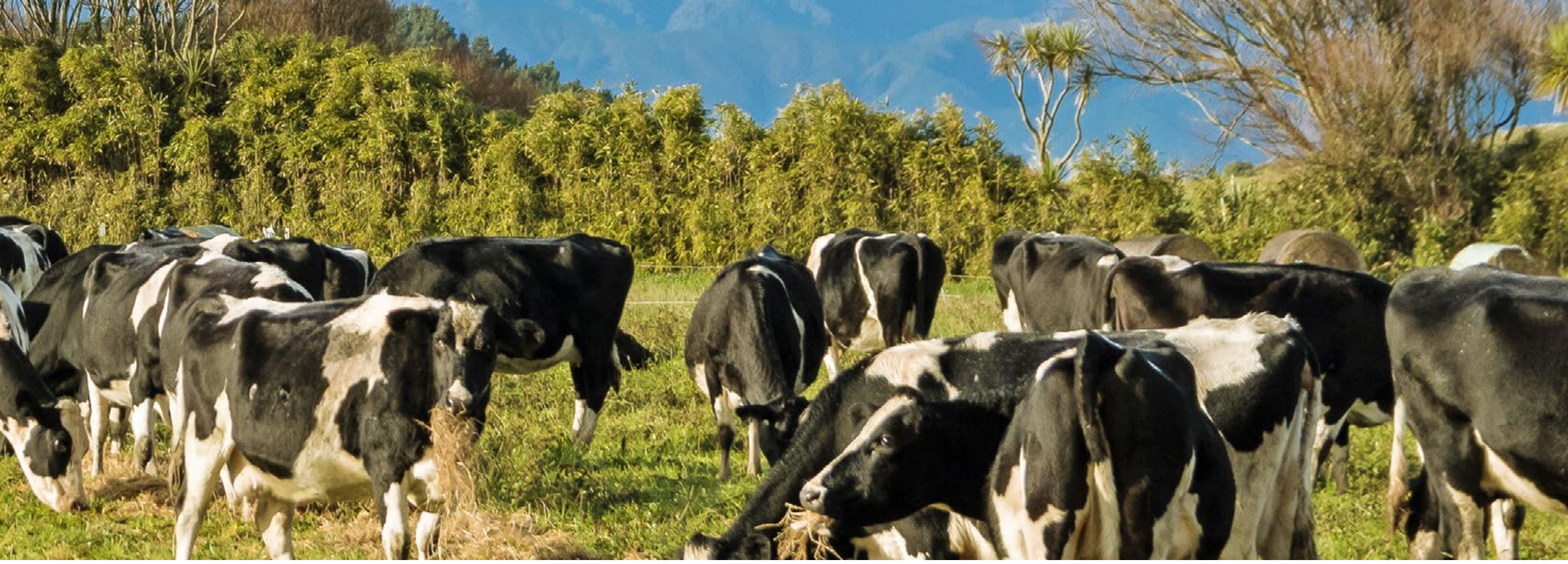
The Canterbury P21 trial aimed to develop dairy systems that blended high production and profit with lower nitrate leaching. Two farmlets were involved: one with a stocking rate of 3.5 cows per hectare (LSE = low stocking rate efficient); the other with 5 cows per hectare (HSE = high stocking rate efficient).

The main differences were, respectively, stocking rate, pasture base (standard plus diverse pasture versus standard pasture only), nitrogen (N) fertiliser use (158 versus 311 kilograms N per hectare per year), grain supplementation (110 versus 475 kilograms dry matter (DM) per cow per year) and winter crop (kale versus fodder beet).

Researchers assessed annual emissions from the two systems, averaged for three seasons (2011/12, 2012/13 and 2013/14). They used calculations based on measurements and estimates of DM intake, CH_4 emission factors, N inputs and N_2O emission factors.

"These calculations were scaled up to an average size Canterbury dairy farm, with a 232 hectare milking platform, and stocking at either 3.5 (LSE) or 5.0 (HSE) cows/hectare," said Robyn Dynes from AgResearch.

Targeted CH_4 and N_2O measurement campaigns were conducted, to determine "local" emission factors. These measured CH_4 and N_2O emission factors for key components of the milking platform and the wintering support block for each system (CH_4 emissions from



animals on ryegrass pasture, kale and fodder beet; N_2O emissions from urine deposited on ryegrass versus diverse pasture, and kale versus fodder beet).

These "local" emission factors were used in the calculation of the GHG footprint of each system.

On a per farm basis, these emissions were about 20 percent higher in the HSE system. This system also had much higher enteric CH_4 emissions from other feed sources on the milking platform (pasture silage and grain).

"Higher CH_4 emissions from HSE were due to the higher DM intake per hectare by the HSE (additional pasture from N fertilizer plus additional supplements) herd compared with the LSE herd," said Robyn.

The HSE system was achieved with more DM being fed per hectare, and this led to 60 percent higher urine and dung emissions for the HSE system, compared with LSE. Similarly, the greater application of N fertiliser resulted in emissions from N fertiliser in HSE system that were double those of the LSE system.

The differences in emissions were driven by differences in N inputs from urine and dung and N fertiliser, because the emission factors were the same or very similar for both systems.

The LSE system resulted in a reduction in total on-farm emissions of about a quarter, compared with the HSE system.

> **"Although these estimates are surrounded by a significant level of uncertainty, they support previous farm systems modelling assessments," said Robyn.**

"Our results are also comparable with previous GHG emission estimates using the nutrient budgeting model OVERSEER, with both showing the same trend of lower GHG emissions from the LSE system."