

Mitigating carbon and nitrogen losses from stony soils

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Irrigation and addition of nitrogen fertiliser has the potential to transform dry, eastern areas into highly productive farming regions with many associated economic and social benefits. However, as these soils are typically shallow and stony, irrigation and nitrogen inputs need to be managed carefully to avoid increases in greenhouse gas emissions and decreases in groundwater quality. This is to ensure healthy rivers and lakes and to meet cultural expectations of Māori to sustain their relationships with te taiao.

We have established a new experimental platform to investigate, for the first time in stony soils, opportunities to manipulate biological processes that modify both soil carbon and nitrogen cycling, leading to reduced nitrogen leaching and gaseous losses. We are using continuous measurements to estimate carbon and nitrogen inputs and losses using paddock-scale eddy covariance for carbon exchange, large lysimeters from undisturbed soil monoliths for nitrate losses and chamber systems to measure nitrous oxide emissions. Our measurements are underway at two contrasting sites with dryland and irrigated lucerne at Ashley Dene Farm, Lincoln University.

We are investigating the soil physical and microbiological properties of soils that regulate carbon and nitrogen dynamics. We will describe the experimental systems that we have set up and the advantages of measurements made at paddock scales. We will present preliminary data from the first season of measurements and describe the modelling framework that we are using to integrate and forecast the impacts of manipulating farm management practices to reduce farm scale nitrogen losses while maintaining productivity on stony soils.