Leaching losses from diverse pasture

The following questions were asked during our live webinar with Scott Graham but due to time restrictions, we were unable to answer these in the session.

How did measured losses compare to Overseer numbers? Given long term soil cycles, climate and drainage modelling may differ but interesting to consider.

We didn't directly compare our data with estimates from Overseer. However, one of the follow-on objectives for this work is to use the data to inform the Overseer model and other decision support tools. Our data has already been used as a validation dataset for testing suggested changes to the Overseer model, addressing issues pointed out by the recent science review of Overseer.

To reduce leaching was over sowing considered instead of cultivation?

We converted our lysimeters primarily from lucerne, thus we considered it necessary to do some level of cultivation of the soil. However, in retrospect, minimizing soil disturbance may have reduced losses. Although, it may not have helped with some of our establishment issues. Thanks for the suggestion.

If there is an obvious leaching loss when ground cover isn't fully established will you be looking at losses from intensive winter grazing?

We are not specifically addressing winter crops. However, it's a similar principle: facilitating growth and complete grass cover following disturbance reduces losses. Plant & Food Research is currently investigating 'catch crops' to quickly establish growth following a winter crop cycle as part of a SLMACC project. As well, AgResearch is looking at other pasture-based wintering options to reduce leaching, so you might like to keep an eye out for outcomes of these projects as well.

Have you compared the impacts of diverse pastures with the impacts of other farm-scale mitigations?

At this point, we haven't done much comparison with other mitigation approaches. Not having identified a consistent mitigation effect of the minimally diverse pasture types investigated here, we feel there are still aspects of diversity that should be investigated. MWLR currently has multiple streams of research on pasture diversity, including GHG measurements over diverse 'regenerative' pasture vs. conventional pasture. We are also working as part of the SFFF Te Whenua Hou Te Whenua Whitiora project led by Ngai Tahu Farming to look at various aspects of pasture species diversity and leaching losses at paired 'regenerative' and 'conventional' farms. There is also some crossover in our findings on the effects of conversion with work done on reducing losses from

winter crops. There is a consistent message: ensuring rapid and complete pasture cover as quickly as possible will reduce losses.

N input in irrigated and non-irrigated is fertilizer N?

The N inputs indicated for our sites are a combination of N from fertilizer as well as effluent (if applicable) and simulated N inputs from animals. Our fertilizer regimes were selected to be consistent with commercial recommendations based on soil tests for each setting. We estimated how much N would be deposited by animals based on dry matter production (and thus feed availability) at each site and assumptions of supplementation at the most intensive site. The exception was Tihoi, where each lysimeter got 1 urine patch each year. Since the entire paddock doesn't receive a urine patch each year, we consider the losses from the lysimeters not to be 'paddock-scale'. As a general rule, urine patches cover about 25% of a paddock annually, so leaching losses from the smaller diameter lysimeters used at Tihoi could be divided by 4 to get an approximate paddock-scale loss, since losses from areas not receiving urine are typically low, 1-4 kg N/ha/y.

Are you going to do any follow up on the N level you found when the ground water level came up?

Unfortunately, we don't intend to follow this up at this time. It was a one-off sample while the water was high. It is difficult to interpret the data since shallow groundwater is likely affected by the wider area, not just the paddock we're working on. Without a confined source area, it's difficult to know the full implications of the measurements. However, it is concerning that groundwater would have such a high concentration, 10.5 mg/L NO3-N. Its symptomatic of high leaching losses in the area.

Did you notice any differences in N uptake between species during the cool season (i.e. when leaching is most prominent), particularly in that 2nd year where there appeared to be a reduction in N leaching under the diverse pasture of the high input system? Did this N uptake fully explain the reduction in N leaching, or did there also appear to be N transformation processes being affected by species (e.g. by plantain)?

In Year 2, production was 27% higher for diverse pasture relative to ryegrass-clover, while drainage and leaching losses were 29% and 65% lower, respectively, for diverse pasture. The absolute difference in leaching was 52 kg N/ha in Year 2 and the difference in biomass produced was 2.9 t/ha. The sink for N in the additional biomass produced would be ~60 kg N, assuming the clover component was fixing its own N (measurements at the site have shown fixation rates of 60-90% of biomass N, depending on N inputs). So, yes, it was most likely the additional N uptake that accounted for the reduced loss of diverse pasture in year 2. However, lower drainage volume and the highest plantain content observed in the diverse sward across the measurement years at that site may also have had an effect. It's difficult to completely disentangle the effects of each.

Is that irrigated effluent only not water irrigation as well?

Our 'Irrigated/Effluent' site was irrigated with both water and effluent, applied through separate emitters of a pivot irrigator. The 'Irrigation Only' site receives water only.

How affordable/practical is it for farmers to use highly diverse species mixes?

We can't currently comment on the economics of using the highly diverse species mixes. However, MWLR is part of the Te Whenua Hou, Te Whenua Whitiora SFFF project led by Ngai Tahu Farming. This project will look at a wide array of metrics, both environmental and economic, for paired 'regenerative' and 'conventional' farms.

What does the replication look like for lysimeters at sites? Are they in separate paddocks, treated separately, or are all the lysimeters in, for example, irrigated + effluent diverse pasture at Ashley Dene, in one paddock?

The lysimeter representing different irrigation and effluent managements are in different areas of the same farm. The core part of this project consisted of 6 lysimeters in a paddock under Irrigation/Effluent (randomly assigned 3 rye-clover, 3 diverse) and 6 in a non-irrigated paddock (all diverse). Three additional lysimeters under Irrigation Only (all diverse) were included for comparison, as they were available following the conclusion of another study. Statistical comparison amongst the sites is problematic. However, the differences in N input between these sites is rather stark, so we still find the 'gradient' to be informative. We can statistically compare rye-clover and diverse pasture effects within a site.

Were the large lysimeters undisturbed soil profiles?

Yes, the lysimeters were carved in situ and the surrounding barrel was lowered around the undisturbed soil column. A steel base plate was forced through the soil to cut off the lysimeter from the soil below and any gaps between the soil and barrel were filled with a sealant to prevent water from bypassing the soil.

If you discount the periods before full establishment how would the results look?

Discounting years with conversion effects, the losses from the non-irrigated site would be much lower, <5 kg N/ha/y. The Irrigated Only site would have losses of 3-10 kg N/ha/y. The high losses from our Irrigated/Effluent site (>120 kg N/ha/y) were already reported separately of annual leaching losses for that site, which were 27-80 kg N/ha/y.

Is the Nitrate data layer shown at start of presentation available via the data portal?

Updated versions of this map are presented in the MfE 'Our Freshwater' report and by StatsNZ (https://www.stats.govt.nz/indicators/nitrate-leaching-from-livestock). You can access the data there.