Fluxmeter News

The latest from the fluxmeter network

Edition 1 - June 2018

Contents

Protecting our groundwater: Measuring and managing diffuse nutrient losses from cropping systems is a FAR-led programme for mixed arable and vegetable cropping systems. The research focusses on measuring diffuse nutrient losses from cropping systems and the mitigation of these losses through the adoption of industry agreed good management practices.

The Ministry for the Environment's Fresh Water Improvement Fund is the main funder for the three year programme of work, with co-funding from the collaborating partners; FAR, HortNZ's VR&I Board, Potatoes NZ, Ravensdown, Environment Canterbury, Horizons Regional Council, Hawkes Bay Regional Council, Waikato Regional Council and Auckland Regional Council.

The collaborating research organisation is Plant & Food Research.

The project builds on a three year programme of work funded by MPI's Sustainable Farming Fund.

Introduction

Welcome to the first Fluxmeter News. This is a new initiative for the project which will keep you up to date our progress. I hope you will find it interesting and informative.

Our Team

The project is being managed Diana Mathers (FAR) supported by;

Matt Norris and Paul Johnstone (Plant & Food Research), Michael White (Ravensdown), Dereck Fergusson (HortNZ's Vegetable Innovation Board), Hugh Rithchie (farmer), Ogi Mojsilovic (Environment Canterbury), Ian McNab (Horizons Regional Council), Paul Train (HB Regional Council), Matthew Taylor (Waikato Reginal Council) and Tom Porter (Auckland Regional Council)

The Plant & Food team are responsible for all the data collection and analysis from the Fluxmeter Network.

Our Objectives

The project continues on from the SFF project and has a new name: *Protecting our groundwater: Measuring and managing diffuse nutrient losses from cropping systems*, but we will often refer to the *Fluxmeter Network* rather than the project's full title.

There are four project objectives deliverable by the end of the project in 2021:

Objective 1
A validated dataset of drainage and nutrient losses and a soil quality monitoring programme from the 12 host farms.

Objective 2
Mitigation plans for the 12 host farms will be developed with supporting resources using Good Management Practice (GMP) guidelines and informed by the validated fluxmeter dataset. Information on GMPs and environmental risks will be extended to all cropping farmers.

Objective 3
An engagement and related action plan will be developed with Overseer® Ltd to enable the validated dataset of nutrient losses to be used to validate the crop module in Overseer®.

Objective 4
An engagement plan with Māori farmers and iwi in the fluxmeter catchments will be developed to enable iwi to be actively involved in the fluxmeter network work programmes and facilitate information exchange between parties.

These objectives have been designed to work together to capitalise on the value of the data and to increase awareness and understanding about New Zealand's cropping systems.

A key component in this work programme is collaboration:

- The science team is working closely with the project team to identify how we can get best value out of the data being collected, specifically how it can inform farmers about management decisions they may be considering to reduce environmental risks
- We are working with the Overseer Ltd team to find ways data can inform the Overseer crop module.
- The project has a specific focus on working with Maori land managers. We are keen to develop networks with iwi so that learnings can be shared as we work towards a better understanding of the interaction between the farm and the environment.

A technical review of the Fluxmeter Network performance

The fluxmeter network was installed in 2014 and since then it has been used to collect information about drainage and nutrient losses from arable and vegetable cropping systems. This is important information for the sectors and we must have confidence that the fluxmeters are performing well and providing reliable results.

A technical review, undertaken by Plant & Food Research in June 2018, has evaluated the measured drainage volumes from each of the sites against modelled (SPASMO) outputs for the period between 1 September 2014 and 28 February 2018. For most sites this is at least three years of continuous data collection including the period when the fluxmeters were settling in, and across multiple crop rotations.

With the exception of Site 8, fluxmeters at all sites have effectively captured drainage water. At times there are large variations in the volumes captured by individual units (there are twelve fluxmeters at each site) and these differences relate to different drainage patterns which are affected by topography, soil physical properties and crop factors.

Site Performance

The review confirmed that eleven of the twelve fluxmeter sites are operating in a manner suitable for the generation of robust data on nitrogen and phosphorus losses in drainage water (Table 1).

At seven of the sites (Sites 1, 2, 3, 4, 5, 6 and 10), the captured drainage volumes were highly consistent with the SPASMO model predictions for the timing of drainage events and patterns of drainage accumulation (Table 1).

At the other sites and at certain times, the captured drainage volumes deviated from the modelled predictions. At Sites 7, 11 and 12, there were times when the fluxmeters flooded and too much drainage water was captured. When this happened, nitrogen and phosphorus losses were estimated by using a combination of modelled drainage values and measured concentration data. Nutrient concentration data were evaluated to ensure that their values were consistent with the water draining through the soil profile, as opposed to water from bypass flow or ground water infiltration.

At Site 9, we collected less drainage than expected. Soil physical characterisation will be used to confirm whether the captured volumes are being underestimated.

At Site 8, concerns have been raised about the performance of some of fluxmeters which have captured no drainage in the 41 months of monitoring. The performance of this site will be monitored during this winter and spring and if a significant number of units continue to collect no drainage water, reinstallation might be required. Soil moisture monitoring at depth at the site does confirm the site has remained very dry throughout the monitoring period.

Table 1. Summary of performance for the 12 fluxmeter sites for the period 1 September 2014 to 28 February 2018.

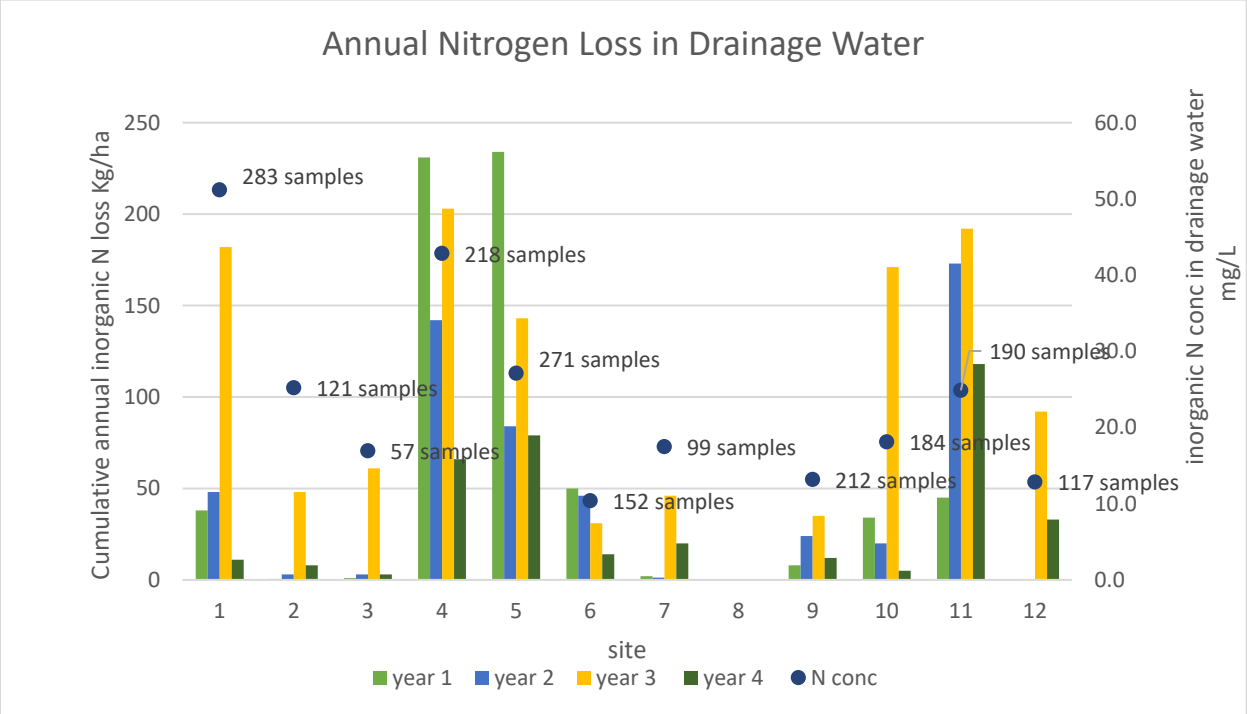
Site	Region	Site Performance [1]	Description
1	**Canterbury**	✓	Site performing well.
2		✓	Site performing well.
3		✓	Site performing well.
4	**Manawatu**	✓	Site performing well.
5		✓	Site performing well.
6		✓	Site performing well.
7	**Hawkes Bay**	✓?	Interpret with some caution: Modelled drainage and measured concentrations used to estimate losses in Years 3 and 4.
8		X	Poor data and concerns about performance of fluxmeters.
9		✓?	Interpret with some caution: Drainage potentially underestimated.
10	**Waikato**	✓	Site performing well.
11	**Pukekohe Pukekawa**	✓?	Interpret with some caution: Modelled drainage and measured concentrations used to estimate losses in Years 1, 2 and 3.
12		✓?	Interpret with some caution: Modelled drainage and measured concentrations used to estimate losses in Year 4.

[1] ✓ = Performing well with no serious concerns.
✓? = Some concerns related to high or low drainage volumes, however, the fluxmeters are effectively capturing drainage.
X = Poor data; fluxmeters not operating effectively.

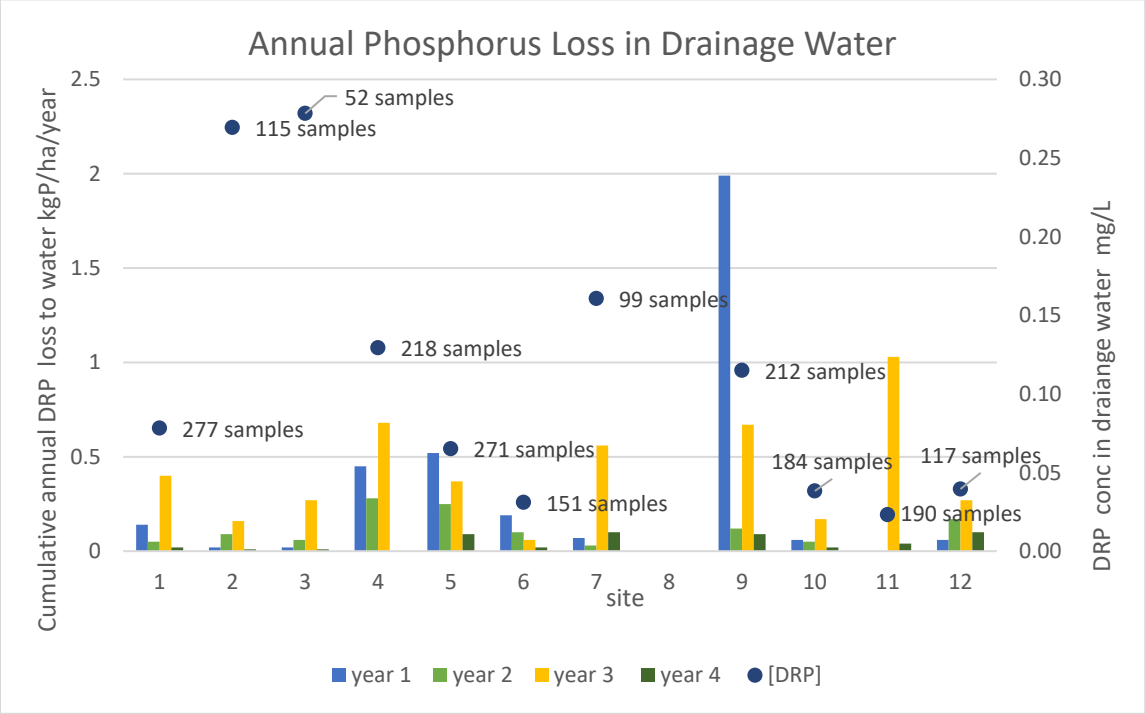
Nutrient Losses

Nutrient losses are variable across the sites and the years. High net losses are associated with high drainage volumes and high inorganic nitrogen concentrations in the drainage water. In most cases drainage losses occurred during the late autumn, winter and/or early spring months when rainfall and soil moisture levels were highest. Graphs 1 and 2 are the cumulative annual N and P losses from the 12 sites. For both graphs Year 1 =1 September 2014 to 30 August 2015, Year 2 =1 September 2015 to 30 August 2016, Year 3=1 September 2016 to 30 August 2017 and Year 4=1 September 2017 to 28 February 2018 (6 months).

Graph 1 Annual cumulative Nitrate losses (kg/ha) and average nitrate-N concentrations (mg/L) for drainage samples collected between 1 Sept. 2014 and 28 Feb. 2018.



Graph 2 Annual cumulative phosphorus losses (kg/ha) and average Dissolved Reactive Phosphate (DRP) concentrations (mg/L) from drainage samples collected between 1 Sept. 2014 and 28 Feb.2018.



The majority (50–95%) of the phosphorus loss was in the dissolved reactive form (DRP)

For more information and a copy of the full report refer to *Rootzone reality: technical review on network performance* (Norris, Johnstone, Liu, Arnold, Sorenson, Green, van den Dijssel, Dellow, Wright, Clark 2018) on the FAR website.

Soils and Sediments

The new soils initiative in the project is designed to encourage farmers to begin to monitor and record changes in their soil quality. My literature review found there were many soil monitoring programmes and ranging from those that only used visual assessment techniques to those that depended on specialised equipment. All required holes to be dug! I have compared three programmes:

Soil Health Guide Northern Central Victoria

This is an Australian programme which provides information to help farmers identify possible soil health issues. There are nine simple visual tests, conducted in the paddock, which are cheap and easy to do with some home-made equipment such as wire quadrants. The programme is supported by trained extension officers.

Visual soil assessment VSA

This New Zealand programme uses visual indicators taken in the field. It is designed for farmers and requires no specialised equipment. The visual indicators have been calibrated against quantitative (measurement-based) indicators of soil quality. The programme appears to be well-known, but not well used.

Soil Quality Monitoring system (SQMS)

The SQMS was developed by Plant & Food Research and is designed as an on-farm tool for monitoring and interpreting changes in soil quality. The programme depends on some specialised equipment.

The following indicators consistently appear across many soil monitoring programmes and will be the basis of soil monitoring at the fluxmeter sites.

Biological	Earthworms	
Chemical	pH, min N (quick Test) and total carbon.	
Physical	Inherent	Soil class and soil texture.
	Visual	Structural condition (clods and soil aggregates-size and distribution), soil profile (compaction and pans), soil colour.
	Bulk density	Bulk density corer.
	Penetrometer	Soil Health Guide Northern Central Victoria method.
	Aggregate stability	Soil Health Guide Northern Central Victoria method.
	Erodability	Soil texture, topography, dominant cultivation practice and fallow periods.

Our challenge is to get buy-in from the host farmers about the value of monitoring for soil quality.

My literature review on managing sediments on cropping farms has unearthed a dearth of scientific evidence for controlling sediments in cropping situations, both in preventing movement in the first place and capturing sediments after they've moved, before they move too far. However, a good comprehensive resource for New Zealand cropping farmers for managing sediments and soil erosion is HortNZ's *Erosion & Sediment Control Guidelines for Vegetable Production* (http://www.hortnz.co.nz/assets/Uploads/Auckland-Waikato-ES-Control-Guidelines-1-1.pdf)

Working with the Overseer® team

Overseer® Ltd are committed to a programme of continuous improvement and they have recognised the potential value of the fluxmeter data set for validating the crop modules of the Overseer model. The project's Overseer objective enables us to develop a team with a dedicated focus on improving the model for cropping farmers, this starts with knowing where to focus our efforts. We will be depending on input from the Overseer users who work with arable and vegetable farmers and regional council staff to steer us in the right direction. Three areas have already been identified;

1 Seed crops

Robust scientific information is required to support the modelling of seed crops in Overseer. Providing this will be challenging because of the diversity of seed crops grown in arable rotations. A possible efficient approach is to develop a smaller set of "generic" seed crops to run in the Overseer engine. For example a generic "brassica" seed crop could represent a multitude of actual brassica seed crops - cabbage, cauli and so on. Solving this will take some time and in the interim a short term solution is required. The Best Practice Data Input Standards recommendation for many seed crops is; "Use closest crop but extend growth period as much as possible". This provides challenges to the users and is likely to lead to inconsistencies in interpretation and incorrect budgets. The best short term solution seems to be to continue to use rye-grass seed as the proxy for many seed crops, knowing that these budgets will also be incorrect, but at least consistently incorrect across all Overseer users.

2 "Years in pasture" and its impact on the supply of soil N

In the Overseer, the "years in pasture" value is important for determining the supply soil of nitrogen through mineralisation processes and the value selected for this parameter has a big impact on nitrogen the losses reported in the nutrient budget. In a cropping rotation, "years in pasture" can be assessed as a function of both the restorative and depletive parts of the rotation over the previous 10 years. This can be tricky and open to interpretation by the users leading to the possibility of incorrect N loss numbers being reported. It is important for farmers and regional councils that Overseer nutrient budgets are as accurate as they can be because we rely on them to demonstrate that t farm-consent requirements for nitrogen management are being met. We will be exploring how the Fluxmeter Network's mineral and potentially available N data can be used to validate the "year's in pasture" parameter for arable systems.

3 Value for Money – What can the Overseer nutrient budget tell farmers?

Helping farmers to move beyond thinking that the nutrient budget is just for compliance and to see value for their investment.

For more information about the Fluxmeter Network

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