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MITIGATION ACTION PRIORITISATION AND RESOURCE TOOL FOR FRESHWATER FARM PLANS

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Abstract

Freshwater farm plans will soon be compulsory for all pastoral farms larger than 20 hectares as part of the Government's Action for Healthy Waterways reforms. We present a prototype geospatial resource tool developed to help the dairy sector identify and prioritise on-farm mitigation actions for water quality improvement. The tool locates and presents the nearest water quality monitoring data for a property so the user can understand their catchment context, and it prioritises on-farm actions based on a dairy typology framework. The tool further prioritises potential mitigation actions by contaminant (nitrogen, phosphorus, sediment, and *E. coli*), and can rank actions by either their effectiveness in reducing contaminant loss, cost-effectiveness, or by capital cost. The project was DairyNZ-led and funded, in collaboration with AgResearch, and co-funded by the Our Land and Water National Science Challenge Rural Professionals Fund. A final version of the tool will be freely available on the DairyNZ website after the current prototype has undergone further user-interface development.

Introduction

This paper presents an online geospatial resource tool that was developed to enable users to identify and prioritise mitigation actions for water quality improvement that are most relevant to a specific dairy farm property. The prioritisation of actions is based on the new dairy typology framework that incorporates climate, soil drainage, slope, and wetness (McDowell *et al*., 2020; Monaghan *et al*., 2021a; 2021b;). The tool also displays the nearest downstream water quality monitoring data, so the user can better understand their catchment context.

A comprehensive body of scientific knowledge underpins established mitigation actions for the key contaminants (nitrogen, phosphorus, sediment, and *E. coli*) relative to their effectiveness and cost-effectiveness (McDowell *et al*., 2018). For each mitigation action the prototype tool also provides links to key online resources, so users have access to current best-practice guides and information. The tool developers acknowledge that no two farms are the same, and so each farm will have a tailored solution for a given question. As such the tool has been designed to be used in conjunction with expert knowledge and on-farm visit(s) to ascertain site-specific actions and understand farmer goals.

How the tool works

The landing page for the current prototype tool is depicted in Figure 1. It enables the user to select the location of their property and then return information about the respective property titles relating to the dominant typology, and surface water quality data (Figure 2).

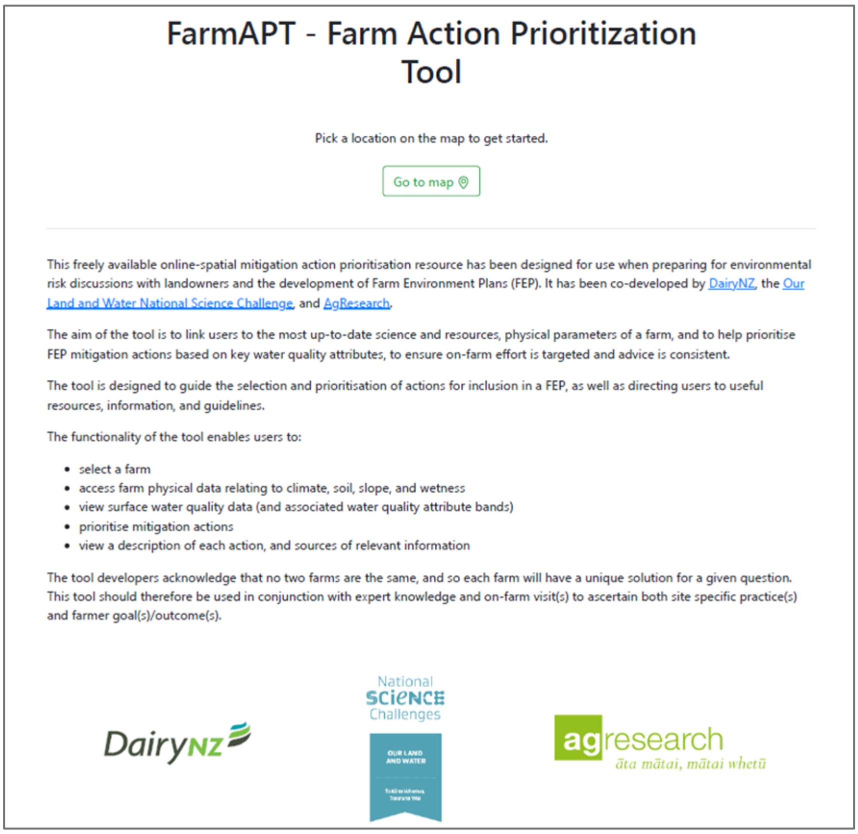

Figure 1: Tool landing page (screen-capture from prototype tool).

Typologies

There are currently 20 dairy typologies (McDowell *et al*., 2020; Monaghan *et al*., 2021a; 2021b). A typology is a combination of the following four geophysical attributes that can drive nutrient and contaminant losses:

- Climate:
    - Cool = < 12°C mean annual temperature
    - Warm = ≥= 12°C mean annual temperature
- Soil drainage:
    - Light = profile available water at 60 cm <85mm
    - Well-draining = New Zealand Fundamental Soil Layer drainage class 1, 2 or 3
    - Poorly draining = New Zealand Fundamental Soil Layer drainage class 4 or 5
- Slope:
    - Flat = up to 7°
    - Rolling = 7° and steeper

- <u>Wetness:</u>
    - Dry = mean annual rainfall <= 1,100 mm
    - Moist = mean annual rainfall >1,000 mm and < 1,700 mm
    - Wet = mean annual rainfall ≥=1,700 mm
    - Irrigated = at least 50% irrigated land

Surface water quality data

Surface water quality data, in the tool, is retrieved from the first available monitoring site downstream of the selected property. When a farm spans multiple sub-catchments, the site with the least satisfying indicator is chosen. If no sites are located downstream of the farm, the first upstream site is used if, and only if, the farm and the upstream site are within the same sub-catchment. Water quality state is given as five-year medians over the 2015-2019 period. Raw data can be accessed on [LAWA's download page]. If no monitoring site could be associated with a farm, or none of the sites have data for a specific contaminant, modelled water quality state is used instead. The modelled outputs are from NIWA's 2013-1017 modelled river water quality state. The complete dataset is available on [MfE's data portal].

Water quality attribute bands are from the National Policy Statement for Freshwater Management 2020 (Ministry for Environment, 2020), and where there is no water quality attribute band, the available national water quality data has been ranked from lowest value to highest value and reported as a quartile (Q1-Q4).

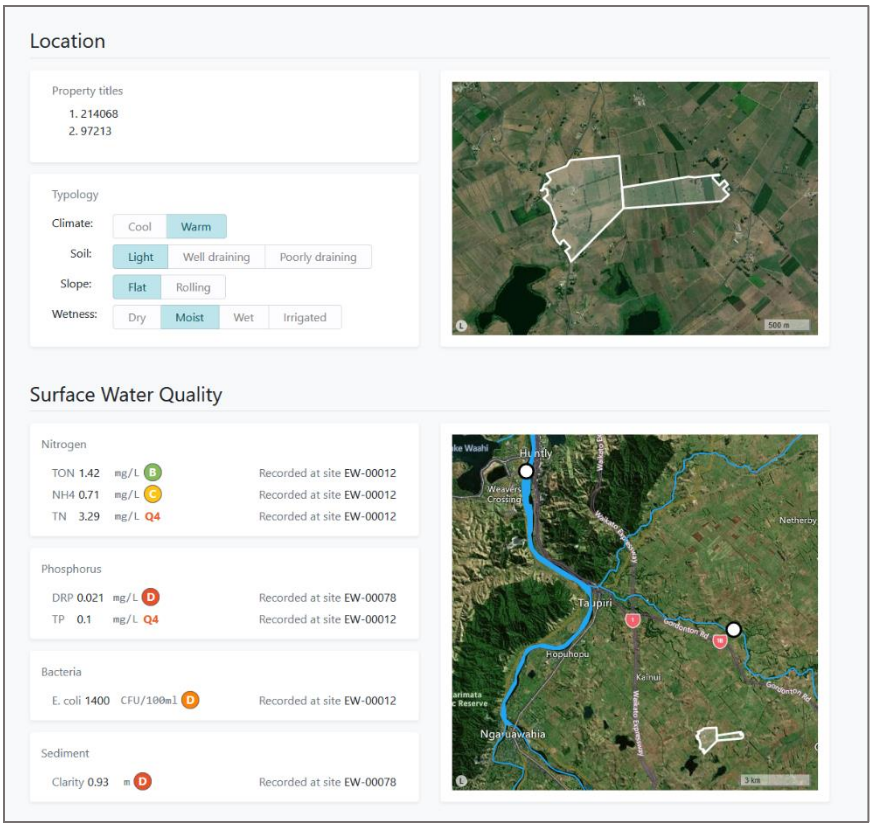

Figure 2: Interactive map of selected farm property titles (screen-capture from prototype tool).

Mitigation actions

A database of dairy mitigation actions for water quality has been compiled (Chapman, *et al.*, 2020; Macintosh and McDowell, 2020; McDowell *et al.*, 2013; 2018; 2020; McKergow *et al.*, 2007; Monaghan, 2016; Monaghan *et al.*, 2021b). Figure 3 shows an example mitigation action and associated text returned by the prototype tool. Mitigation actions have been scored (low, medium, and high) for the following attributes using existing published research and expert knowledge:

- <u>Effectiveness</u>: the relative reduction in contaminant loss for nitrogen, phosphorus, sediment, and *E. coli*:
    - Low = limited reduction in loss
    - Medium = moderate reduction in loss
    - High = significant reduction in loss

- <u>Cost-effectiveness</u>: the relative cost in terms of the quantity of contaminant that could be mitigated for nitrogen, phosphorus, sediment, and *E. coli*:
    - Lowly cost-effective = relatively high cost to mitigate each unit of contaminant
    - Moderately cost-effective = relatively moderate cost to mitigate each unit of contaminant
    - Highly cost-effective = relatively low cost to mitigate each unit of contaminant

- <u>Capital cost</u> to the farm business (for established mitigations only):
    - Low = limited input of time and expenditure. Limited practice change required
    - Medium = moderate input of time and expenditure. Some practice change
    - High = significant input of farmer time and significant expenditure. Significant practice change required

Established mitigation actions are those which have a long history and are well recognised, having been tested over a range of conditions. They include stock exclusion, and dairy effluent and fertiliser management (Monaghan *et al.*, 2021b). Whereas developing mitigations actions have a short history of development and have been tested at a handful of locations only. They include various edge-of-field mitigations, in-stream sorbents, controlled drainage, and retention dams and bunds (McDowell *et al.*, 2020).

Actions in the prototype tool are also grouped by management category as follows:

- Effluent
- Erosion/soil
- Farm system
- Grazing/cropping
- Irrigation
- Nutrient
- Waterways
- Winter grazing

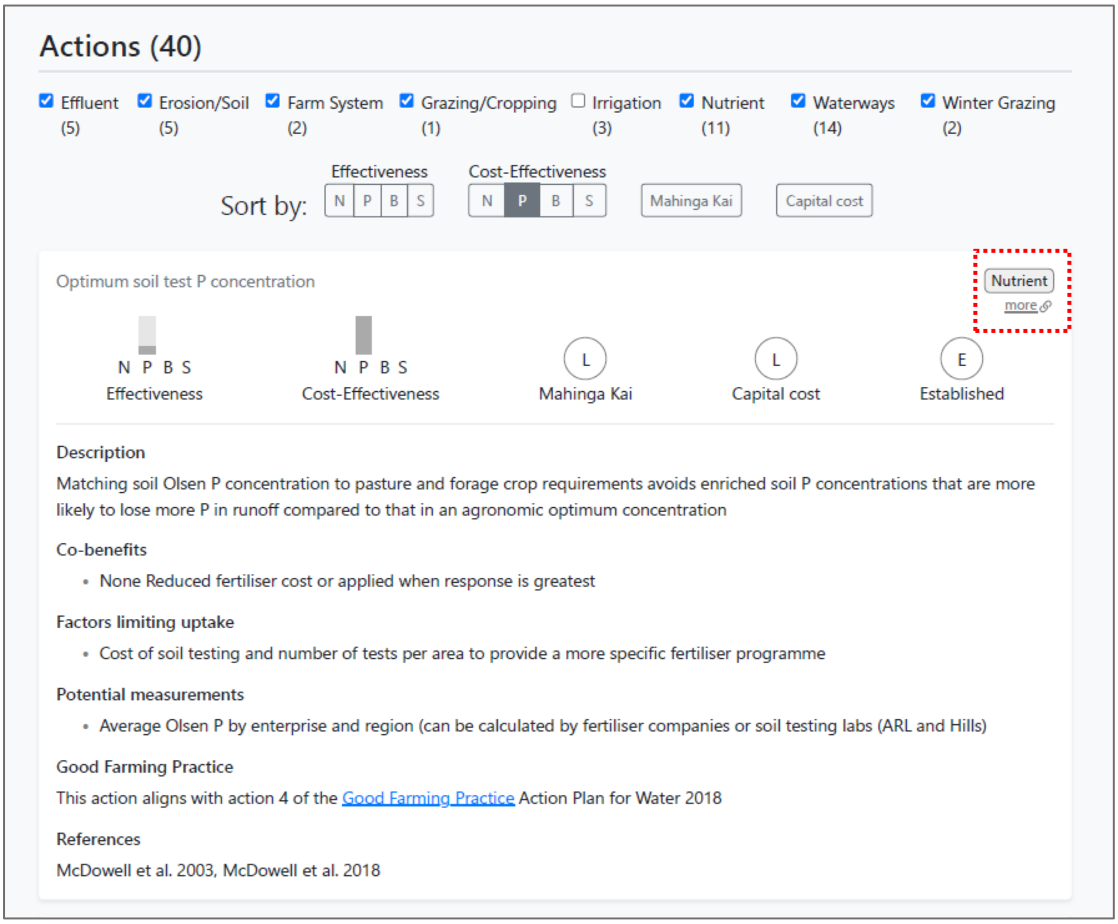

Figure 3: Example mitigation action and associated text. Red box highlights interactive link to more information and DairyNZ resources. N is nitrogen, P is phosphorus, B is bacteria (*E. coli*), and S is sediment (screen-capture from prototype tool).

Next steps for development

The prototype tool has been user-tested by a selection of rural professionals and dairy farmers. They generally found the tool easy to use and indicated that they would recommend it to others. Analysis of survey data collected from the user testing groups indicated a high level of support for the tool, the approach to testing and the added value it brings to the farm environment planning process. Next steps are to now take the tool from a working prototype and develop it into a fully functional version to support the continued uptake of mitigation actions on dairy farms to help improve water quality. On-going development of the tool's functionality will align water quality mitigation actions with actions for GHG's to support farmers to act on water and climate requirements and better understand action co-benefits. The final version of the tool will be available open access on the DairyNZ website.

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