Environmental Research on the New Lincoln University Dairy Farm

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Introduction

A major challenge to the New Zealand's growing dairy industry is to achieve an annual productivity gain of 4% in order to remain internationally competitive. However, it is important to ensure that this productivity gain is achieved without significantly comprising the quality and integrity of New Zealand's "clean and green" environment.

There is increasing public concern about the effects of dairying on the environment, both within New Zealand and by our overseas customers. One of the main concerns is the possible threat to the quality of groundwater and surface water, particularly by nitrate, phosphate and microbial contaminants.

Nitrate leaching from soil is of concern because of its impact on drinking water quality and the effects that nitrate can have on rivers and lakes. A high nitrate concentration in drinking water is a recognised health hazard and a high concentration in rivers and lakes can cause excessive growth of algae and weeds, which may reduce the fish population. Nitrate leaching also represents a financial cost to the farmer and a loss in soil fertility.

The establishment of the new Lincoln University dairy farm is designed to enable us to develop and test practical methods to improve productivity and at the same time protect the environment.

The objective of the environmental project on the new Lincoln University dairy farm is to develop best management practices under irrigation which will ensure that the dairy industry's 4% productivity gain is achieved in a sustainable way, and that the wider environment is protected.

Environmental research programme

Four environmental monitoring systems have been installed on the new dairy farm.

Lysimeter programme

Sixty "soft-top" lysimeters have been installed in six locations on the dairy farm (Figure 1).

The development of "soft-top" lysimeters allows cattle grazing to occur without interference.

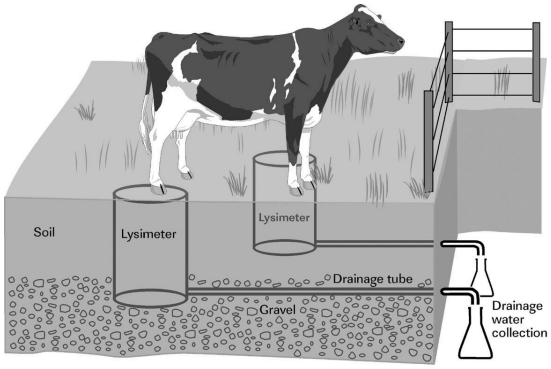

Figure 1: Environmental monitoring system for dairying on lighter free-draining soils.

The lysimeters are used to measure and monitor drainage water quality, nutrient leaching losses and drainage water losses on contrasting free-draining soils under a range of typical and advanced farm inputs and management conditions. Drainage water is collected from each lysimeter immediately after rainfall, or irrigation, has generated a drainage loss. Leachate is analysed for N (NO_3^-, NH_4^+, NO_2^-, total-N) and P (DRP, total-P) concentrations. Results will inform the farm management team of the effects of the various management systems on drainage water quality and help direct changes in management so that the environmental integrity of the farming system is achieved.

Pipe drainage measurement and monitoring system

Because the Temuka soils on the south block of the farm have an impervious subsoil they are suited to a pipe drainage measurement and monitoring system, and unsuited to lysimeter monitoring. Six "nova-flow" drainage pipes have been installed in hydraulically isolated drainage plots (each 100 square metres) in the Temuka soil at the South end of the new dairy farm (Figure 2).

Automatic samplers are used to collect drainage water samples from the pipe drain outfalls. Automatic drainage water samplers are required at each outfall in order to collect the drainage water in proportion to the flow rate in the drains. Tipping-bucket sensors automatically determine the flow rate. Rainfall and irrigation are recorded at the site using a tipping bucket rain gauge, attached to a data logger. Data from the drainage samplers, rain gauge and other sensors will be sent by telemetry to the laboratory.

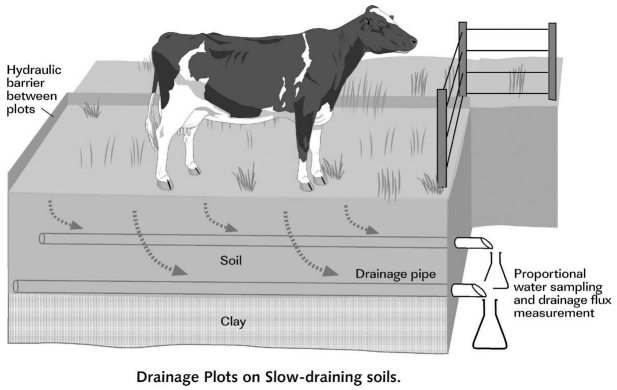

Figure 2: Environmental monitoring system for dairying on heavier, slow-draining soils.

Groundwater monitoring wells

Because the North block of the farm has free-draining soils and sits above a shallow unconfined aquifer, direct measurements of the effects of the dairy farm on groundwater quality can be made. To do this, nine groundwater-monitoring wells have been installed at three clusters on the farm (Figure 3).

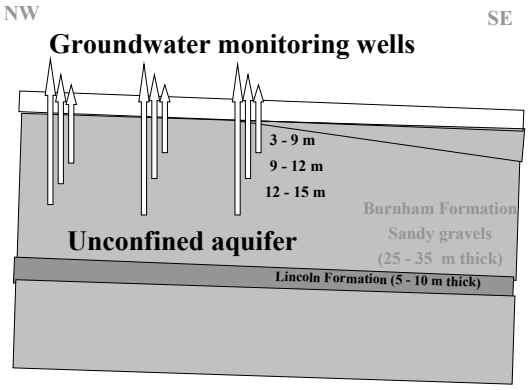

Figure 3: The groundwater monitoring wells on the new Lincoln University Dairy Farm.

The wells in the NW corner of the farm allow measurement of the quality of the incoming water and the wells in the centre of the block and at the SE corner allow us to detect any changes in water quality that may occur. The wells in each cluster are at different depths (9, 12 and 15 m) to enable us to measure the extent of mixing of the aquifer and to ensure that we can detect the full effect of the farm on water quality. Water samples are analysed for N, P and selected microbes (*E coli*. and *Campylobacter*).

Soil quality monitoring programme

A soil quality-monitoring programme is being conducted to ensure that best management practices are developed which protect the soil from physical degradation by pugging and compaction, as well as maintaining soil fertility for optimum production.

The soil quality-monitoring programme will measure changes in the following key parameters at selected sites on the property:

- *Soil fertility*

  Soil pH, Olsen-P, Quicktest Ca, Mg, K and Na, sulphate-S, organic-S.
- *Soil physics*

  Air-filled porosity (macroporosity @ -10 kPa), soil aggregate stability, bulk density.
- *Soil biological indicators*

  Mineralisable-N, hot water extractable C, organic-C, total-N.
- *Plant analysis*

  Plant samples will be analysed for nutrient concentration.
- *Nutrient balance*

  Nutrient budgets for the farm will be calculated.

The environmental research programme on the new Lincoln University dairy farm will allow us to test, and demonstrate some new environmental technologies under realistic conditions on a commercial farm. The research programme will also provide additional information on nutrient leaching losses under commercial farming conditions, and the farm will act as a vehicle by which new findings and new technologies from our studies can be translated into on-farm management practices.

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