Nitrogen, water quality and the weather

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Summary

- Weather and soil type have a significant influence on the nitrate concentration found in water.
- The proportion of nitrogen (N) inputs recovered in production (N use efficiency) on Irish dairy farms is typically 25% to 33%.
- Fertiliser N readily converts to a soluble form (nitrate) that does not bind to soil and is easily leached to ground water.
- Areas in the country that have more intensive dairying have been found to correspond with the rivers and estuaries showing higher nitrate concentrations.

Introduction

The increase in dairy cow numbers from one million in 2012 to 1.5 million this year is unlikely to slow down given the relative financial returns from dairying in comparison with other enterprises. Ireland exports a large amount of dairy products produced based on our green image and sustainable grass-based production systems. However, this increase in dairy cow numbers is often questioned as being incompatible with improving ecological and environmental standards. For example, an EPA report shows clear distinctions between regions of the country where N concentrations are high and low. While phosphorous (P) is the main concern for rivers and lakes (fresh water), N is the nutrient that impacts on coastal/salty water. Estuaries on the east and south coast have high nitrate concentrations in comparison to the rest of the country. These areas correspond to (i) areas with the greatest increase in cow numbers and (ii) areas with free draining soils.

The recent changes in the dairy industry have taken place against the back drop of environmental regulations, namely the "Nitrates Directive" and the "Water Framework Directive" (WFD). The nitrates regulations restrict farm stocking rates to two cows per hectare unless a derogation has been sought and approved. Ireland must get permission to implement the derogation process from the EU every four years and it should not be taken for granted. For the WFD assessment, the EPA classifies the quality on over 5,000 "water bodies" nationally and they include ground water, rivers, lakes, estuaries and coastal water. The five categories are high, good, moderate, poor and bad. The WFD objectives are that all monitored water bodies meet good or high status and that existing high status water bodies should not deteriorate. Worryingly, a recent water quality report from the EPA showed a downward trend in river water quality. While agriculture is only one of a number of sectors that influence water quality, should this downward trend continue, it may affect Ireland's implementation of the Nitrates derogation in the future.

Agricultural Catchments Programme (ACP)

The ACP has been monitoring the effectiveness of the Nitrates regulations in six small (*ca.* 1,000 ha.) catchment areas for the last 10 years. In addition to measuring farm production (land use, stocking rate, fertiliser application etc.), each catchment has a monitoring station recording the volume (discharge) and nutrient (N and P) concentration of the water leaving the catchment every 10 minutes. While farm practice is important, the ACP has found that soil type has a very significant influence on N concentrations. Free draining soils are more risky in terms of N losses. The Ballycanew catchment has a heavy soil and its average N concentration (2.5 mg/l) is two to three times less than Timoleague (5.7 mg/l) and Castledockrell (7.0 mg/l). This is because soil does not hold onto nitrate, which

dissolves easily in water. Water percolating through the soil in free draining catchments carries dissolved nitrate that eventually ends up in the estuary via spring fed watercourses.

Weather is also a significant factor impacting on the nutrient concentration of water. The dry summer of 2018 shows this (Figure 1). During the drought, soil bacteria continued to break down organic matter, releasing mineral N. However, as grass was not growing due to drought stress, there was little or no uptake of either this naturally occurring N or any other applied fertiliser N. When the rain did eventually come in the autumn, much of this unused N was washed through the dried out soil and into ground water. The water tables then rose and the streams started to flow with concentrations of N that were higher than that found in previous, drought free years.

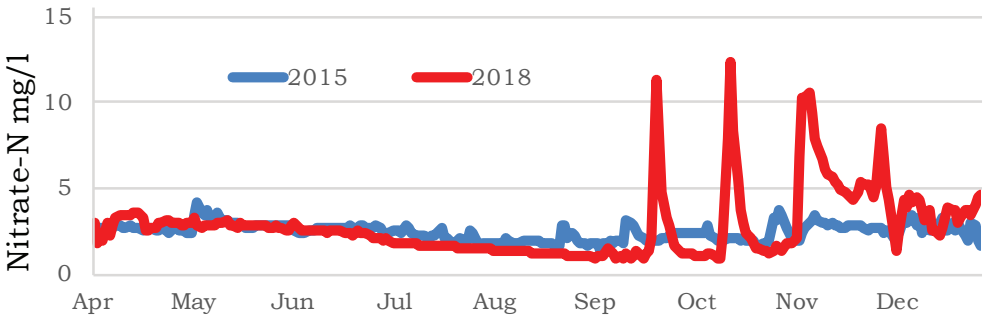

Figure 1. *Nitrate in Ballycanew in 2015 and 2018*

Conclusions

When you compare the farm N inputs (N in fertiliser, meal etc.) with off-takes (milk and livestock sales etc.) typically only 25% of the N is recovered, the remainder being lost to the atmosphere, water or bound up in soil organic matter. More efficient N use of up to 33% can be achieved and this has a dual benefit of reduced input costs as well as reduced environmental losses. If we are to achieve maximum N use efficiency, it is critical to manage fertiliser applications to suit the soil type, weather and growing conditions. Correct timing of N will significantly reduce losses and give greater growth response per kg N applied. The ACP has recently launched a website (www.acpmet.ie) displaying hourly weather updates from each of their six catchments, including soil temperature. This information will assist farmers near to the catchments to maximise N use efficiency on their land.