# NITRATE AND PHOSPHATE: A PROBLEM FOR WATER QUALITY

FACT SHEET 7

## Why is nitrate a problem?

Nitrogen is an essential element – vital for life. It is found in soil and water in several forms, mainly as nitrate ($NO_3$) and ammonium ($NH_4$). The formation of nitrate is part of the nitrogen cycle in the environment and occurs when microorganisms break down decaying plants, manures, fertilisers and other organic residues. Plants take up the nitrogen as a nutrient, and many crop plants require large quantities to produce high yields. Additional nitrogen is applied to crops in the form of inorganic and organic fertilisers to maximise yields.

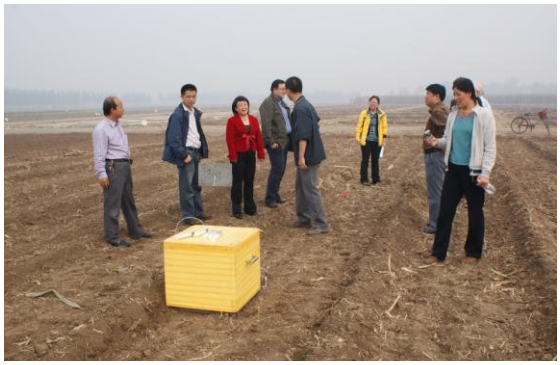
### Effects of nitrate on the aquatic environment

Nitrate is highly soluble and rain and irrigation water can leach unutilised nitrate into groundwater and carry it into watercourses. In watercourses it provides a nutrient boost in that environment that can alter the ecological balance. High nitrate concentrations in drinking water have been associated with health implications for humans and animals. Nitrate in water is tasteless, colourless and odourless and can only be detected by chemical analysis.

### A Greenhouse Gas

Nitrogen in the form of nitrous oxide ($N_2O$) is a very potent greenhouse gas (GHG). Although there are relatively small amounts of $N_2O$ emitted from agricultural sources, the warming potential is about 300 times that of carbon dioxide. $N_2O$ emissions arise from the breakdown of fertilisers and manures (~33%), and from leaching and runoff (~26%). In recent years emissions have been reduced through improvements in agricultural practice that have reduced losses from fertilisers, and through reduced fertiliser application to grasslands. Nevertheless, emissions of $N_2O$ as a direct result of soil nutrient management are the dominant source total UK agricultural GHG emissions, accounting for 38% of the agricultural total ($CO_2$ equivalent) as compared with 36% for ruminant digestive emissions.

Source: Defra agricultural emissions figures from the 1990-2007 Inventory (2009)



Gas chamber for measurement of direct GHG fluxes ($N_2O$ and methane) from the soil surface, in this case in a maize field on the North China Plain.

## What can be done to reduce nitrate pollution?

Contaminated water destined for human consumption can be treated by various processes (e.g. reverse osmosis, ion-exchange) or can be blended with water from a less contaminated source to ensure drinking water standards (50mg/l) are met. However, treatment is expensive: prevention is preferable.

Good farming practice minimises the risks of nitrate pollution. For example -

- Through careful consideration of all possible sources of nitrogen available to the crop, e.g. from soil organic matter, manuring, the inclusion of legume crops in the rotation, the nitrate status of irrigation water, and residual soil nitrate (determined by soil and water sampling) in the calculation of fertiliser applications.
- Through careful control of the frequency and timing of fertiliser applications to avoid over-application of nitrogen fertilisers.

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# NITRATE AND PHOSPHATE: A PROBLEM FOR WATER QUALITY

FACT SHEET 7/b

## Why does phosphate produce water quality problems?

Phosphate is non toxic – in fact like nitrate, it is also vital for life. Also like nitrate, when excess phosphate enters water courses it provides a nutrient boost that is generally manifested as excessive algal growth. The algae may produce toxins that negatively affect other aquatic wildlife; excessive plant growth can reduce oxygen levels, which may impact fish stocks, degrade habitats, lead to loss of species and generally reduce the amenity value of the waterway. Phosphates can originate from many sources including some detergents, sewage and manure but they are also a component of artificial fertilisers.

Unlike nitrate, the amount of phosphate in drinking water is not regulated, though the WHO (World Health Organisation), has provided a maximum 'safe' level of around 5 mg per litre. High levels (above 100 mg/l) can adversely affect processes in water treatment works.

In river environments, soluble reactive phosphorus concentrations of less than 100 μg/l are considered desirable to reduce the threat of over-enrichment of this nutrient.

## What needs to be done to reduce phosphate pollution?

As with nitrate, where phosphate originates from agricultural sources, good farm management practices are the key to reducing release of phosphates into the wider environment, especially those processes that minimise sediment loss from soils since phosphorus is found attached to soil particles. Further reductions can be achieved by installing phosphorus stripping at sewage treatment works and also maintaining septic tanks in good working condition.

## **WENSUM ALLIANCE** Research Team at UEA

The Wensum Alliance is being led by Prof. Kevin Hiscock and Prof. Andrew Lovett from the School of Environmental Sciences at the University of East Anglia in Norwich. The first phase of the project runs until 31 March 2014. For further details please contact:


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If you would like to join the **Wensum Alliance** and be part of this project, please get in touch. Your local knowledge, experience, expertise and advice will be invaluable in helping to develop the right management solutions for reducing pollution in the Wensum catchment.

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