

Nitrous oxide emissions within a farming system occur from three sources: soil microorganism activity, organic manure management and application, and nitrogen fertiliser application. Every process which adds nitrogen to the soil increases the likelihood and extent of N_2O formation. The processes involved form a vital part of the nitrogen cycle and can therefore not be eliminated, however they can be managed more effectively to ensure that N_2O emissions and nitrogen losses contributing to wider environmental pollution are minimised.

N_2O Formation

Plant-available nitrogen (ammonium and nitrate) is present in the soil as a result of fertiliser application or from the breakdown of organic matter (manures, plant residues and composts, etc) by soil organisms. Ammonium is rapidly converted to nitrate through the process of *nitrification*. This reaction releases N_2O as a by-product. Nitrate is soluble and very mobile which makes it prone to being lost from the soil through leaching. In water-logged conditions nitrate can be transformed to nitrogen gas (N_2) through *denitrification* – N_2O is again released as a by-product of this process.

Efficient use of nitrogen and careful management of factors affecting soil processes are vital both in terms of N_2O reduction and productivity. Improved nitrogen efficiency will result in reduced N_2O emissions.

Nitrate Leaching

Nitrate leaching is a problem because nitrate is soluble and does not bind to the soil surfaces – this makes it susceptible to loss in drainage. Nitrate leaching can lead to eutrophication and acidification of fresh water, estuaries, and coastal zones which in turn has implications in terms of biodiversity loss, toxic algal blooms, and reef degradation which can harm shellfish and fisheries. Eutrophication and acidification creates anaerobic conditions which promote the production of N_2O as nitrate is transformed to N_2 gas. This is thought to be an important contributor to global N_2O emissions but as yet has not been quantified. Reducing nitrate losses via leaching is therefore an important factor in minimising N_2O emissions from agriculture.

Volatilisation of Ammonia

Another major pathway of nitrogen loss from farming systems is via the volatilisation of ammonia from soils and its deposition elsewhere, which can have a range of ecological implications down wind. Ammonia is easily converted to nitrate and can become at risk of leaching. Reducing ammonia losses is therefore another potential mitigation practice to take into account when trying to minimise N_2O emissions from a farming system.

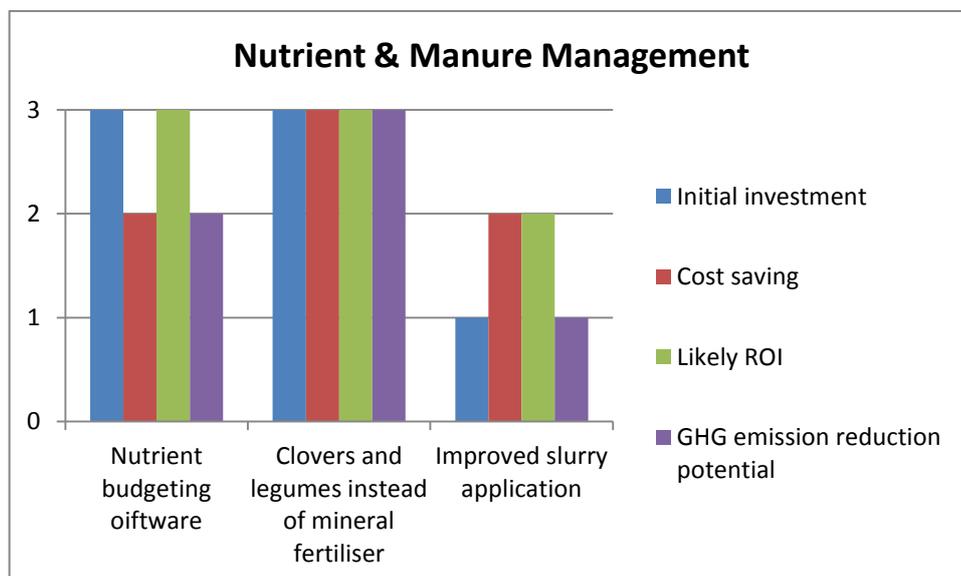
Economic Benefits of Nutrient and Manure Management

We have researched three of the most popular nutrient and manure management options and assessed their relative benefits based on:

1. Initial investment
2. Cost saving
3. Likely ROI

4. GHG emission reduction potential

The graph below shows the results of the research.



Results: Immediately we can see that nutrient and manure management measures have higher benefits all round. Using legumes in place of mineral fertiliser comes out trumps, with all four areas rated as excellent. Using nutrient budgeting software is a close second, with low investment costs (free software) and excellent ROI.

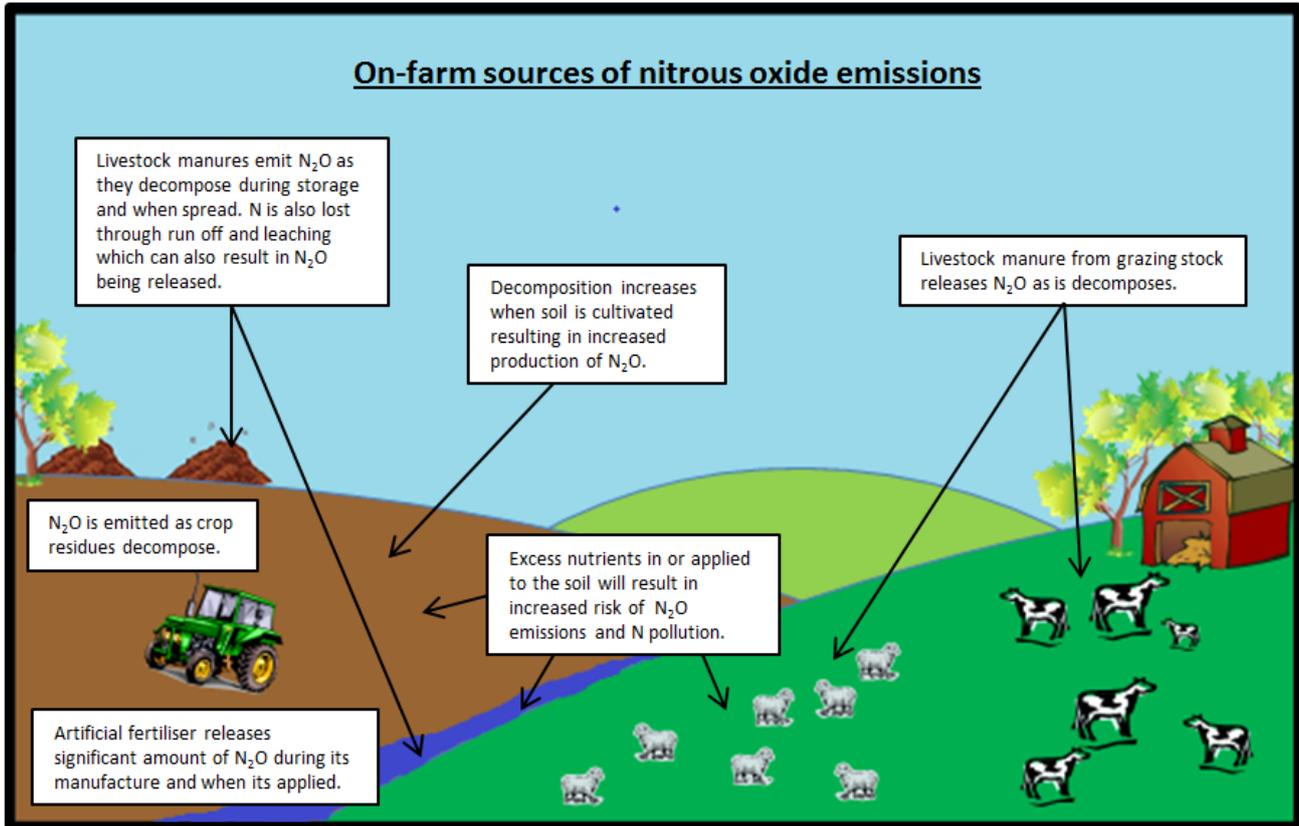
Economic verdict: use legumes such as clover to add Nitrogen to the soil and enjoy excellent economic benefits.

Further Information

There are a number of management measures which contribute to minimising both N₂O and nitrogen losses, these include:

- careful planning to ensure that any **surplus** within the system is minimal
- considering the type of **fertility inputs** used
- ensuring optimal soil chemical and **biological** conditions
- ensuring that **applications** are **timed** effectively and make best use of conditions
- ensuring that optimal application **methods** are used
- ensuring that **manures** are **stored** and managed effectively
- effective management of crop **residues**

The following factsheets in this series focus in more detail on the management practices that can be implemented to take steps towards improving a farm's impact on greenhouse gas emissions with particular reference to N₂O.



Sources of N_2O emissions within a farming system

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