FARM NET ZERO

Reducing Nitrogen Usage in Crop Production

Overview

Understanding of the sources of on-farm emissions presents an opportunity to not only reduce the carbon footprint of a business, but also to increase economic efficiency and overall resilience. Carbon is a useful metric in which to comprehend how resource efficiency can be optimised, aligning with greater business resilience and environmental practices.

Legislation mandates the reduction of emissions by 78% by 2035, progressing towards Net Zero and emission neutrality by 2050. Agriculturally classified land comprises 72% of the land area of the UK, as such is a vital industry in the achievement of this goal.

Rotational Design

Reducing the use of nitrogen in an arable rotation can initially appear daunting, but examining rotational and contractual choices can help to minimise the quantity required.

Knowing the parameters of the high and low nitrogen crops within a rotation can help aid tactical management decisions. For example, when rotation planning growing crops such as winter wheat with a high nitrogen demand following beans, oilseed rape or potatoes would have a 30kg lower requirement when compared to following another cereal due to the assumed Soil Nitrogen Supply (SNS).

Calculating the SNS of a field is a requirement of good nutrient management planning and can result in economic savings through optimising nitrogen usage. The lower the SNS the greater the nitrogen demand of the following crop.

Previous Cropping	Soil Nitrogen Supply (SNS)*
Cereals	1
Forage Crops	1
Sugar Beet	1
Beans/Peas	2
Potatoes	2
Oilseed Rape	2
Uncropped Land	2

*Nitrogen recommendation based upon a Medium Soil in an area of Moderate rainfall (600-700mm annually), Figures taken from RB209 Section 4, 2021

Nitrogen as a Greenhouse Gas

Nitrogen is a large source of arable farming emissions due to the nitrous oxide (N_2O) released during the manufacture and application process. Compared to carbon dioxide (CO_2), N_2O is 265 times more potent, therefore, every 1 tonne of N_2O is equivalent to 265 tonnes of CO_2.

Greenhouse Gas (GHG)	Carbon Dioxide Equivalent (CO_2e)	Proportion of UK Emissions Attributed to Agriculture
Nitrous Oxide (N_2O)	265	70%
Methane (CH_4)	28	49%
Carbon Dioxide (CO_2)	1	1.6%
Overall GHG	-	10%

Data courtesy of: DEFRA. (2020) Agricultural Statistics and Climate Change. Tenth Edition and IPCC. (2014) Fifth Assessment Report (AR5).

Greenhouse Gas Emissions (GHG) are categorised into three scopes, which are combined to calculate total farm emissions:

Scope 1 – **DIRECT EMISSIONS:** Sources of emissions owned or controlled by the company such as tractors, farm machinery, gas for heating and from change of land use. Additional emissions arise from N<O released as a consequence of manure storage and application.

Scope 2 – **PURCHASED EMISSIONS:** Emissions associated with the generation of purchased electricity used on the farm.

Scope 3 – **INDIRECT:** Indirect emissions associated with the production, processing and distribution of inputs into the farming system. Artificial inputs of fertilisers and pesticides carry a historic emission value which as the end-user the farming business must account for. This also includes embedded emissions in machinery, building materials and farm infrastructure.

Variety Choice

- Contract availability of lower nitrogen demand cereal crops such as malting barley, rye or oats
- Promoting nitrogen capture with cover crops, companion crops or clover understoreys
- Blended seed choice with older, less nitrogen demanding varieties

Produced by the Farm Carbon Toolkit on behalf of Farm Net Zero.
Learn more at: farmcarbontoolkit.org.uk/farm-net-zero

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Nitrogen Management

There are many alternative methods towards understanding crop requirement and consequent quantity of nitrogen used on farm. Management practices such as measuring grain nitrogen to determine the success of previous management can be undertaken on a block or field basis. For example, the economic optimum rate of nitrogen for wheat is considered to be 11%* for feed and 12% for bread making. Analysis of the harvested grain nitrogen content can infer whether nitrogen can be reduced or timings adjusted to meet this standard, with a 0.5% increase in grain protein tending to infer 25kg of nitrogen use.

Understanding the various nitrogen requirement of individual crop type can also guide rotational choices and management decisions. If you are trying to reduce nitrogen use on farm, consideration can be given to the input requirement - particularly in cereals where a spring wheat has approximately double the demand of a malting barley. Consideration of mitigation methods before high nitrogen use crops such as cover cropping, undersowing or companion cropping may reduce demand for artificial fertiliser.

Baseline nitrogen requirements, additional use depending on average yield and specification.

Cropping Choice	Nitrogen Requirement*
Spring Wheat	150kg
Spring Oats/Rye/Triticale	70kg
Spring Oilseed Rape	80kg
Spring Linseed	50kg
Spring Barley (Feed)	110kg
Spring Barley (Malting)	70kg
Sugar Beet	100kg

*Nitrogen recommendation based upon a Mineral Soil of SNS 2, Figures taken from RB209 Section 4, 2021

Cropping Choice	Nitrogen Requirement*
Winter Wheat	190kg
Winter Oats	130kg
Winter Rye	90kg
Winter Oilseed Rape	190kg
Winter Barley (Feed)	140kg
Winter Barley (Malting)**	90kg

*Nitrogen recommendation based upon a Medium or Mineral Soil of SNS 2, Figures taken from RB209 Section 4, 2021

Potatoes

Contract choice and variety selection has a huge impact upon the nitrogen use of potato cropping. The higher longevity and the more indeterminate a variety is, the lower the requirement for nitrogen. When planning potato cropping, choosing a Group 4 (very long haulm longevity, indeterminate) such as Royal or Markies has a much lower nitrogen requirement compared to a Group 1 (short haulm longevity, determinate) varieties Estima, Innovator or Accord.

Consideration of planting and lifting date is also vital if you are trying to reduce the farm nitrogen requirement. Potato cropping specifications which require longer growing periods are likely to have a greater requirement for nitrogen. Contracts or markets which support shorter growing periods alongside less nitrogen hungry varieties are likely to improve the carbon footprint of a farm, through reducing the requirement for bought in nitrogen. Equally, consideration of the storage time for the harvested crop is vital, with emissions associated with fuel and electricity usage contributing to the carbon footprint. Therefore, short storage contracts, 100% renewable tariffs or the ability to produce renewable energy in-house from solar or wind should be implemented to maximise resource efficiency.

Length of Growing Season	Nitrogen Requirement*			
	Group 1	Group 2	Group 3	Group 4
Up to 60 days	70-110kg	50-80kg	40-70kg	**N/A**
60-90 days	130-160kg	60-120kg	40-100kg	20-40kg
90-120 days	190-220kg	110-160kg	80-100kg	40-60kg
Over 120 days	**N/A**	150-180kg	120-140kg	60-80kg

*Nitrogen recommendation based upon a SNS 2, Figures taken from RB209 Section 4, 2021

This factsheet was produced by the Farm Carbon Toolkit on behalf of Farm Net Zero, a project led by farmers in Cornwall, exploring the contribution that agriculture can make to achieving Net Zero. This project is funded by the National Lottery Community Fund.

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