Farm Net Zero: Arable Farming

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.

Political 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.

What are arable emissions?

Agriculture is responsible for a very small proportion of the UK emissions of Carbon Dioxide (CO_2). However, there are multiple greenhouse gases which contribute to climate change, which are measured as an equivalent of the global warming potential to carbon dioxide (CO_2e). Therefore, the relative contribution of each gas is corresponds to its 100 year global warming potential, the higher the value the larger this value (CO_2e) is.

Agriculture contributes 70% of UK Nitrous Oxide (N_2O) emissions, arising from both direct and indirect sources such as fertiliser, manure and cultivation processes. Another key source of agricultural emissions arises from Methane (CH_4), associated with manure usage. Anaerobic decomposition of manure during production and storage produces Methane, following application aerobic conditions drastically reduce this production. Although agriculture emits a proportionally low CO_2 compared to other UK industries, it should be considered a focus of arable farming emission reduction. Main contributions to CO_2 would arise from fuel use associated with crop production such as machinery usage, crop drying or storage.

Greenhouse Gas (GHG)	Carbon Dioxide Equivalent (CO_2e)	Proportion of UK Emissions Attributed to Agriculture
Nitrous Oxide (N_20)	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).

Key Insights & Recommendations

- Increasing use of legumes within the rotation to reduce reliance upon manufactured fertiliser
- Correct management of field nutrition requirements, including correcting pH where required
- Consideration of variable rate input application, including lime, fertiliser and pesticides to meet crop requirements
- Soil management to alleviate compaction or correct any underlying structural or drainage features impeding successful crop growth
- Implementation of cover or catch cropping systems to scavenge nutrients, suppress weeds and provide residues towards the building of soil organic matter
- Introduction or enhancement of existing field margins through increasing width, species diversity or management practices

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_2O 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.

For further information about the calculator methodology, visit: farmcarbontoolkit.org.uk.

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

Nitrogen Management

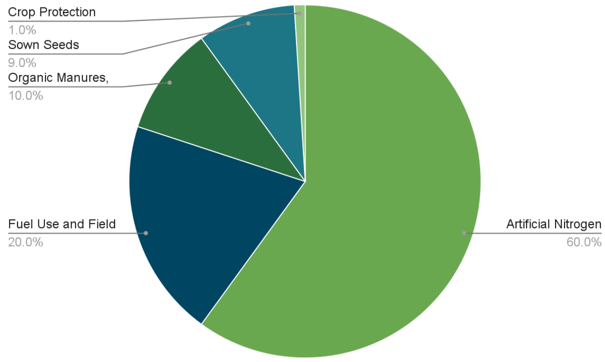
The emissions released from the use of artificial fertiliser arise approximately 50% from production and 50% from application. Fertiliser manufacture has a vast energy requirement and natural gas demand, during which nitrous oxide is often lost; technologies to reduce emissions can prevent this leakage in the production of both Ammonium Nitrate and Urea. Manufactured or organically derived sources of nitrogen fertilisers are necessary to produce food and fuel in the UK; balance is required between productive benefit and the potential environmental cost from the loss of this nutrient to the wider ecosystem via air and water pathways.

Estimates suggest that between 10-30% of all applied nitrogen fertiliser is lost and therefore not utilised by the crop to which it is applied. Technology to reduce losses such as chemical urease and nitrification inhibitors are designed to prevent large nitrogen wastage and the associated consequent emissions. Ensuring optimal uptake of nitrogen fertilisers increases the likelihood of plant utilisation and response; maximising resource efficiency through management techniques can decrease the total nitrogen requirement of the arable business through diminishing application losses.

Use efficiency is influenced by application method, timing and the environmental conditions at the time of spreading. Additional variencies can be found within different varieties of a crop type, so considerations must be made for uptake requirement and growth pattern. Consideration of precision farming techniques such as variable nitrogen and the tailoring of artificial inputs with the underlying consideration of balancing productive yield to consequent emission cost.

Opportunities for Sequestration

- Incorporation of straw and crop residues
- Implementation of cover crops within the arable rotation to reduce periods of bare soil and increase vegetative biodiversity
- Ensure there is a diverse cropping rotation, variety of rooting profiles increases biotic response in soil
- Management of hedgerows to support large growth profiles and increased carbon sequestration
- Reduction in tillage and maintenance of field margins and buffers



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Fuel Use Efficiency

- Identification of activities or machinery with the highest fuel use to indicate where future modifications or replacements would result in the highest emission savings.
- Reduce fuel use where possible through ensuring that equipment is well maintained with the correct tyre pressure.
- Replacement of fossil fuel use with renewable energy; switching from average to ‘green’ tariffs or the implementation of on-farm renewable energy production utilising solar, thermal or wind energy.
- Optimising grain storage settings and design to ensure crops are cool and at the correct humidity, thereby reducing drying costs.

Cultivation

Excessive or unnecessary cultivation can degrade organic matter content within the soil, releasing carbon to the atmosphere and depleting the potential future capacity of soils to store carbon dioxide. The movement of soil through cultivation creates an aerobic environment in the soil - resulting in greater oxidation of organic matter by soil microorganisms.

Tillage activities contribute to fuel use, ensuring that any mechanical intervention used is completed at the correct speed, depth and timing reduced the need for consequent further rectifying activity. The greatest loss of soil organic matter occurs following land-use change, such as when ploughing out of permanent pasture. Reducing the number of passes and lessening disturbance correlates to lowering the total GHG emissions from soil management.

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