Return of the MACC

TEAGASC researchers have performed an analysis of abatement potential for greenhouse gas emissions in Irish agriculture for the commitment period 2021-2030.

Climate change and agriculture

In order to address climate change, 197 countries signed up to the Paris Agreement, which seeks to keep global temperature rise this century below 2°C above pre-industrial levels. The EU has also set emissions reduction targets, with Ireland allocated a 20% reduction in emissions to 2020 and 30% to 2030, compared to 2005. Recently, the Department of Communications, Climate Action and Environment (DCCAE) published Ireland's roadmap for reducing emissions in the form of the National Mitigation Plan Consultation. Teagasc has submitted a response to this consultation outlining both the challenges and options available for emissions reduction.

Why are these climate targets a challenge to Irish agriculture? Well, firstly, agriculture accounts for one-third of national greenhouse gas (GHG) emissions.

Secondly, agricultural production, particularly dairy, is growing post quota removal, and Foodwise 2025 has set ambitious targets for further growth in primary production and exports. In order to meet these twin goals, there is the need for a roadmap that examines the potential of cost-effective GHG mitigation. Hence the need for a Marginal Abatement Cost Curve (MACC) that identifies the most cost-effective pathway to reduce sectoral emissions.

Projecting emissions to 2030

Agricultural emissions in 2005 were 18.7Mt CO_2e. In the absence of any mitigation, agricultural GHG emissions are projected to increase by on average 9% by 2030 relative to the 2005 baseline. This projected increase is mainly driven by increased dairy cow numbers and fertiliser use. However, the extent of any increase by 2030 is highly uncertain, and is dependent on future changes in total animal numbers and fertiliser inputs. The range in 2030 emissions projections in our analyses could be between 19.45 and 21.75Mt CO_2e by 2030 (**Figure 1**). The projected baseline level of emissions, which is roughly at the midpoint of this range, would be 20.45Mt CO_2e in 2030.

In this current GHG MACC, Teagasc has quantified the abatement potential of a range of mitigation measures, as well as their associated costs/benefits. The objective of this analysis is to provide clarity on the extent of GHG abatement that can realistically be delivered through cost-effective agricultural mitigation measures, as well as clarity on which mitigation measures are likely to be cost prohibitive and which should be prioritised.

The solutions

Over the last number of years, Teagasc has been working to develop solutions. Much of the answer lies in farm efficiency: if we can produce food with fewer inputs, then this reduces emissions to the atmosphere and costs to the farmer. This will be achieved through adoption of measures such as dairy EBI, beef genomics, improved animal health, extending the grazing season, and use of sexed semen. These efficiencies will reduce the carbon footprint of dairy and beef, and stabilise methane emissions via increased product per head, improved fertility and/or reduced need for replacements. Improved nutrient management planning, particularly optimising soil pH, in combination

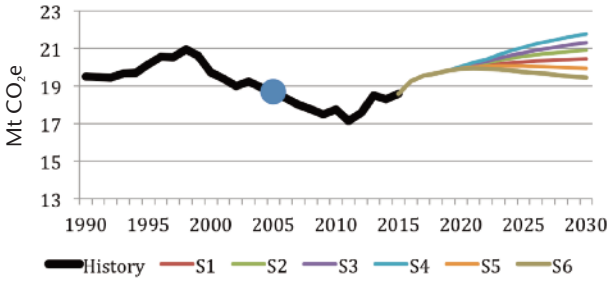

FIGURE 1: GHG emission projections under the six scenarios – this analysis excludes mitigation actions. The blue dot indicates the emissions level in 2005 against which future emissions reduction will be measured.

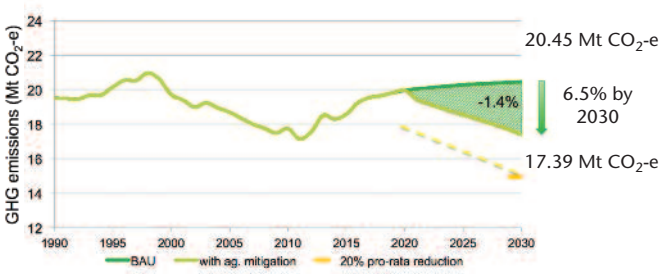

FIGURE 2: Agricultural GHG emissions from 1990 and projected to 2030, without and with mitigation. The orange line represents a pro-rata 20% reduction in sectoral emissions.

with optimal use of slurry and legumes, will help increase nitrogen efficiency and reduce nitrous oxide emissions.

Other strategies can reduce GHG emissions even further. Examples include the development of novel, low-emission fertilisers, reducing crude protein in bovine and pig diets, fatty acids supplementation to reduce methane, drainage of poorly drained mineral soils, and adding amendments to manures during storage.

The total mean abatement potential arising from cost-beneficial, cost-neutral and cost-positive mitigation measures for agricultural emissions (methane and nitrous oxide), and assuming linear rates of uptake, was 1.85Mt CO_2e per annum between 2021 and 2030, compared to the baseline scenario. The maximum annual abatement in the year 2030 was 3.07Mt CO_2e (**Figure 2**).

In addition, enhancing carbon sequestration and reducing soil carbon losses are key strategies to reduce sectoral emissions. This will principally be achieved through increased afforestation, reducing carbon losses on organic soils and enhancing pasture sequestration.

Bio-energy and energy saving can also play a substantial role in reducing Ireland's dependence on fossil fuels. The main strategies include energy saving via the use of plate coolers in milking parlours and bioenergy via wood and wood residues for heat generation, short rotation coppice for bioenergy and biogas/bio-methane (generated primarily from grass production). However, realisation of the bio-energy potential of agriculture will depend on policy.

Knowledge implementation

As the 2030 GHG reduction target is a multi-annual target (effectively targets for cumulative emissions reduction over time), the total amount of abatement achieved will be highly dependent on rates of uptake at farm level. Ultimately, the quicker adoption of measures should lead to a larger cumulative emission reduction. This means that understanding barriers to uptake and understanding the role of knowledge transfer (KT) in overcoming obstacles to adoption will both be more important than ever. Emissions reductions can only be realised if the desired mitigation actions are supported by a comprehensive KT programme.

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Both publications are available on www.teagasc.ie.

Authors

Gary Lanigan
Principal Research Officer – Greenhouse Gas Emissions, Teagasc Crops, Environment and Land Use Programme, Johnstown Castle, Co. Wexford
Correspondence: gary.lanigan@teagasc.ie

Trevor Donnellan
Head of Agricultural Economics and Farm Surveys Department, Teagasc Rural Economy and Development Programme, Athenry, Co. Galway

Kevin Hanrahan
Head of Programme, Teagasc Rural Economy and Development Programme, Athenry, Co. Galway