Teagasc Opening Statement to the Joint Committee on Environment and Climate Action regarding sequestration and land management/nature restoration

15 November 2022

Introduction

Firstly, can I thank the Joint Committee for the opportunity to present in relation to sequestration and land management / nature restoration.

The 2021 Climate Action and Low Carbon Development (Amendment) Act sets out in law Ireland's commitment to reduce overall greenhouse gas (GHG) emissions by 51% by 2030 and achieve climate neutrality by 2050. The sectoral emissions targets set by Government in 2022 include a 25% reduction (5.75 Mt CO_2e) in emissions from the Agriculture sector. The setting of a national target for LULUCF (Land Use, Land Use Change and Forestry) has been deferred to allow new scientific knowledge emerge, but is expected to be within the 37%-58% range set out in the 2021 Climate Action Plan. The Teagasc Marginal Abatement Cost Curve incorporates measures to reduce emissions (or increase sequestration/offsetting) from (i) Agriculture, (ii) LULUCF and (iii) Bioenergy. The Irish government has also declared a Biodiversity Emergency, and this together with the climate targets, has significant implications for land use and management in Ireland. Teagasc is an active member and contributor to the National Land-Use Review.

Current land-based emissions, removals and uncertainties

There are large scientific uncertainties associated with the measurement of agriculture and LULUCF emissions and removals due to the biogenic nature of the emissions, making it difficult to both mitigate emissions, enhance removals and to verify the extent of the mitigation achieved also emphasised in the Climate Action Plan. These uncertainties can have significant effects on our inventory.

For instance, new scientific findings have led to recent changes in the LULUCF inventory which have increased emissions from sitka spruce on peat soils, which represent approximately 38% of the Forest land category. The EPA's latest estimates published in June 2022 indicate that with existing measures, Ireland's LULUCF emissions will reach 11.1 MtCO_2eq by 2030. This represents a 62% increase from 6.8 MtCO_2eq in 2018, whereas previous projections made as recently as 2021 indicated a 48% increase from 4.8 Mt to 7.1 MtCO_2eq over this period. These increasing emissions are driven by emission factor refinement for forestry on peat soils, a reduction in the forest sink, sustained emissions from grassland on peat soils, low afforestation rates, and the age-class profile of forests with a large proportion ready for clear-felling. This highlights the effects that high uncertainties can have on the inventory and the need to have national emission factors to best represent the greenhouse gas emissions from Irish soils.

The Teagasc Forestry Development Department is actively promoting targeted Forestry as an economically viable diversification option for farmers. The new Forestry Programme will provide significantly increased financial incentives and payments for farmers to establish forestry on their land and Teagasc will be working to ensure that this new scheme is highly promoted to farmers.

Grassland emissions and removals

The LULUCF sector has been a source of emissions since 1990 but on a net-net basis the sector has been an overall sink for CO_2. In the Irish inventory, contrary to popular expectations, the largest LULUCF emissions source is grassland which emitted 7.6 Mt CO_2eq in 2021. Indeed, the 3.9 million hectares of grassland on mineral soils were estimated in the national inventory to sequester c. 2 Mt CO_2eq. However, there was also approx. 337,000 hectares of managed pasture on drained peat soils which were calculated to emit c. 9.6 Mt CO_2eq. The high emissions from drained peat more than negates the carbon removals on mineral soils that cover an area 10-fold larger than peat soils.

As stated, there is high uncertainty relating to emissions and removals surrounding LULUCF and new emission factors emerging from scientific research can have a large impact on inventories. Currently, the emission and removal calculations for grassland in the national inventory use generic Tier 1 emissions factors and there is an urgent need to generate national-specific factors for grassland on mineral and organic soils. Teagasc is currently establishing the **National Agricultural Soil Carbon Observatory (NASCO)** which will be completed in 2023. This observatory will consist of circa 30 sites where field-scale CO_2, CH_4 and water fluxes will be directly measured using eddy covariance flux towers. Of the 30 towers 8 are being established on agricultural grassland on peat soils and 22 on mineral and peaty mineral soils.

The current extent of grassland on peat soils is also uncertain with current estimates of between 300,000 to 400,000 ha. Research is currently being carried out to better quantify this area. Further research is also required on the drainage status of these agricultural peat soils as drainage was carried out in the 1960s and 1970s with little knowledge on maintenance and status of drains since installation. The drainage technology used at the time was not as efficient as modern drainage practices. Both of these factors result in high uncertainties about the drainage status of these grassland peat soils.

Teagasc has commenced a number of research projects on agricultural grasslands on peat soils and has recently appointed a new permanent researcher to deepen the organisation's capacity in this area. A new research project **ReWet** has commenced that is testing management strategies for rewetting of drained grasslands on peat soils. This research will provide practical demonstration for farmers on how to rewet soils and evaluate the efficacy of different practices. Teagasc is also part of an international EJP Soil[1] project **INSURE** that is developing Indicators for successful carbon sequestration and greenhouse gas mitigation by rewetting cultivated peat soils with partners in Finland, Norway, Netherlands and Switzerland. Teagasc research will build upon the NASCO investment and the Peat farming EIPs funded by DAFM in 2021.

Within the Teagasc Signpost farms programme the soil organic carbon baseline levels are currently being measured across c. 120 Signpost Farms, with these soils being resampled regularly.

[1] European Joint Programme Co-fund on Agricultural Soil Management contributing to key societal challenges including climate change, water and future food security

Mitigation measures and enhancing carbon sinks to 2030

There is considerable scope to both reduce LULUCF emissions and also to enhance carbon sinks. In order to achieve long term net Climate Neutrality, the rate of afforestation will have to increase significantly. Increasing afforestation rates to 8,000 ha per annum by 2030 would result in a 2.1 $MtCO_{2e}$ yr^{-1} by 2050. However, in the short term, afforestation will contribute little to 2030 targets due to the fact that a) there are net GHG emissions associated with land preparation for forest establishment and b) forestry takes a period of time to achieve maximum growth rates. Alternative management of the current forest estate provides an opportunity to maintain the forest C sink. Reduction in deforestation and extending forest rotations could reduce and delay emissions associated with harvest, although impacts on forest owners' incomes and the timber industry would need to be assessed.

Reducing the large emission source associated with managed grassland on peat soils will be imperative for LULUCF mitigation as this is the largest source. Reducing CO_2 emissions from grassland on peat soils generally involves raising the water table but not flooding. In addition, the input of nutrients from animals, manures and mineral fertilisers further increases CO_2 emissions. Experiments investigating alternative management strategies for grassland on peat soils, ranging from reducing nutrient input to raising the water table by different amounts have commenced in Teagasc. The impact on farmers' incomes and catchment spill over impacts much be carefully assessed.

The impact of grassland management on mineral soils is also being explored as part of the VistaMilk SFI Centre where we are using a combination of flux towers, soil carbon measurement and soil carbon modelling to quantify the impact of managements, such as soil fertility, multi-species swards and grazing intensity on soil carbon sequestration. Modelling conducted as part of the Teagasc MACC suggests that improved pasture management on 450,000 ha can sequester an average of 0.26 $MtCO_2eq$ yr^{-1} by 2030. This data will be used in conjunction with Earth Observation data from satellites and drones in order to estimate plant growth which in turn is being used to model CO_2 balance for forest, cropland and grassland ecosystems across the country as part of a Microsoft/SFI co-funded data platform **Terrain AI**, led by Maynooth University and involving Teagasc, TCD, UCD, DCU and UL.

The C sequestration potential of hedgerows has been investigated in Teagasc for many years (e.g. Green et al. 2019). Teagasc research has recently been completed to improve the capacity for national estimation of hedgerow carbon sequestration in an EPA-funded **FarmCarbon** project in conjunction with FERS Ltd. This research found that increasing hedge width and height can substantially increase both above and below-ground C sequestration, whilst also providing increased biodiversity but removal of hedgerows and replacement with young hedges results in C loss. The project estimated that nationally the mean C stocks across all hedgerows were c. 67 tC h^{-1} (57 tC ha^{-1} and 10 tC ha^{-1} for aboveground and belowground biomass, respectively). Improved cropland management, via straw incorporation, use of cover crops and targeted incorporation of manures and/or digestate can also contribute significantly to improved farm carbon balance, whilst also improving soil health, nutrient availability and reduce nitrate leaching to water. Research has recently started in developing agro-forestry for cattle to increase carbon capture by trees and mitigate emissions from cattle.

Conclusion

The next decade and beyond provides the agriculture and land-use sectors with challenges, but also opportunities. Research currently underway by Teagasc and others will reduce the uncertainty associated with land emission and sequestration, which is particularly important for managed grasslands on peat soils. Improved management of mineral soils can enhance C sinks and also improve nutrient availability, reducing the need for and cost of fertiliser inputs. Forestry will have a very important role to play in the journey to climate neutrality, and the incorporation of trees into agricultural systems, via shelterbelts and/or agro-forestry could also improve C sequestration. New ways of utilising our soils and our landscape and tailoring land-use solutions for specific situations will be required.

Appendix Teagasc research objectives on soil carbon

Teagasc research, using projects such as National Agricultural Soil Carbon Observatory and the Signpost Farms Programme, aims to improve the measurement of C sequestration and focuses on:-

- Producing Irish-specific CO_2 emission factors for drained and rewetted peat soils.
- Producing Irish-specific land management C sequestration factors across the main mineral and organo-mineral soils that are verifiable and can be inputted into national inventories.
- Improving estimation of carbon sequestration in hedgerows and on farm woodland.
- Developing a Land-Use decision support tool that aids in the development of a national Land-Use Strategy.
- Developing a carbon farming decision support tool.
- Developing strategies that increase and incentivise C sequestration and monetise the long term curation of soil C stocks, ensuring that farmers can gain added value for good soil husbandry.