Assessment of GHG accounting and net-zero frameworks: A land and agriculture case study

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Introduction & Problem Statement

The global food system is estimated to be 21-37% of total net anthropogenic emissions[1].

Land sector has the potential to contribute about 30% or 15GtCO_2e/yr of mitigation potential in 2050 to deliver 1.5°C[2].

Net Zero targets include the UK Government Net Zero 2050, UK NFU NZ2040, and voluntary retailer and producer targets.

The details behind net zero targets differ in scope, timeframe, treatment of removals and offsetting, adequacy and fairness[3,4]

Organisation and product GHG accounting in the food system to inform GHG management and net zero targets is undertaken using a range of protocols and standards

Protocols attempt to standardise principals, scope, methods across accounting and reporting but uncertainties exist and need managing from (i) input data (ii) scope and/or allocation methods (iii) epistemic uncertainty in the modelling process[5].

Research Questions

1. Why do GHG accounting and net-zero standards exist in the land and agriculture sector?
2. How does uncertainty in the quantification of emissions/removals impact the goals of the standards?
3. Do corporate standards and targets serve their purpose?
4. In what ways does this actually matter to GHG management and net-zero?

GHG Accounting Standards

Voluntary Organisation Reporting

Accounting: GHG Protocol Corporate Standard[6] is for Scope 1(direct), 2 (indirect emissions from electricity), and 3 (value-chain emissions).
Net Zero Target: The Science-based Targets Initiative targets reduction rates of 4.2% /yr on all GHG's.
Scope: Corporate – Scope 1,2 & 3; SME's Scope 1 & 2

Product Reporting

Accounting: GHG Protocol Product Standard / PAS 2050[7] / ISO 16064[8]
Net Zero Target: Product accounting is used to inform organisations Scope 3 accounting and emissions intensity.
Scope: Cradle-to-gate

Case Study

Comparison of modelling approaches for no-till UK arable within PAS 2050 framework

A theoretical experiment to analyse application of the PAS 2050 accounting standard using a fictional arable farm in East Anglia, that is reporting the net per tonne GHG emissions of winter wheat production for a voluntary supply chain scheme.

A stated aim of PAS 2050 is to "*allow for the quantification, management and potential comparison of GHG emissions from goods or services using a common, recognized and standardized approach to life cycle GHG emissions*".

PAS 2050 is prescriptive with boundaries of assessment but not on modelling approaches applied to estimating N_2O and soil organic carbon (SOC) which are emissions hotspots. H**ow can** choice of models used to estimate GHG emissions create variation in GHG estimates in a PAS 2050 assessment.

Scope of Assessment (Farm-Gate)

Scope 3
Indirect-value-chain emissions

Production of diesel
Production of fertiliser
Production of pesticides

Scope 2
Indirect emissions from electricity production

Electricity

Scope 1
Direct emissions

Application of fertiliser
Indirect N_2O & Leaching
Crop Residues
Diesel

Biogenic emissions/removals

Change in Soil Organic Carbon Stocks

Farm Input Data & Methods

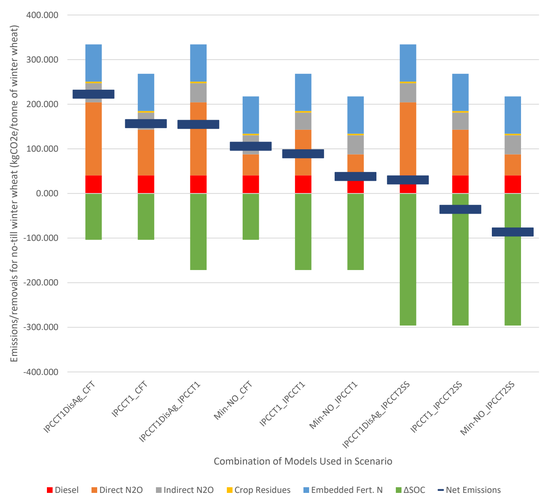
1. Case study a 250 hectare arable operation in UK.
2. Assume the operation went from conventional to no-tillage in 1996 and has been applied for 20 years.
3. Fuel use and crop management data is all taken from DEFRA statistics[9], National Fertiliser Survey[10] and LCA's[11].
4. Models used for N_2O emissions quantification were:
   1. IPCC Tier 1 Approach[12],
   2. IPCC Tier 1 Disaggregated Approach[12],
   3. MIN-NO N_2O emissions factors[13]
5. Models for SOC quantification:
   1. IPCC Tier 1 Approach[14],
   2. IPCC Tier 2 Steady-State Model[14],
   3. Cool Farm Tool model (Based on Ogle et al. 2005 and IPCC 2006 Guidelines).

Results

Depending upon the combination of modelling approaches used estimated net emissions varied from 222.49 to -86.28 kgCO_2e/tonne of wheat.

SOC removals estimates range from the lowest at -103.80 for the CFT to -295.93 kgCO_2e/tonne for the IPCC-Tier 2 Steady State model.

Direct N_2O varied between 0.86 and 2.98 kg N_2O-N with the UK specific MIN-NO EF's giving the lowest values.



Discussion

When uncertainty in input data and scope is removed from GHG quantification, variations in applied modelling approach for N_2O and SOC emissions/removals is a major source of variation and uncertainty for estimation of net emissions from no-till wheat, with estimates ranging from net emission to net removal.

PAS 2050 is limited in ability to provide comparable emissions estimates between business if modelling and quantification approaches differ.

Agreement between models that N_2O emissions are an emissions hotspot, and that no-tillage provides a carbon removal option indicates that PAS 2050 can aid organisation level management decisions to impact emissions and track progress.

Further study

Expand this case study to include the model uncertainty in comparison between different model outputs.

Next Steps

Research will expand to include

- Research into data and metrics that can be developed for application of accounting and net zero standards to global supply chains. Global case studies will include hotspot emissions from land-use change and deforestation.
- Expand life-cycle approach to consider land use, land tracking metrics, biodiversity and water.

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