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Carbon calculation in agriculture – considerations for applications of organic materials

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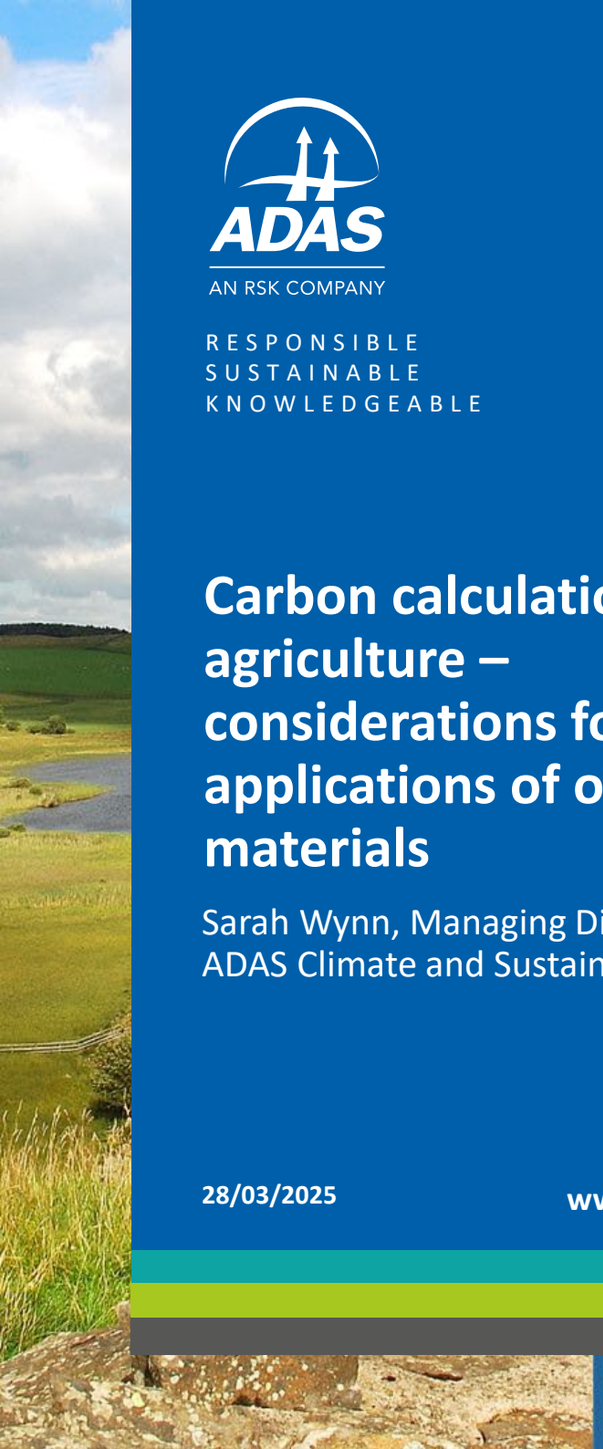








Agricultural carbon footprinting

- Why is it done, approaches and challenges
- Harmonisation of calculations

Implications for organic materials applied to land

Calculating emissions from organic materials

Incorporating organic materials into farm carbon footprints

Key points

- Reducing emissions on farms requires farmers to be able to make informed decisions
- Farm carbon footprints can support those decisions, but are only as good as the data that goes in
- To make best use of organic materials to mitigate emissions farmers need robust emissions data for production and use

What are the emissions from the production process – the embedded emissions?

What are the emissions from the use phase? What removals occur?

Agricultural carbon accounting

Drivers

- UK Net Zero Legislation
- Pressure on food and drink businesses to measure and report emissions
- Agriculture responsible for >90% of these emissions

Agricultural carbon accounting helps to:

- Support better choices
- Identify opportunities to reduce emissions
- Reward good practice

Challenges

- Need for high-quality activity and emission data
- Data collection can be time-consuming
- Key emission sources driven by biogeochemical processes –
  - Challenging to calculate so models are used

Carbon assessment

- Scope 1 – modelling of soil based emissions
- Scope 1 – combustion of fuel
- Scope 2 – electricity use
- Scope 3 - embedded emissions in purchased inputs
- Carbon removals

Challenges

- Complexities around modelling of soil emissions
- Affected by
  - Rate of N
  - Availability N
  - Soil moisture
- Complexity of carbon removals especially in soil

Solution

- Farm level carbon calculators developed
- Provide
  - Emissions factors
  - Model parameters for soil emissions
  - Calculations
  - Summarised outputs

…but, results are highly variable different tools provide different results from same farm. How does a farmer trust these results and use them to make decisions.

Defra's Harmonisation of Agricultural Carbon Accounting

Purpose of the project

- Defra recognised high level of variation in results of agricultural carbon calculators
- This project sought to
  - Measure the level of divergence in farm-level assessments
  - Identify the reasons for this divergence
  - Create a set of recommendations to bring about harmonisation
- ADAS undertook this project in 2022-2023

Project results

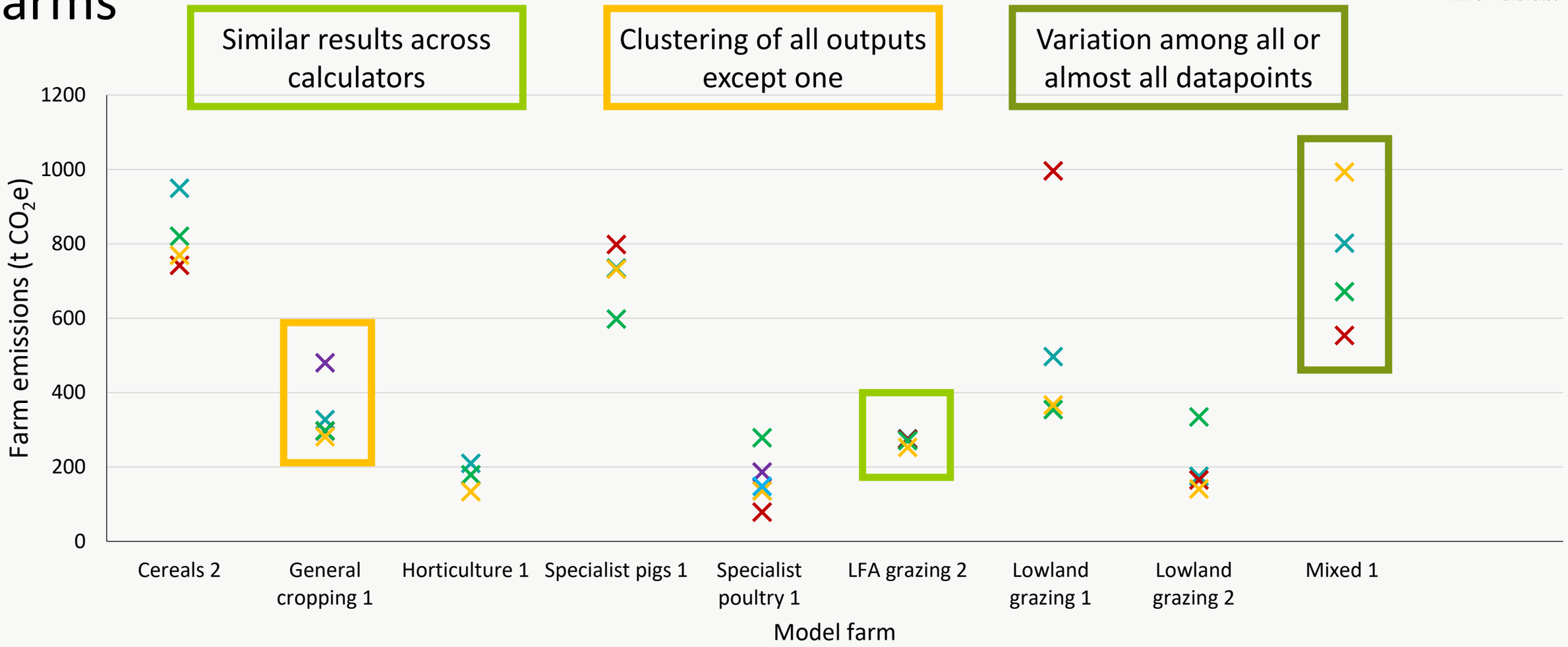
- All calculators provide a baseline understanding of emissions to facilitate the start of a decarbonisation process.
- But the calculators differed in the robustness of their calculations and emission factors, their system boundaries, as well as the level of precision that they provided.
- This resulted in there being a high level of variation in the outputs.

Next steps

- Tools coming together to identify areas where harmonization can occur
- Defra Food and Drink Transparency Partnership – developing data tools

Project report available here

Extent of variation: Farm-level emissions for a subset of model farms



Note: These do not include carbon stock changes

Reasons for divergence

- **System boundaries** – what is included and excluded in the assessment
- **Emission factors** – data sources and age
- **Data entry factors** – the level of detail users enter and the support they have in entering data
- **Calculations** – level of detail of calculations and assumptions made
- **Carbon stock change** – the carbon stock changes included and their calculation
- **Mitigation** – what mitigation levers are available in the calculator

How does this relate to organic materials?

- Limited availability of emission factors for novel fertilisers
- Limitations of calculators:
  - Can the calculators incorporate a novel fertiliser manufacture emissions – what evidence is needed?
  - Does the novel fertiliser require a modification to N_2O calculations?
  - How does tool account for carbon removals?
- May require bespoke calculations to be made increasing cost and complexity

If we are to help farmers to use organic materials to better manage their farms for lower emissions, we need to have better, more consistent data available for the organic materials that they are using.

Production emission factor for organic fertilisers

What can fertiliser producers do to help?

- Create robust, transparent emission factors

Activity data X Emission factor

= Emissions

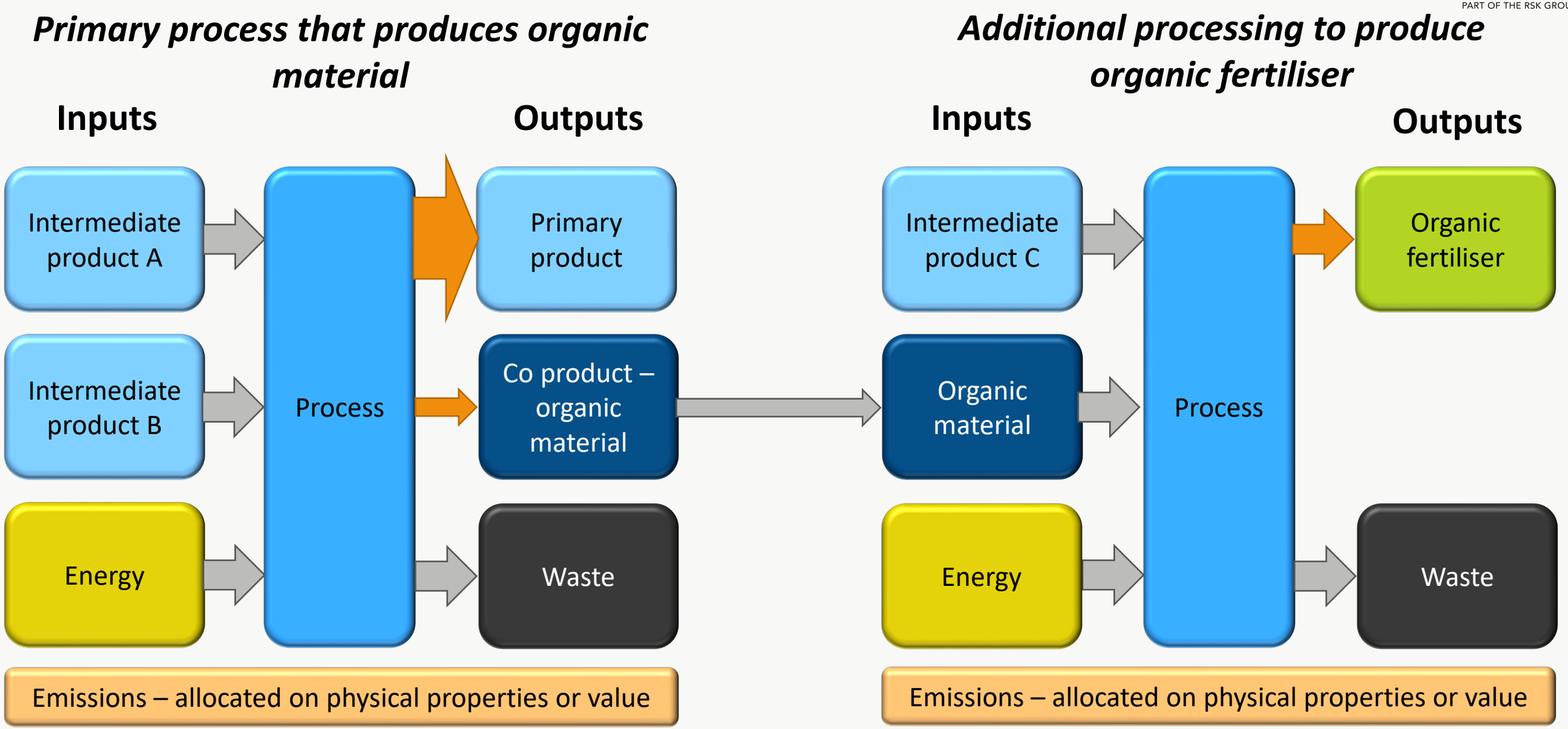
- An emission factor is a coefficient that describes the rate at which a given activity releases greenhouse gases (GHGs) into the atmosphere
- Guidelines in development for increased consistency for novel fertilisers

How to create emission factors

What you can do:

- Follow appropriate standards (GHG Protocol product-level standard, ISO 14067)
- Be as transparent as you can
- Where there is uncertainty, be clear on this and take a conservative approach so as to not underestimate emissions or overestimate removals
- Beware of making unfounded green claims – there is greater scrutiny on these, particularly around overestimating carbon sequestration

Assessing emissions from organic fertiliser production



Assessing emissions from organic fertiliser production

Inputs

- What are being used as the ingredients?
  - Are they manufactured?
  - Are they bi-products?
  - Are they waste products?
- How are emissions from primary process allocated?

Co-product – this is produced during the studied product's lifecycle and has a value as an input to another product's lifecycle.

A co-product without economic value is considered a **waste** and has no emissions or removals allocated to it.

Process

- What energy is required and what is the source?
  - Electricity (grid or renewable)
  - Diesel (transport or generators)
  - Gas (natural or biogas)
- Are there any emissions of carbon dioxide, nitrous oxide, methane or any other GHGs released in the processing?

End product

- What level of nitrogen does it contain – in what form?
- What level of carbon does it contain – in what form?

Source: GHG Protocol

Emissions from use

Emissions

- Nitrogen in the material is likely to result in losses of nitrous oxide at application
- Are you trying to make specific claims about lower emissions?
  - YES - You need robust scientific assessment in field, across multiple sites & years showing N_2O emissions for whole year following application, compared to untreated to create new emission factor
  - NO – Use default IPCC emission factors for N_2O (direct and indirect) emissions – easier to include in existing calculators

Carbon removals

What is the fate of carbon?

- Does your organic material create additional, permanent removal of carbon from the atmosphere?
- Or realistically does it just create more available carbon to feed an active soil microbial community and will therefore be respired away?
- What robust evidence do you have to support any claims?
  - Ideally need trial data that shows increases in soil organic carbon content over time.
  - How much is lost via respiration vs stored in soil?

Conclusions

- Strong pressure on farmers to reduce emissions
- Organic and novel fertilisers have a role to play
- Good data on production and use phases is required
- Production of novel use data requires trials and evidence
- Challenging to incorporate into calculators

Do not let a good story get in the way of robust science!

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