Guidelines for conducting a carbon audit on farm and farm products

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Background

Since the COP21 Paris Agreement set the world on a course towards climate neutrality, many multinational supply-chain companies have set targets towards carbon neutrality by 2050. Many of these targets are informed by the Science Based Targets Initiative. These targets have created significant interest from farmers and supply chains in understanding their carbon position and a potential trajectory towards carbon neutrality to meet future supply chain demands. In response, a number of greenhouse gas accounting tools have started emerging, some producing different results.

There is therefore a need for a common agreed standard that has scientific integrity and fully consistent with IPCC -approved national greenhouse gas inventory methodology for Australia, but also compliant with international frameworks, like SBTI, GHG Protocol, and compliant with ISO lifecycle assessment standard, as per the Climate Active - National Carbon Offset Standard.

This short document aims to provide a guide to ensure farm carbon audits have integrity and comply with international standards and frameworks. This then guides the choice of tool used, first ensuring this is 100% compliant with the guidelines below.

The basic concept

A whole farm carbon audit needs to comply with the following guidelines:

1) The methodology used should be consistent with the IPCC-approved, Australian National Greenhouse Gas Inventory (NGGI) methodology, only making adjustments where these are required to be more specific to the farm rather than a state or country (e.g. The NGGI uses the proportion of land area per state to determine indirect nitrous oxide from nitrate leaching, but at a farm boundary this is either property does or does not receive enough rainfall to leach);
2) The methodology used should align with:
    a. The Climate Active "Draft Guideline: Land and Agricultural Emissions"
    b. The SBTi FLAG Guidance
    c. The ISO 14040 Life Cycle Assessment framework and
    d. The **ISO 14067 standard - Carbon footprint of products**
    e. Where the audit is self-declared, it should align with ISO 14021:2016 standard for **Self-declared environmental claims.**
    f. Farm Scope 3 emissions factors should be aligned with the Ecoinvent or AusLCI database.
3) The calculation should be conducted within a pre-farm to farm gate Life Cycle Assessment framework (ISO 14040), with the boundary representing the whole of farming enterprise (all activities within the ABN) e.g. if there are separate physical properties within the farm enterprise, movement of product between farms needs to be included as Scope 1 emissions. This applies to agistment properties if part of the business unit.
4) The greenhouse gas balance must be calculated on an annual timestep, but with the annual change in soil and tree carbon sequestration calculated based on a 10-year running mean, to minimise rainfall variability influences.

5) The audit should include:
    a. Scope 1 emissions: All direct greenhouse gas emissions (CO_2, CH_4, N_2O) from within the farming enterprise. The audit can also include the annual net change in soil and tree carbon, within the property boundary, but based on a 10-year rolling mean.
    b. Scope 2 emissions: This would mainly be electricity purchased from a fossil fuel origin onto the farm. This is included as the farmer now has choice to generate or buy renewable energy.
    c. Scope 3 emissions: Scope 3 emissions should be included in a carbon neutral product audit, as these emissions are essential to producing that product, but not all Scope 3 emissions are needed in carbon neutral property audit, only those that are essential to the management of the property. Scope 3 includes all pre-farm embedded emissions associated with the purchase of products onto the farm e.g. lime, steers, urea, herbicides. Some selected post-farm emissions are also included "where these are deemed to be under the control of the farmer's choice".

        For a corporate company, ensure alignment with:
        - GHG Protocol Corporate Value Chain (Scope 3) Accounting and Reporting Standard.
        - ASRS 2 Climate-related Financial Disclosures including all 15 GHG Protocol scope 3 categories.
    d. Allocation: Where more than on product is produced, a protein-based allocation (livestock) or mass-based (lint vs seed) should be applied to apportion the emissions between the products
        i. Before applying allocation, ensure the proportion used is acknowledged between the industries. e.g. 15% of dairy farm emissions can be allocated to red-meat production, but only IF the bull calves are sold to a beef producer.
    e. **Carbon credits sold**: Carbon credits generated within but sold out of the boundaries of the audit, must be debited to the final balance. Likewise carbon credits generated and retained within the boundaries of the audit (i.e. an inset) are credited once off and retired. In other words, the final net emissions position should be increased by the number of carbon credits sold, or decreased by the number of carbon credits retained within the boundary. This is to avoid double counting of carbon offsets sold outside of the boundary, where clearly the intention of the new owner is to use these against their balance.

Tools

Greenhouse gas emissions

For the farm-based greenhouse gas emissions audit, any tool used must fully comply with the above standard.

Soil Carbon

For the purposes of a farm-based carbon audit, soil carbon should ideally be measured *in situ*, using the sampling methodology originally developed under The Soil Carbon Research Program (SCaRP) and prescribed under the Australian government method: Carbon Credits (Carbon Farming Initiative—Estimation of Soil Organic Carbon Sequestration Using Measurement and Models) Methodology Determination 2021.

Specifically:

- Soil organic carbon ideally needs to be measured in the top 30 cm (minimum) using the dry combustion method after removal of plant residues and root material carbonates (where present).
- Wet chemistry methods such as Walkley-Black are discouraged due to the high degree of variability in using this method.
- New laboratory methods using spectroscopic analysis can be considered if validated against the CSIRO or state department spectral libraries developed from SCaRP. *In situ* spectroscopic analysis or remote sensing are not valid as yet.
- Note that a single soil sampling event is insufficient to derive an annual time step change in soil organic carbon and would normally require a minimum of two soil sampling dates at least five years apart.
- If soil samples are not available, using a simulation model is potentially acceptable, on condition that this has been validated in the peer reviewed literature for this situation it is being used in e.g. FullCAM, SOCRATES, DayCent, Roth-C, SGS model. These models must be validated to the local soil and farming system, ideally including at least 20 years of *in situ* management history and run using climate data from the Bureau of Meteorology.
- Ideally, a combination of measurement and modelling (as per the ACCS method) is required to validate the history and trajectory of the change in soil organic carbon over time, with a detailed analysis of the soil profile providing associated chemical and physical properties used in the simulation. In this case, a time series of soil organic carbon analyses could be used if coupled with the above modelling protocol.

Tree Carbon

For the farm tree carbon audit, a very similar approach should be taken to soil sampling, where direct measurement by an accredited auditor would be the highest standard applied. This can be coupled with modelling using a peer reviewed tree growth model, demonstrated to be applicable to the Australian context e.g. FullCAM, 3PG, with the same validation and the review requirements as per the soil carbon method.

While the Greenhouse Accounting Framework (GAF) calculators provide a look up table version of the FullCAM model, it should be clearly noted that this was not to the integrity of having complied with the process above. These lookup tables can only provide a general indicator.

The final calculation

The net carbon position of the farm enterprise or product from the farm is then obviously a summation of the emissions minus the annual change in soil or tree carbon for that annual time-step.

A Carbon account/audit (CA) is the same as Net Emissions (NE = t CO_2e/ business unit) and includes:

- All GHG from boundary of the farm enterprise
- Annual change in soil and tree carbon
- Adjusted for carbon offsets bought or sold (note SBTI only allows purchased offsets for the intractable residual emissions).

The Carbon footprint (CF) or emissions intensity (EI = t CO_2e/t product) uses the same calculation as above, but the dominator is now the unit of product produced.

In this case also include all Scope 3 emissions (pre-farm GHG and some post farm), as these are essential for the product produced.

Net zero is then calculated as zero t CO_2e/ denominator (being either the business enterprise or the product).