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Carbon accounting in horticulture

Overview of accepted approaches and expected regulations

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Introduction

Environmental awareness is increasing amongst businesses in the horticultural sector. As a result, an increasing number of horticultural businesses commit themselves to ambitious greenhouse gas (GHG) emission reduction targets. Although there is a wide array of methods available to account GHG emissions within horticultural value chains, no agreed upon guidance is available to account for GHG emission reductions and removals related to land management. This is a pity, as such activities are part of the mitigation potential in horticulture and are increasingly acknowledged as way to limit global warming to 1.5°C (IPCC, 2021).

Furthermore, an increasing number of horticultural businesses acquire carbon credits by investing in projects beyond their own value chain. The carbon credits are used to make up for GHG emissions within the value chain that cannot be eliminated right away. There are risks associated with this practice, as carbon credits yield potential to undermine GHG emission reductions within the value chain and may give stakeholders a false impression of the environmental impacts or benefits of a product.

This factsheet aims to explain what carbon credits and GHG emission reductions and removals related to land management are and how they can be accounted for in the horticultural sector. It focuses on similarities and differences of commonly used approaches, methods and regulations. This factsheet does not deal with the quantification of carbon offsets and GHG emissions and removals related to land management, nor is it intended to give individual companies guidance on how to calculate or report GHG emissions.

The concept of carbon accounting in horticulture

To reach GHG emission reduction targets, businesses can either take reduction measures within or beyond their own value chain. Emissions within the value chain of a business can either relate to sources owned or controlled by a business (scope 1), to emissions related to the generation of energy (scope 2) or to emissions which are a consequence of a business's activities but occur from sources not owned or controlled by the business itself (scope 3). To use their full mitigation

potential, horticultural companies are in the position to deliver emission reductions as well as carbon removal and storage activities.

- **Emission reductions:** lowering the release of GHGs into the atmosphere from a specific activity compared to a benchmark year.
- **Carbon removals and storage:** the two-step process of capturing units of GHGs from the atmosphere and locking them away permanently in a form other than atmospheric gas.

GHG emission reduction measures beyond the value chain refer to the concept of carbon offsetting. Carbon offsetting is the practice of reducing, avoiding or removing GHGs from the atmosphere (elsewhere) to compensate for emissions occurring in the value chain. Businesses can funnel funds for projects beyond their own value chain that reduce, avoid or remove units of GHGs from the atmosphere. These units of GHGs that would have been emitted in the absence of the project, can be issued as tradable 'carbon credit'. Businesses may acquire these carbon credits as alternative for direct GHG emission reductions to neutralise GHG emissions that cannot be eliminated right away. Although another unit of GHG is reduced, avoided, or removed from the atmosphere, the original emitted unit of GHG is still out there. Typically, two types of carbon credits are distinguished:

- **Emission reduction or avoidance credits:** representing a unit of GHG emissions reduced or avoided relative to a forward-looking counterfactual baseline (i.e. what would the emissions have been in the absence of the specific project?)
- **Removal credits:** representing an increase in carbon removals from the atmosphere relative to baseline removals.

Table 1 outlines (sub-)categories of emission reductions and removal activities for both emission reductions beyond and within the value chain. What (sub-)categories are relevant to an individual business, largely depends on the sector and the types of activities performed by the business. Table 1 only lists (sub-)categories primarily relevant for horticulture.

Table 1 *Type and (sub-)categories of emission reductions and removal activities within and beyond the value chain*

Type	Category and sub-category (if applicable)		Description
within value chain	Emission (reductions)	Emissions (non-land)	Emissions from a specific activity within the value chain, apart from emissions related to land management. *Example: fuel combustion for transport or heat*
		Emissions (land)	Emissions resulting from activities related to land management. *Note: emissions related to land management can occur in open and protected cultivation.*
		• *Land use change (LUC)*	*Biogenic GHG emissions resulting from carbon stock losses due to land transformations.* *Example: deforestation*
		• *Land management GHG emissions*	*GHG emissions resulting from land management practices, including biogenic carbon stock losses.* *Example: tillage, fertiliser application*
	Carbon removals & storage		Increase of carbon storage in land as a result of sustainable land management practices. Including those transferred via biogenic sinks. *Example: carbon sequestration in soils, CO_2 removals of horticultural crops through photosynthesis*
beyond value chain	Emission reduction or avoidance credits		Representing a unit of GHG emissions reduced or avoided relative to a forward-looking counterfactual baseline (i.e. what would the emissions have been in the absence of the specific project?). *Example: renewable energy projects*
	Removal & storage credits		Representing an increase in carbon removals from the atmosphere relative to baseline removals. *Example: afforestation projects*

Table 1 shows both carbon removal and storage credits and carbon removal and storage activities within the value chain can refer to the identical natural process (i.e., capturing carbon from the atmosphere and store it in another form than atmospheric gas). Although they have closely resembling characteristics, they are inherently different in terms of scope, ownership, effect, marketability and method of quantification. Table 2 compares these key features of carbon removal and storage activities and carbon offsets.

Table 2 *Comparison of key features of carbon removals and storage activities within the value chain vs. carbon offsets*

	Carbon removal and storage activities within the value chain	**Carbon offsets**
Scope	*Within* a business's own value chain.	*Beyond* a business's own value chain ('elsewhere').
Ownership	Reduced, avoided and removed units of GHG's travels *with* the physical product.	Reduced, avoided and removed units of GHG's travels *separate* from the physical product.
Effect	Immediate, taking away actual CO_2.	Reduction of future emissions, not addressing any actual CO_2 in the atmosphere at present.
Marketability	Not issued tradable (or only excess units).	Issued tradeable.
Method of quantification	Quantified using an inventory approach (i.e. what are the absolute GHG emissions reduction relative to the benchmark year emissions?)	Quantified using project or intervention accounting method against a counterfactual baseline (i.e. what would have been the emissions in the absence of the specific project?)

The role of carbon accounting in a business sustainability strategy

As illustrated in Figure 1, businesses generally follow a four-step approach to effectively reduce GHG emissions. How to account for carbon offsets and GHG emissions and removals related to land management, plays an important role in how to map emissions, how to make use of the mitigation potential (i.e. what emission reduction measures should be taken), whether to offset and how to report and claim GHG emissions.

Figure 1 *Four step approach of an effective GHG emission reduction strategy*

Step 1: map emissions
The first step of effective GHG emission reduction is to quantify GHG emissions, i.e. to calculate the carbon footprint. In horticulture, a wide array of methods is available to calculate the carbon footprint. The next section elaborates further on methods available for horticulture and how they deal with the issues related to carbon accounting within and beyond the value chain. To allow comparability and a level playing field for businesses, the use of harmonised and sector-specific methods is preferred.

Step 2: emission reductions
Based on the carbon footprint, a business can carry out a hotspot analysis (i.e. identify the main contributing elements to the carbon footprint). This hotspot analysis serves as an instrument to identify relevant GHG emission reduction measures and thus on which activities to focus attention and to determine GHG emission reduction targets. GHG emission reductions focus on activities that are directly related to a business's operations (i.e. within the own value chain of a business).

Step 3: offsetting (optional)
In situations where not all emissions can be eliminated right away by means of emission reductions, some businesses may use carbon offsets as an additional way to cut GHG emissions. Most businesses acquire offsets – to meet voluntary reduction targets – at the voluntary carbon market. Mandatory carbon markets are used by governments and businesses legally required to cut GHG emissions. The mandatory carbon market is regulated by (inter)national or regional carbon reduction regimes. The voluntary market, however, is largely unregulated and a minimum level of quality of the carbon credits cannot be ensured. Currently, no agreement on a set of criteria is available to assess the quality of carbon credits. Criteria such as 'real', 'measurable', 'permanent', 'additional' and 'unique' are commonly used in verification standards and international best practices. These quality criteria are further explained in Table 3. To ensure a minimum quality level, businesses should either carry out their own due diligence or use independently verified standards (e.g. Verified Carbon Standard, Gold Standard) or certification standards (e.g. PAS 2060 on carbon neutrality).

Table 3 *Criteria carbon offsets should comply with to meet a minimum level of quality*

Criteria	Explanation
Real	Offsets should ensure the reductions have actually taken place and are monitored and verified.
Measurable	Offsets are quantifiable and use scientifically robust measurement tools, against a verified emission baseline.
Permanent	Offsets should ensure the reductions are taken away from the atmosphere for a long period of time.
Additional	Offsets should ensure the reductions are additional to what would have been emitted in absence of the project and/or policy measures.
Unique	Offsets should not be used, insured and claimed more than once (double counting).

Step 4: report and claim
The last step of an effective GHG emission reduction strategy is reporting and claiming. Horticultural businesses face a rapidly growing pressure from e.g. consumers, retailers and investors to report (and claim) transparently about their GHG emissions. Until now, there is hardly any legislation in force for horticultural businesses on how to report and/or claim GHG emissions and how to deal with carbon offsets and carbon removals and storage. Although various voluntary reporting frameworks are available (e.g. Global Reporting Initiative and CDSB framework for reporting environmental and social information), efforts to report and claim GHG emissions in the horticultural sector have been highly fragmented. With the upcoming Corporate Sustainability Reporting Directive (CSRD) and Green Claims initiative of the European Commission, that situation might change. CSRD will ensure businesses disclose consistent and comparable sustainability reports at company level (including supply chain for GHG emissions) and Green Claims initiative aims that product claims are being substantiated against a harmonised method. Both initiatives are further explained later in this fact sheet.

A wide array of standards: which one to apply?

To calculate the carbon footprint of a product or a business, a wide array of standards is available for horticultural business. What standard to use is case-specific and largely depends on what the results of the carbon footprint will be used for: will they be used for internal purposes only or will they be used for GHG emission reduction target setting, for public reporting or to make claims?

Methods for carbon footprinting exist at both organisational and product level, and can be either used to account for carbon emissions or to set a GHG emission reduction target (and make claims). Table 4 lists methods primarily relevant for horticulture and how they are placed in this matrix.

Table 4 *Matrix of carbon footprint methods*

	Carbon accounting	Target setting & claims
Organisational level	ISO 14064:2018 GHG Protocol Land Sector and Removal Guidance Organizational Environmental Footprint (OEF)	SBTi Forests, Land & Agriculture (FLAG) Guidance
Product level	ISO 14067:2018 PAS 2050-1: 2012 Product Environmental Footprint (PEF)	-

Methods to account for emission reductions have been well established over the past decades, although there is a lack of agreed upon methods to account for GHG emission reductions and removals related to land management. Several important activities (e.g. soil management practices, biogenic products etc.) and its associated GHG impacts are either neglected or included inconsistently and inaccurately in carbon footprint calculations. Accounting methods for carbon removal and storage activities are in development (e.g., GHG Protocol Land sector and Removals Guidance), but have not been published yet (February 2023). Therefore, this fact sheet does not deal with how carbon removal and storage activities might be accounted for in carbon footprint calculations.

How methods and standards deal with the issue of carbon offsetting, is briefly described below. Only methods and standards primarily applicable to horticulture are included.

ISO standards and PAS 2050

ISO 14064:2018 (organisation focused) and ISO 14067:2018 (product focused) are the all-rounders of the carbon footprint standards. If no regulation applies, these international accepted standards can be followed. However, both standards do not provide guidelines for horticulture specifically. ISO 14064:2018 states carbon offsets may be reported, and if so a business shall disclose the GHG scheme under which the carbon offsets were acquired. Businesses shall not include carbon offsets in the calculation of a carbon footprint (ISO, 2018). PAS 2050:2012 is another internationally widely used product standard. Its supplementary document PAS 2050-1:2012 provides additional requirements to calculate the carbon footprint of horticultural products. The PAS standard states GHG reductions should be directly attributable to changes associated with a product's life cycle (BSI, 2012). This means carbon offsets shall not be included in the carbon footprint of a product.

Environment Footprint (EF) methods

The Environmental Footprint (EF) method is a harmonised life cycle assessment based method to quantify the environmental impacts associated with a products life cycle (PEF) or organisation (OEF). Although EF covers a broader range of environmental indicators, the climate change indicator can be used to determine the carbon footprint. The EF methods have been developed by the European Commission (EC). The EC encourages individual sectors to develop product category specific calculation rules in PEF Category Rules (PEFCRs). In the horticultural sector, the following methods have been developed in the context of PEF over the past years:

- HortiFootprint Category Rules (Helmes, et al., 2020)
- Growing Media Environmental Footprint Guideline (Gual, Koukouna, & Lucherini, 2021)
- FloriPEFCR – in development (see WUR, 2022)
- Shadow PEFCR for Fruits and Vegetables – in development (see Freshfel, 2022).

The EF methods do not allow carbon offsets in the life cycle impact assessment, neither do the category-specific PEFCRs. However, carbon offsets may be reported separately as 'additional environmental information' (Zampori & Pant, 2019).

Greenhouse Gas Protocol
Greenhouse Gas Protocol is an international standard for corporate accounting and reporting of GHG emissions. GHG Protocol offers several widely used standards, such as: Corporate Standard and Corporate Value Chain (Scope 3) Standard. In September 2022, Greenhouse Gas Protocol released its draft Land Sector and Removal Guidance for pilot testing. The guidance addresses how companies should account for GHG emissions related to land management, land use change and biogenic products. The guidance will be finalised and published in the course of 2023. This guidance is primarily relevant for horticultural businesses. According GHG protocol, carbon offsets may be used if they adhere to specific quality criteria and are reported separately. The latter is especially relevant, as it might mean GHG Protocol might not allow businesses to use internal carbon offsets as net emission reduction.

Science Based Target initiative
Science Based Targets Initiative (SBTi) helps companies to set scientifically proven GHG emission reduction targets. SBTi is currently the highest recommended target setting guide available for businesses. For calculating GHG emissions, SBTi refers to the standards of GHG Protocol. Besides its general guidelines, SBTi provides various sector specific standards. Businesses that are active in agricultural production or with 20% of their overall GHG emissions coming from land related activities, are required to set targets in accordance with the Forest, Land and Agriculture (FLAG) guidance.

The guidance acknowledges horticultural businesses can deliver both emission reductions and carbon removals. With the FLAG guidance these removals can be used as means to reach GHG emission reduction targets, if they take place within the value chain of the business. Emission reductions and removals related to FLAG activities shall be reported separately.

Carbon offsets shall not be used to meet FLAG targets. Any sale or purchase of carbon credits should be dealt with in a business's inventory according to GHG Protocol guidance.

Expected regulations

Due to the continued proliferation of environmental information, labels and claims made in horticulture, it's difficult for consumers and businesses to make sense of them. The European Commission is working on several initiatives on how to disclose environmental information (e.g. claims, labels). Many of them include rules on carbon offsetting. The most relevant for the horticultural sector are listed here below.

Initiative on substantiating green claims
Green Claims initiative (GCI) of the EC is meant to make environmental claims reliable, comparable and verifiable across the EU market. GCI is part of the EC's Circular Economy Action Plan (CEAP). In April 2022, Directorate-General for the Environment highlighted the initiative will focus on voluntary claims made by businesses (DG-ENV, 2022). This means that businesses may or may not communicate environmental claims, and once they do, they will be either advised or required to substantiate these against a standard method. If a EU legal framework is established, GCI proposes to use the Product and Organizational Environmental Footprint Methods (EF methods) as standard claims have be substantiated against, either as a complement to existing standards (DG Environment, 2021). The inception impact assessment of the initiative states GCI will provide clear rules on the role of carbon offsets in making environmental claims (DG Environment, 2021). Given the envisioned use of the EF methods, it's likely carbon offsets shall not be used to substantiate environmental claims. Absolute clarity will be available with the release of the official policy proposal, expected in the course of 2023.

Corporate Sustainability Reporting Directive (CSRD)
In April 2021 the European Commission adopted a proposal for a Corporate Sustainability Reporting Directive (CSRD). The CSRD requires large EU businesses to disclose information on how

sustainability matters affect the business itself, and the impact of the business on environmental and social aspects (a concept referred to as 'double materiality'). CSRD applies also to horticultural businesses, exceeding at least two of the following criteria: >250 employees, a turnover of >40 million EUR or total assets of >20 million EUR (EP, 2022).

According to the CSRD framework, businesses may disclose carbon offsets, if done separately and in accordance with clear requirements described in an 'optional disclosure requirement'. However, within the CSRD framework, carbon offsets shall not be used to calculate its total GHG emissions, nor shall they be used as a means to reach GHG reduction targets (EFRAG, 2022). This approach aligns with the PEF method, where carbon offsets shall not be included in the results of the study, but may be reported separately as 'additional environmental information'.

Businesses may include carbon removals within their own value chain in the calculation of the carbon footprint, but should report transparently on how and to which extent they use carbon removals. As soon as methods on GHG removal accounting are available, they shall be applied. Carbon removals beyond the business value chain, shall be reported separately nonetheless.

Proposal for a Regulation on an EU certification for carbon removals
In November 2022 the EC adopted a proposal for a regulation on an EU-wide certification framework for carbon removals. The proposal aims, among others, to develop methodologies to account for different types of carbon removal activities and to set up an EU-wide certification framework to ensure high-quality carbon removals. The certified carbon removals, generated by either carbon farming, permanent storage or carbon storage in long-lasting products and materials, can be (financially) rewarded by private or public sources. For example, by issuing them as tradable carbon credits at the voluntary carbon market. The EC is considering to revise existing rules on carbon storage accounting in the EF methods, once a consensus method is available (EC, 2021).

Concluding remarks

On a regular basis claims are being made in the horticultural sector, amongst others the claim on carbon neutrality. To substantiate these claims a wide array of methods is used. However, there is no agreed upon guidance available how to deal with GHG emission reductions and removals relating to land management in the horticultural sector and how to deal with the issue of carbon offsets. This makes claims vague and inconsistently substantiated.

Horticultural businesses have the unique position to deliver both GHG emission reductions and removals to utilise their mitigation potential within their value chain. In case not all emissions in the value chain can be eliminated right away, businesses can acquire either carbon avoidance credits or carbon removal credits. Carbon removal credits and carbon removal activities within the value chain have closely reassembling characteristics, but differ in terms of scope, ownership, effect, marketability and method of quantification (see Table 2).

A minimum quality level of carbon credits cannot be guaranteed at the voluntary carbon market, therefore horticultural businesses should carry out their own due diligence process or make use of a certification standard. Commonly used quality criteria for carbon offset credits in verification standards and international best practices are: real, measurable, permanent, additional and unique.

There are multiple standards and methods available to guide the use of offsetting in carbon footprinting at product or organisational level. These standards and methods, and how they deal with the issue of carbon offsetting, are listed in Table 5 (below).

Table 5 *Description of how various standards deal with the issue of carbon offsetting*

Scope	Standard/method	Guidance on carbon offsetting
Organisational level	ISO 14064:2018	Offsets may be reported, and if so: • The GHG scheme under which the offsets are generated shall be reported • Offsets shall not be included in the calculation of the GHG emissions.
	GHG Protocol	• Offsets may be used to meet GHG targets, only if a business is unable to meet the GHG targets though reductions within the value chain • Offsets shall be reported separately • Offsets shall adhere to specific quality criteria.
	SBTi FLAG	• Offsets shall not be used to meet FLAG targets • Any sale or purchase of carbon credits should be dealt with in a business's inventory according to GHG Protocol guidance.
	OEF method	• Offsets shall not be included in the impact assessment.
Product level	PEF method	• Offsets may be reported separately as additional environmental information.
	PAS 2050-1:2012	Offsets shall not be included. Any emission reductions should be directly relatable to the product under study.

The European Commission is publishing several initiatives impacting the horticultural sector on how to disclose environmental information (e.g. claims, labels). Many of them are expected to include rules on carbon off setting: Green Claims initiative (GCI), Corporate Sustainability Reporting Directive (CSRD) and the Proposal for a Regulation on an EU certification for carbon removals.

Methods and regulations seem to favour a clear hierarchy for dealing with carbon offsets: reduce as much GHGs as needed to limit global warming to 1.5°C. Carbon offsets may then be considered as temporary solution in case emissions are not in line with the 1.5°C trajectory. If carbon offsets are considered, removal credits are clearly favoured above reduction/avoidance credits. Furthermore, it looks like according to (upcoming) methods & regulations carbon offsets:

- shall be reported separately
- shall not be included in the GHG inventory
- shall not be used to make claims.

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