CARBON REMOVALS EXPERT GROUP TECHNICAL ASSISTANCE

Review of certification methodologies for carbon farming – survey results and first assessment of coverage of the QU.A.L.ITY criteria

FINAL VERSION 14 July 2023: *including input from the meeting of the Expert Group Carbon Removals on 21 and 22 June 2023.*

Partners for Innovation B.V. (PfI)
Withoedenveem 8
1019 HE Amsterdam
The Netherlands

Wageningen University and Research
Wageningen Environmental Research (WEnR)
Droevendaalsesteeg 3
6708 PB Wageningen
The Netherlands

Authors: Sven van Baren, Eric Arets, Caroline Dankers, Jan Peter Lesschen (WEnR), Jasmijn Sybenga, Francisca Demmendal-Wit and Peter Karsch (PfI).

Contact persons:
Jan Peter Lesschen, Wageningen Environmental Research
Tel: +31-317-484687, e-mail: janpeter.lesschen@wur.nl

Peter Karsch, Partners for Innovation B.V.
Tel. +31-20-6200511 / +31-6-20607579 (mobile), e-mail: p.karsch@partnersforinnovation.com

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List of abbreviations

COP	Conference of the Parties of the UNFCCC
BECCS	Bio-Energy with Carbon Capture Storage
DACCS	Direct Air Carbon Capture and Storage
CFCR	Certification Framework for Carbon Removals (Com (2022) 672)
CRETA	Carbon Removals Expert group Technical Assistance (consortium WEnR and PfI supported by CNG)
GHG	Greenhouse Gases
IPCC	Intergovernmental Panel on Climate Change
JRC	Joint Research Centre
LCA	Life Cycle Assessment
LULUCF	Land Use, Land-Use Change and Forestry
MRV	Monitoring, Reporting and Verification
NFI	National Forest Inventory
REDD+	Reducing Emissions from Deforestation and forest Degradation
RS	Remote Sensing
SBTi	Science Based Targets initiative
SOC	Soil Organic Carbon
WCaG	Woodland Carbon Guarantee

1 Introduction

1.1 Introduction: purpose and contents of this document

This document was prepared to provide input for the discussion on certification methodologies for carbon farming that was held during the meeting of the Expert Group Carbon Removals in Brussels on 21-22 June 2023 to inform the ensuing scoping papers. The document aims to provide an overview of existing certification methodologies for carbon farming practices and their main characteristics. The main input in terms of methodologies included in the review originates from a survey that was conducted through the EU Survey website in April / May 2023 (see also next paragraph for further information). In addition, this review aims to identify elements from the existing methodologies in terms of implementing the QU.A.L.ITY criteria for further analyses. These elements will be used as input for the scoping papers that will be prepared in the second half of 2023 for the three main types of carbon farming activities that are subject to the work of the Expert Group: those related to agriculture on mineral soils, forestry and peatland. The review and identification of best practices is intended to provide input for the certification methodologies that will be applied once the proposal for a Certification Framework for Carbon Removals (further "CFCR") is adopted (expected early 2024).

Based on the discussion in the Expert Group Carbon Removals meeting in June and input received in writing, this document was finalized in July 2023 in order to serve as a basis for the scoping papers.

1.2 Identification of methodologies: call for input through EU Survey

The overview of methodologies included in the current document is mainly based on the results of the call for input through the EU Survey website that was open from 14 April until 12 May 2023. The survey was launched by DG CLIMA to gather information on certification methodologies for carbon farming. The survey was targeted on result-based methodologies, in line with the EC proposal for a CRCF. This means that activity based methodologies such as organic farming, were not included. The survey was targeted in particular at practitioners who understand carbon farming certification in details. While a first analysis of the survey has been made by the CRETA consortium on 12 May 2023, the current document provides a more in-depth overview focussing on the responses related to their coverage of the QU.A.L.ITY criteria. The analysis is based on the answers of the respondents; given the large number of methodologies, it was not possible to check all background information. Further information on the types of respondents and methodologies resulting from the survey can be found in chapter 2.

Additional methodologies included in the review:

As a first step, a comparison of the list of methodologies was made with available literature (mainly existing reviews, see also Annex B) and expertise available within the CRETA consortium. This has resulted in a selection of additional methodologies. The overview tables in the paragraphs 3.1.1, 4.1.1 and 5.1.1 indicate which methodologies are input from the EU Survey and which were added.

1.3 Selection of methodologies for further assessment

To qualify for inclusion a methodology should:

- Be applicable to at least one of the types of carbon farming practices that are subject of the work of the Expert Group on Carbon Removals, i.e. those related to agricultural mineral soils, forests and peatlands.

- Have reached a development stage allowing the methodology, i.e. a methodology that is in a very early stage of development can provide interesting insights but still has to prove its merits. The early-stage methodologies are hence included in the overview, but only methodologies in a more mature development stage are further assessed in terms of their coverage of the QU.A.L.ITY criteria.

We have classified the methodologies in accordance with the following definition of development stages:

Table 1 Classification of development stages

	Development stage	Short explanation
1	Methodology under development	Developing the methodology has started/is ongoing
2	Methodology available but not yet applied	Methodology available (incl. as draft/review version)
3	Methodology applied in a pilot	A first project has been certified using the methodology
4	Methodology is applied at scale	Methodology is available for certification of carbon farming practices, several/many projects certified

The methodologies included for further review are those that were classified as being in development stages 3 and 4, i.e. to qualify as a potential source for a best practice, a methodology should at least once (pilot scale) be applied to certify carbon credits of a carbon farming project.

1.4 Identification of best practices

Further to the purpose of this document as explained above, best practices are defined as examples from existing certification methodologies of reliable and coherent ways of addressing (one or more of) the QU.A.L.ITY criteria. Based on the input received through the EU Survey and further assessment of the certification methodologies, potential elements of the existing methodologies related to the QU.A.L.ITY criteria are proposed in the chapters 3 to 5 for the three types of carbon farming activities. These elements will be further elaborated and discussed in the scoping papers. The overview will be adapted and refined after discussion in the Expert Group meeting and receipt of written input.

2 Overall results of the call for input

2.1 Overview of methodologies

The EU Survey resulted in a total of 127 individual unique responses that were received by the extended deadline of 12 May. Based on a first screening 23 responses were excluded as these were either opinions, lacked information related to the QUALITY criteria or were not focussed on Carbon Farming. A further 15 responses were included in the preliminary analysis but were not further assessed as their relevance to carbon farming was not evident and/or the respective methodology was not yet sufficiently developed. Finally, 5 methodologies were added that were not included in the responses to the survey but were retrieved from other sources (as explained in section 1.2). As a result, a total of 94 methodologies were analysed as part of this review.

2.1.1 Methodologies per type of carbon farming

Of the 94 included methodologies, 52 were focussed on agricultural land management, 24 on forest (management) and 6 on peatland. Furthermore, there were 6 responses that focussed on multiple carbon farming activities and 6 that addressed other activities (biochar, blue carbon and enhanced weathering).

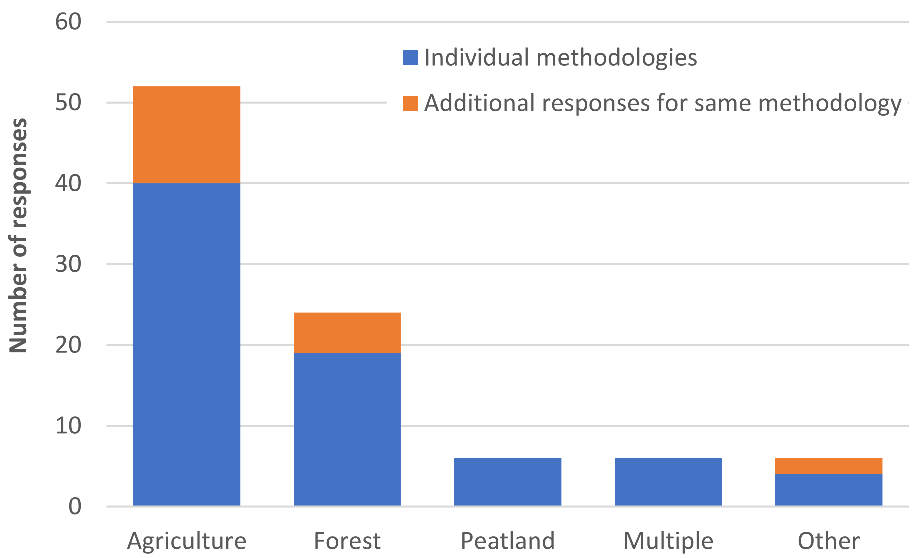

Figure 1 Methodologies by type of carbon farming

2.1.2 Development stage

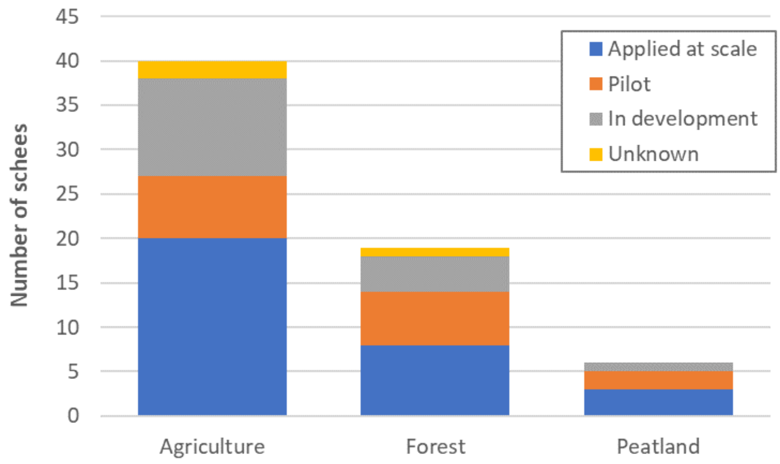

Figure 2 Methodologies by type of carbon farming and development stage

2.1.3 Methodologies included in the review: geographical scope

Methodologies per geographical region

The EU survey in combination with the additions made based on other reviews (see also paragraph 1.2) resulted in a total of 94 methodologies with relevance to certification of carbon removals. As shown in the figure below, most of the methodologies (54) have an international geographical scope, while the others are focusing on a specific country or are developed at country level and intended to be upscaled to the international level. Most of the national methodologies are from France (12) followed by Spain (7), the Netherlands (7) and Italy (6).

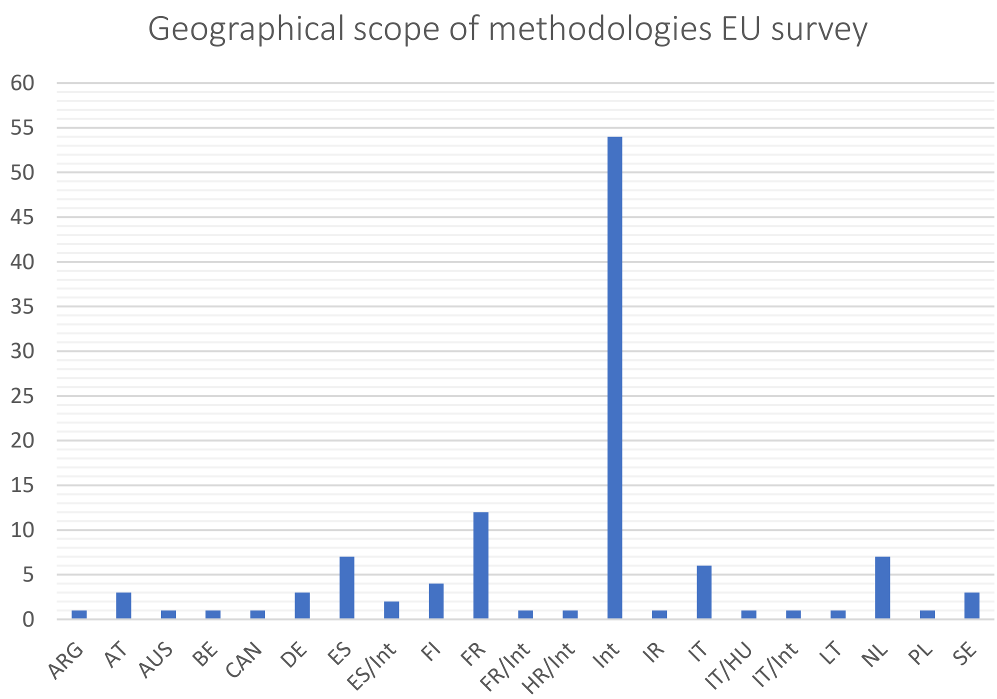

Figure 3 Geographical scope of certification methodologies

The first paragraph of the chapters 3, 4 and 5 provide an overview of the geographical scope of the methodology per type of carbon farming (respectively for agriculture, forestry and peatland).

2.1.4 Type of Respondent

Below the type of respondent is displayed. The explanations of abbreviations given in Figure 4 are given in the table below.

Table 2 Abbreviations and their explanation

Short	In full
DMS	Developer of a methodology or standard
EMCS	Entity managing a certification scheme and/or a registry of certificates
PP	Pilot project (e.g. LIFE, Horizon, national/regional project…)
I	Intermediary (entity providing consulting services to a group of operators to help them obtain certification)
CB	Certification body (entity conducting audits or developing methodologies / tools for audits)
EO	Economic operator (entity carrying out a carbon farming activity, e.g. individual farmer, forester, etc.) or association representing those operators (e.g. cooperative, industry association)
Oth	Other (with explanation, see also Annex C)
UoC	User of certificates (entity using carbon farming certificates for scope 3 reporting or impact finance, e.g. agro-industry, financial operator)

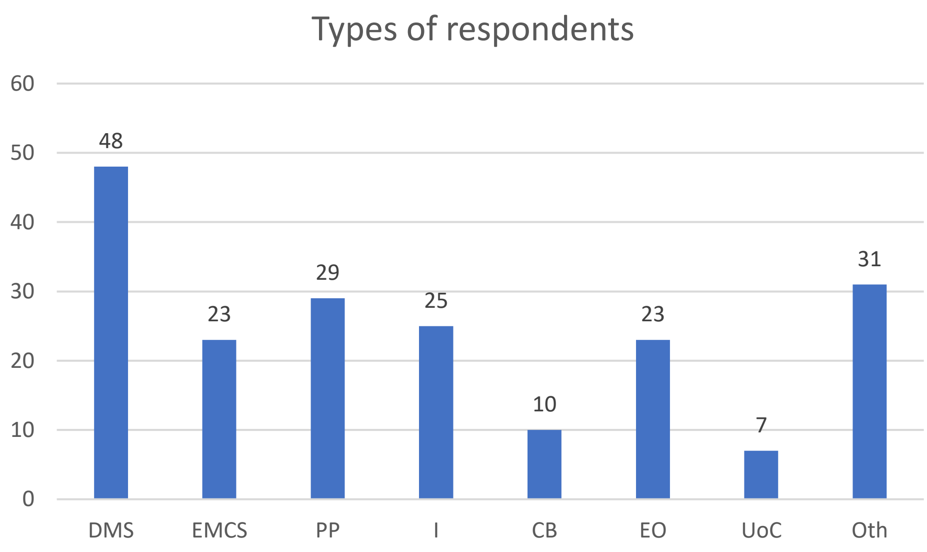

Figure 4 Type of respondents to the EU Survey (note: multiple answers possible)

It is to be noted that many respondents have indicated to fulfil several of the roles that are specified in the table above (55 respondents fulfil more than one role). The figure hence indicates the number of times a certain role was mentioned by a respondent. As shown in the figure, a large number of respondents (48) are (inter alia) developers of methodologies or standards (that in most cases have provided information on their own methodology / standard). In addition, many respondents (29) represent a pilot project in which a methodology is trialled for the first time. Intermediary organisations assisting operators to obtain certification, and economic operators themselves are also well represented (25 respectively 23 respondents), as are entities managing a certification scheme or registry (also 23). Certification bodies (10 respondents) and users of certificates (7) are to a lesser extent represented in the survey.

3 Certification methodologies Agricultural sector/mineral soils

3.1 Overview of methodologies for the agricultural sector

Agriculture

Most methodologies for carbon farming in agriculture have an international coverage (25). For Italy there are six carbon farming methodologies included in the survey. For France there are four carbon farming methodologies in agriculture, Spain has three methodologies that were included in the survey and the Netherlands two. All other countries included only one methodology: Argentina, Australia, Belgium, Canada, Germany, Hungary and Sweden (Figure 5).

We also made an overview of the type of agricultural activities that are addressed by the different carbon farming methodologies. For agriculture most are focussed on soil carbon sequestration, of which 38 methodologies are looking at arable soils (83%), and in 25 methodologies (55%) SOC in grassland has been explicitly mentioned as well. Soil N_2O emissions are addressed in 20 methodologies (43%), mostly related to reduced fertilizer application. In 14 methodologies (30%) carbon sequestration in biomass, mainly related agroforestry, but also conversion to perennial systems, is taken into account. In 6 methodologies also emission reduction from livestock is taken into account, and 5 methodologies can be considered as full farm approaches, where all emissions and removals on farm are taken into account (Label bas Carbon – Carbon Agri, BOVIDCO2, ArdiCarbon / BehiCarbon, ANCA, and Boden.Klima).

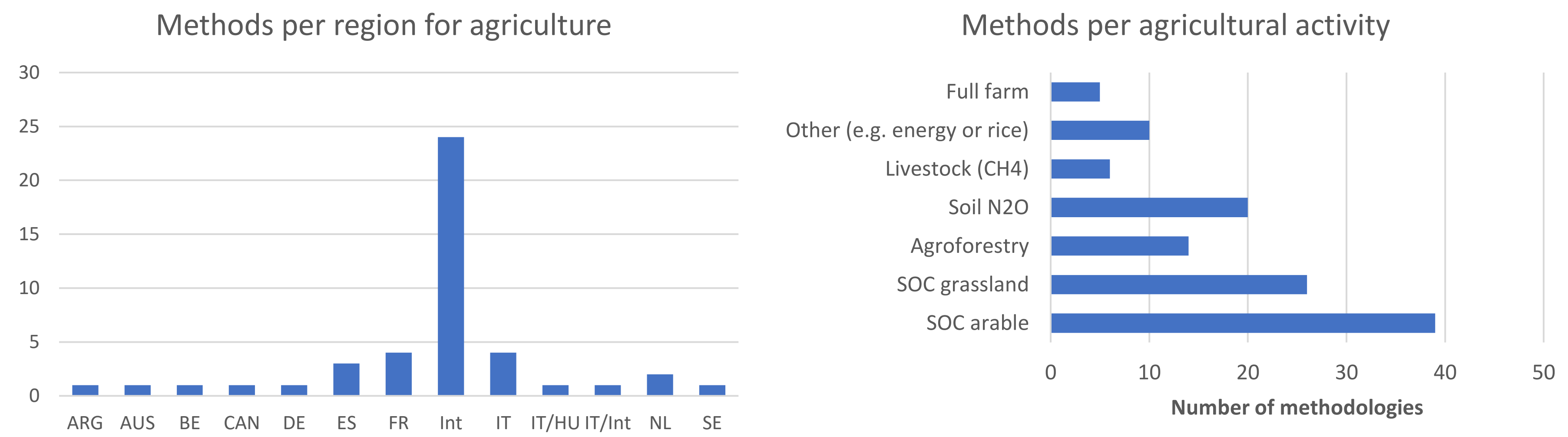

Figure 5 Methods per region for agriculture (left) and per agricultural activity (right) included in the survey

3.1.1 Survey responses and additional methodologies from other reviews

Table 3 Overview of certification methodologies agriculture/mineral soils

ID	Short name	Development level	Geographical focus	Validated against standard:	Eligible practices	Included in further analysis
4	Ormex	Applied at scale	Int	ISO-14065 VVB	Carbon storage (CO_2e stored as C in the soils, N_2O reduction): No tillage, cover crops, inter-cropping, reduced fertilizers, planning of bushes, cultures rotation, manure, mulching, cultures association Rice production: CH_4 reduction Cattle: CH_4 reduction	yes
10	Remote-C	Pilot	IT		Reduced tillage (minimum tillage, strip tillage), cover crops, crop residues incorporation, organic fertilizers (slurry, digestate, compost), double cropping, enriched crop rotation (with cereals grains, legumes). All the practices are verified for CO_2 removal in terms of soil organic carbon sequestration.	no
11	Agroforestry Carbon Tokens	In development	Int		Planting trees in agricultural fields (crop- and grassland) without reducing the productivity of the area but diversify the agricultural production. Only additional stored carbon in woody tree biomass that remains on the field is eligible and its possible stable use of the wood products (building material, biochar etc.).	no
14	Tru Carbon	In development	Int		The methodology is based strictly on true measurements, so it doesn't separate soil type.	No
22	Azolla	In development	Int	The methodology is based on ISO 14064-2, Verra's methodological tools.	* Agricultural land (mineral soils) * Woody biomass on agricultural lands (perennial crops + agroforestry) Three types of credits that can be generated within this methodology: Carbon Reduction Credit, Carbon Farming Credit, and Regenerative Credit.	no
23	Indigo Ag - Verra	Applied at scale	Int	Verra VM0042	Non-exclusive list of potential improved agricultural land management (ALM) practices that could constitute a project activity, incl.: Reduced fertilizer application Improved water management/irrigation Reduce tillage/improve residue management Improve crop planting and harvesting Improve grazing practices	yes
36	VERRA	Applied at scale	Int	The methodology is validated against the Verra's Verified Carbon Standard (VCS).	The VM0042 methodology for Improved Agricultural Land Management is designed to certify improved agricultural land management practices resulting in net GHG reductions in agricultural lands with mineral soils. Specific practices eligible for certification include conservation tillage, cover cropping, crop rotation, nutrient management, and reduced tillage.	yes

ID	Short name	Development level	Geographical focus	Validated against standard:	Eligible practices	Included in further analysis
63	eAgronom - Verra	Applied at scale	Int	Verra	Practices are for now limited to what is measurable at large scale and are focussed on soil carbon sequestration. The following list of practice changes is not exhaustive but represents most of the cases: 1. Reduce soil disturbance (tillage), 2. Generate biomass that will stay above/below ground (e.g. cover crops, harvest residue management), 3. Switch a part of synthetic N to organically sourced N (e.g. manure, slurry, digestate, legumes in the cover crop or crop rotation) where possible and optimize N inputs (the right dose at the right time) to achieve productivity while reducing leakage, 4. Do not reduce agriculture productivity since farmers need to earn a living and we need to feed a growing population	yes
97	Sequana – Verra	Applied at scale	Int	Gold Standard, Verra, Regen Network, Plan Vivo, CAR and ISO Standard for the (sampling design)	Improved agricultural management in both grazing and cropping systems. Carbon, but model can also be used to calculate Nitrogen and Methane emissions	yes
89	AgreenaCarbon Project	Applied at scale	Int	Agreena Programme is utilising a methodology which is adopted by the VCS standard.	Six project activities are eligible for the programme, which lead to a corresponding reduction or removal of CO_2 and N_2O: - Reducing tillage to lower soil disturbance and increase residue retention and carbon inputs - Leaving crop residues on top of the soil in order to improve nutrient cycling and soil quality - Planting a cover crop through the winter or all the way through to the next harvest to increase organic matter carbon inputs - Planting catch crops in between spring and winter crops - Reducing the rate of nitrogen fertilizer applied and switching from synthetic fertilizers to organic fertilizer (manure) - Applying nitrification inhibitors to limit nitrification within the soil	yes
80	Boomitra	Applied at scale	Int	Verra	The methodology is very broad in terms of the activities permitted, as long as they increase soil carbon and cause carbon sequestration in an additional and net-negative manner. Boomitra has direct experience implementing the methodology in the following systems: improved grazing: Mexico, Argentina, Uruguay, Paraguay, Brazil, Colombia, Mongolia, Namibia, Kenya improved residue management in wheat/rice/corn/sugarcane systems: Kenya, India, Brazil, Central America	yes
25	Soil carbon monitor	In development	NL	Expected in the second half of 2023	• No tillage of grassland on mineral soils contributes to increasing the soil organic matter content. • To ensure that there is no tilling of the grassland, farmers may not plough or otherwise till the selected plots of grassland for at least ten years in a row.	no

ID	Short name	Development level	Geographical focus	Validated against standard:	Eligible practices	Included in further analysis
26	GEOCO2	Pilot	IT/HU		The practices improving carbon stocks considered by the project are the following: 1) Reduction of soil tillage (from conventional to minimum tillage, or no tillage); 2) Integration with other tree crops and orchards; 3) Use of cover crops; 4) Bio products and organisms; 5) Use of ground rock dust blends as a soil improver; 6) Compost addition; 7) Manure addition; 8) Crop residues incorporation (organic mulches or pruning addition to soil); 9) Biochar (external) and other pyrolysis products incorporation; 10) Farm edge and rows, trees and shrubs (high, medium, low biomass).	no
27	CAR Soil Enrichment Protocol	Applied at scale	Int	Climate Action Reserve	Project activities are those activities that are necessary for the implementation and maintenance of one or more new agricultural land management practices which are reasonably expected to increase SOC storage and/or reduce emissions of CO_2, CH_4, and/or N_2O from agricultural land management activities, including changes to: ▪ Fertilizer (organic or inorganic) application; and/or, ▪ The application of soil amendments (organic or inorganic); and/or, ▪ Water management/irrigation; and/or, ▪ Tillage and/or residue management; and/or, ▪ Crop planting and harvesting (e.g., crop rotations, cover crops); and/or, ▪ Fossil fuel usage; and/or, ▪ Grazing practices and emissions.	yes
62	CAR Soil Enrichment Protocol	Applied at scale	IT/Int	ISO	Fertilizer, amendments, irrigation, tillage, residues management, crop rotation, cover crop, fossil fuel usage and grazing.	yes
60	CAR Avoided grassland conversion		IT	ANSI	Avoided conversion of grasslands to croplands	yes
32	ReGeneration Soil Carbon	Applied at scale	Int		Eligible projects must sign a contract with ReGeneration and an agronomic expert in regenerative agriculture and soil conservation. The agronomist establishes a roadmap together with the farmer which is the trajectory of the transition to regenerative agriculture, comprising the following practices: Maximum ground cover; Crop diversification over time and space; Companion crops and pulses; Minimal tillage, if possible direct seeding or strip-till; Installation of agroecological infrastructures (hedges, trees, flower strips); preponderance of grazing for herbivores; Minimal dependence on external supplies of organic matter (fodder, straw, covers, manure, compost); Minimal dependence on inputs; No synthetic nitrogen in prairies and decrease in field crops	yes
37	Carbon standards Mediterranean	In development	ES	Not yet, contacts with International Sustainability &	Soil carbon sequestration in perennial crops	no

ID	Short name	Development level	Geographical focus	Validated against standard:	Eligible practices	Included in further analysis
	permanent crops			Carbon Certification		
42	CO2-land	In development	Int	In the application phase according to ISO 14064-2	Farming land, management practices to increase SOC	no
43	Label Bas Carbone - Grandes Cultures	Applied at scale	FR	Complies with the national Low-Carbon Label standard (decree n°2018-1043 and order of 28 November 2018).	The Field Crops method targets direct emission reduction levers on farm, that can be grouped into 2 categories: • GHG emissions avoided such as Nitrogen fertilization (mineral and organic), Reduction of farm energy consumption (fuel, electricity, etc.) • GHG sequestration through Carbon storage in the soil.	yes
67	Label Bas Carbone – Plantation de vergers	Applied at scale	FR	Complies with the national Low carbon label standard (decree n°2018-1043, order of November 28, 2018)	Planting orchards on a land not cultivated for this use, for example on cultivated agricultural plot(s) (arable land or perennial crops such as viticulture or permanent meadows) induces the sequestration of CO2, in the soils and the biomass. Furthermore, the manufacture and the transport of the fertilizers allow to (indirectly) reduce the emissions of N2O. Finally, the valorization of the co-products of the orchard and the substitution to fossil energy can induce an indirect reduction of emission of CO2 and CH4.	yes
68	Label Bas Carbone - Haies	Applied at scale	FR	Complies with the national Low-Carbon Label standard (decree n°2018-1043 and order of 28 November 2018).	Different management itineraries allow carbon sequestration through the sustainable management of hedgerows. At the farm level, different itineraries are possible: - Planting on soil without trees (peripheral hedge) - Planting on colonization hedges - Enrichment of degraded or relict hedges - Improved management of existing hedgerows	yes
90	Label Bas Carbone - Carbon Agri	Applied at scale	FR	French Label Bas Carbone	Range of practices to reduce GHG emissions on livestock farms including improved herd management, feeding practices, fertilization practices and carbon sequestration practices.	yes
49	C-farms	Pilot	IT		Carbon-farming practices selected for the project include: Agroforestry practices (hedgerows, silvo-arable and silvo-pastoral systems), cover crops, organic amendments (manure, compost, biochar, anaerobic digestate), improved crop rotations, intercropping, maintenance on field of crop residues, reduced soil disturbance (no-till, strip-till, minimum till, reduced till), land-use changes (conversion of cropland to grassland, pasture, orchards, vineyards, poplar plantation), conservation and organic agriculture intended as a combination of 3-4 carbon farming practices.	Yes – for modelling

ID	Short name	Development level	Geographical focus	Validated against standard:	Eligible practices	Included in further analysis
58	BOVIDCO2	Pilot	ES	Not applicable	BovidCO2 is a multi-criteria calculator to measure greenhouse gas (GHG) emissions from beef production and identify the best mitigation options. A module is available to assess the effect of the implementation of different Best Available Techniques at farm level to evaluate the reductions in terms of nitrogen, phosphorus, ammonia and GHGs emissions from livestock.	no
59	ArdiCarbon / BehiCarbon	In development	ES		Certification methodology for sheep farming (ArdiCarbon tool), and for dairy farming (BehiCarbon tool). ArdiCarbon and BehiCarbon are a multi-criteria calculators to measure greenhouse gas (GHG) emissions from sheep and dairy production and identify the best mitigation options.	no
61	aESTI Soil Organic Carbon	In development	Int		Effects of soil carbon sequestration practices are measured in the 0-30 cm top layer of agricultural mineral soils.	no
64	SOC LIFE AMDRYC4	Pilot	ES	Validation has been performed with real soil organic carbon data and quality QA/QC determination methods	In general these are practices that increase the organic content of the soil, such as contribution of manure, contribution of compost, green fertiliser. As well as practices of soil conservation and increase of biodiversity, natural strips...	no
66	Boden.Klima	Pilot	DE	ISO standard is in planning	All relevant practices and their emission of CO2, CH4 and N2O in agricultural farm branches: Cropland, grassland, Dairy cattle, Young cattle, Calves, Mother cow, Cattle fattening, Pig fattening, Piglet production, Piglet rearing, Laying hens, Poultry farming and including the use of peatlands and forest lands.	no
114	Nori Croplands	Applied at scale	Int		Soil carbon sequestration practices in cropland, as part of a switch to regenerative agriculture	yes
74	Quantification Protocol Alberta gvt	In development	CAN	For leakage: Based on ISO 14064:2	Practices: No till + Shifting from fallow to continuous cropping if managed with no till	no
79	Trinity NCM	Applied at scale	Int	Both ISO 14064 and Verra's IALM (VM0042)	Croplands (arable, horticulture and perennial crops): Reduced fertiliser, No herbicide, Reduced herbicide, No insecticide, Reduced insecticide, Controlled Traffic Farming (for soil compaction), Replace 50% synthetic fertiliser with organic manure, Use nitrification inhibitors with nitrogen fertilisers, Use controlled release fertilisers, Replace field diesel with biodiesel, Replace grid electricity with zero emissions electricity, Incorporation or mulching of woody residues, Catch/cover crops, Reduced tillage, No-till (direct drilling) Grasslands: Coppicing, Conservation grazing, Delay or reduce cutting frequency, Cattle and sheep paddock/rotational grazing, Cattle and sheep mob grazing, Conservation grazing (as per best practice	yes

ID	Short name	Development level	Geographical focus	Validated against standard:	Eligible practices	Included in further analysis
					guidelines), Rough grazing for birds, Lenient grazing, Very low inputs, Best practice bracken management, Best practice scrub management, Best practice control of pernicious/noxious weeds, Laying, Gapping	
81	panxchange.com/carbon	Applied at scale	Int	Internally validated and cross-examined against International Carbon Removal and Offset Alliance (ICROA) Standard.	• Changing/expanding crop rotations and cropping intensity • Using cover crops and/or shifting from annuals to perennials. • Reducing tillage and/or adopting residue management techniques. • Using organic matter rather than synthetic fertilizers to better sequester GHGs. • Other practices including improved rotation, inclusion of biomass crops such as hemp, mulching, conversion to woodlots, Alley cropping/silvopasture, improved pasture management and grazing practices.	yes
83	Australian Emissions Reduction Fund	Applied at scale	AUS		Practices: Organic fertilizers (i.e., compost or manure), lime to remediate acid soils, irrigation, re-establishing pasture, clay spreading, inversion tillage, using legume species in cropping or pasture systems, cover crops to promote soil vegetation cover or improve soil health.	yes
85	Regrow MRV	Applied at scale	Int	Climate Action Reserve	Cover Crops, no/reduced tillage	no
86	Soil Capital Carbon	Applied at scale	Int	ISO 14064-2	Under this methodology, regenerative agriculture practices result in the following emission reductions and removals: 1. Reduced need for, and use of, synthetic fertilisers via incorporation of nitrogen-fixing legumes into crop rotation design and increasing substitution with organic fertilisers; 2. Reduced pesticide usage and therefore emissions associated with pesticide production; 3. Reduced use of full inversion ploughing, replacing this instead with reduced tillage and direct drilling (zero tillage) practices; 4. Reduced fossil fuel and energy use (e.g., for irrigation). 5. Agroforestry techniques.	yes
87	Swedish Carbon Storage	Pilot	SE		Carbon sequestration practices	yes
88	Avoided conversion of Grassland - ACR	Applied at scale	Int	ISO 14065	Avoided conversion of grasslands and shrublands to croplands --> Soil carbon stock (and CO_2 related fluxes) + optional: above and below-ground biomass C stock + Direct N_2O emissions deriving from synthetic and organic N amendments + optional CO_2 emissions from fossil fuel combustion + CH_4 emissions have to be included only if livestock are present in the baseline or in the project scenario.	yes
93	Annual Nutrient	Applied at scale	NL	Aligned with EU PEF	Model to calculate carbon footprint of milk on Dutch dairy farms. Recently also soil carbon was included	No, used as monitoring

ID	Short name	Development level	Geographical focus	Validated against standard:	Eligible practices	Included in further analysis
	Cycling Assessment (ANCA)					tool and SOC module still in development
94	Claire Carbon Farming	In development	BE	ISO	Practices that build up organic matter in soil: Green cover crops, including under-seeding grass in maize; Use of compost; Use of farmyard manure; Straw incorporation; Changing rotation; Incorporate (extra) alfalfa in crop rotation; Fields incl. temporary grassland, replace with permanent grassland; Grass-clover instead of ryegrass; Trees and agroforestry; Planting wood edges; Include '(additional) miscanthus in rotation'	no
100	Gold Standard	Applied at scale	Int	Gold Standard	Includes soil from any land and not limited to agriculture land based on adoption of improved agricultural practices.	yes
120	Agsus Protocol	Applied at scale	ARG	Gold Standard, Soil Organic Carbon Framework Methodology, V1 2020	Soil carbon sequestration practices (only soil measurements)	no, based on Gold Standard and scheme outside EU
111	Esca factor EU Renewable Energy Directive	Applied at scale	Int	ISCC	Carbon farming, Organic carbon capture and improvement of biodiversity. Improved agriculture management practices, accepted for the purpose of achieving emission savings from soil carbon accumulation, include shifting to reduced or zero-tillage, improved crop/rotation, the use of cover crops, including crop residue management, and the use of organic soil improver (e.g. compost, manure fermentation, digestate, etc.).	yes
113	SNK Blijvend Grasland (permanent pasture)	Applied at scale	NL		Permanent pasture - organic matter in soils / carbon sequestration	yes
117	Carboneg	Applied at scale	Int	Validation against the BCarbon soil protocol is still in progress.	Regenerative farming practices. CO_2 sequestration	yes
118	Climate Farmers	Applied at scale	Int	DIN EN ISO 14064-2:2019	Cover Crops, Reduced or No-Till, No or reduced application of synthetic fertilisers, Residue Management, Agroforestry, Rotational Grazing	yes
125	Gaïago	In development	Int		Practice = The use of a soil biostimulant. + Soil organic carbon framework methodology (Cover crops, less tillage ...)	no

3.1.2 Assessment of QU.A.L.ITY criteria for selected methodologies

Based on the first screening we made a selection of the methodologies for the more detailed assessment related to the QU.A.L.ITY criteria. Only the methodologies that are already applied at scale and issued certificates were included, which resulted in 26 methodologies that are described in more detail below.

Table 4 Assessment on QU.A.L.ITY criteria - certification methodologies agriculture/mineral soils

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
4	Ormex	- Model is based on IPCC 2009 report, used in FAO tool NEXT. - Direct GHG calculated, stored on farmlands. Leakage included as % of indirect activities (CO_2). - Hybrid baseline. Baseline measurement at different times. Tier 2: Region specific parameter. Tier 3: Sampling baseline privileged. - Uncertainties include leakage, buffer, uncertainty tool recognized by CCP rules of IC-VCM. - Verification by soil sampling and visits by standard and 3rd party auditor (VVB) every 3-5 years. Real-time satellite monitoring to register developments.	- Regulatory and financial additionalities apply	- Monitoring period: 20 years. - Public data via Google Earth, ABC Map & Forest watch for deforestation prior to project implementation. - Certification period: 10 years, renewable. - Release risk mitigation via assessment tool. - Liability mechanism: buffer.	- Only environmentally and socially highly carbon credits are issued. - Co-benefits are monitored via regenerative practice indicators associated with SDG goals.
23	Indigo Ag - Verra	- No specific model mandated. - Direct/indirect GHG (CO_2, CH_4, N_2O) included, procedures estimate reductions and removals from increased soil OM storage. Compatible with regenerative agriculture. - Project-specific baseline: assumes continuation pre-project practices with conditions min. 3 yrs prior to produce annual schedule of activities. The resulting baseline is re-evaluated (VSC standard). If regional applicable performance benchmark approved by Verra is available, then this is used instead.	- Type of additionality is ‘other'. - Rules to establish additionality include to 1) demonstrate regulatory surplus, 2) identify and demonstrate barriers that prevent project activities from occurring (excl. financial barriers), 3) demonstrate that project activities are not common practice (less than 20% used in region)	- Monitoring required for duration of crediting period or 30 years, whichever is greater. - Public data or remote sensing is not required, but remote sensing may be employed. - Crediting period for AFOLU projects is min. 20 years and max. 100 years, renewed max. 4 times. - Ways to mitigate risk release is based on instructions of VCS or other approved Monitoring Report Template. - Liability mechanisms include: a buffer pool to protect against catastrophic reversals.	- The project proponent shall identify potential negative environmental and socio-economic impacts and shall take steps to mitigate them. Additional certification standards may be applied to demonstrate social and environmental benefits beyond GHG emission reductions or removals. - It will be demonstrated how project and additional activities contribute to sustainable development (SDGs): at least 3 SDGs by the end of the first

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					monitoring period and in each subsequent monitoring period.
36	VERRA	- Baseline and project GHG emissions are defined in terms of CH4, N2O and CO2 flux in units of tonnes of CO2e per unit area per monitoring period. - The methodology allows for different quantification approaches for each pool/source of GHG, such as Measure and Model (requires use of biogeochemical model) and Measure and Remeasure (based on direct field measurements). - In addition to SOC stock change monitoring, the methodology requires calculating direct and indirect GHG emissions from agricultural land management activities. - Project-specific baseline, based on historical activity data. The methodology requires the project proponent to calculate baseline emission for each GHG source and sink, using modelling and monitoring data, and adjusted to reflect the project scenario. In the measurement-based approach, the baseline is measured in control sites, with net emission reductions calculated by subtracting project scenario emissions from baseline emissions for each GHG source and sink. - VCS Program project get independent auditing by Verra staff and 3rd party to meet standard's rules. The use of biogeochemical model is approved by a modeling expert. - Verification is required at least every five years.	- Type: Regulatory additionality. The project proponent must demonstrate regulatory surplus and identify barriers to implementing proposed changes in pre-existing agricultural management and show that adopting proposed activities are not common practice, by providing peer-reviewed and/or published studies to support the demonstration of cultural and/or social barriers and calculate the weighted average adoption rate of proposed project activities.	- For ALM projects focusing exclusively on reducing N2O, CH4 and/or fossil-derived CO2 emissions, the project crediting period shall be either seven years (twice renewable for a total of 21 years) or ten years fixed. For all other AFOLU projects: min. 20 years up to max. 100 years, which may be renewed max. 4 times. Also, Verra expects to begin a long-term monitoring system within the next year to allow for the monitoring of AFOLU projects after the end of their crediting period to help ensure 100-year permanence. - No public data/remote sensing - Non-permanence risk in AFOLU projects is addressed through the use of project risk analysis tools, which determine the number of credits to be deposited in pooled buffer accounts, which hold non-tradable buffer credits.	- The project proponent needs to identify and address any negative environmental and socio-economic impacts of project activities and engage with local stakeholders during the project development and implementation processes. Where AFOLU project activities do not impact local stakeholders, the project proponent provides evidence that project activities do not impact local stakeholders at validation and each verification. - Projects can seek certification under the CCB Program or the SDVIS Program to demonstrate their contribution towards achieving other environmental and social objectives beyond carbon reductions.
63	eAgronom - Verra	- Quantification tool and soil model are now confidential company information, but were developed in a partnership with a leading soil modelling. The model is improved with farmer's data. - The quantification tool considers field GHG emissions and takes into account overall farm	- Rules to establish additionality include an investment barrier (equipment, seed costs, labour to manage extra tasks on fields, etc.) and social and knowledge barriers, wherein trust and	- Crediting period of 20 or 21 years depending on the project type followed by a monitoring period. Total length is at least 30 years (= permanence longevity). - EU SOC maps are indicative of potentials but do not reflect the impact of each field evolution	- Approach to no environmental harm: More Carbon in soil, means more OM%, means less erosion and stress, more biological activities and water retention. With practice change implementation and sound

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		emissions using the farm parameters and IPCC coefficients. - Project-specific baseline, using specific field baseline calculation. - Uncertainties: See the VM0042 and VMD0053 and latest agtech solutions - Verification: VM0042 and VMD0053. - Yearly cadence since based on soil models.	genuine agronomic knowledge support are important.	related to practice changes. Soil maps (texture and OM%) are of high importance. - Certification period up to 21 years (3 x 7 years) or 1x 20 years - Mitigation risk release: VM0042. - Liability mechanisms include a buffer pool which is recalculated after each verification event.	agronomic advise, the risk is limited to its minimum. - Approach to monitor co-benefits: VM0042 and Farmer knowledge and professionalism. Biodiversity and soil improvements will be monitored.
97	Seqana - Verra	- VM0042 uses SOC measurements to set the baseline for modelled estimates of SOC stock changes and then requires measurements of SOC every 5 years (or less). This "Measure and Model" approach uses empirical or process-based models to estimate GHG flux in the SOC pool and requires an approved model as well as a range of data inputs. - Emissions factors are used in conjunction with project data in the protocol equations. Default emissions factors can also be used for GHGs related to other project activities. - Hybrid baseline type. - Performance/dynamic baseline - defined using required years of historic management information (a minimum of 3 years and covering at least 1 full crop rotation). A performance benchmark (regional average) is allowed if one is approved by Verra. - There are deductions for certain levels of uncertainty: the extent to which the half width of the 95% confidence interval, as a percentage of the mean, exceeds the threshold of 15% - SOC and bulk density directly measured at t = 0 (or back modelled from measurements collected +/- 5 years of t=0) every 5 years or less; SOC may also be estimated via emerging technologies (remote sensing) with known uncertainty.	- Regulatory additionality; Financial additionality - Additionality requirement: (1) identify barriers that would prevent the implementation of a change in pre-existing agricultural practices and (2) demonstration that the adoption of the suite of proposed project activities is not common practice (defined as greater than 20% adoption)	- Monitoring period is min. 20 years to max. 100 years, which may be renewed max. 4 times. - Seqana is collaborating with Gold Standard and the original authors of VM42 and VMD53 to develop a similar protocol that will define further details on how statistical models can be applied to model SOC stock change with remote sensing data. - Minimum of 20 years up to a maximum of 100 years - Certification period: 30 years. - To account for possible future reversals or losses, an insurance mechanism is in place whereby a certain amount of credits are withheld from each issuance event.	- Verra requires every project to uphold certain standards defined in the CCB (CLIMATE, COMMUNITY & BIODIVERSITY STANDARDS). These cover many aspects of the sustainable development goals. - All CCB projects are subject to desk and field audits by qualified independent third parties to ensure that they meet the standards and apply their methodologies properly. In the beginning bespoke indicators are defined, that need to be accepted by Verra and Validators.

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		- In the Measure and Model approach yearly issuance are possible, while the yearly change is modelled after 5 years or less.			
89	AgreenaCarbon Project	- The net GHG emissions reductions and removals according to VM0042 methodology using Quantification Approach 1: Measure and model. - RothC model is used to quantify SOC changes. - Project-specific baseline using a 5-year historical look-back period - N2O from use of nitrogen fertilisers and nitrogen fixing species calculated according to VM0042. - Carbon leakage according to VM0042 methodology. The program engages the calculations from the new application of organic amendments from outside the project activity and leakage from productivity declines. - Combination of verification methods including remote sensing data (field boundaries, soil management and cover crops), pattern analysis of input data from the farmers and field visits (about 10% of participants every year).	- Additionality test according to VM0042, which contains three steps: the i) regulatory surplus, ii) barrier analysis and iii) the Common Practice Test (based on the CDM Methodological Tool. - Financial additionality is considered one of several barriers that may exist in carbon projects, yet other barriers can be identified in lieu of financial barriers.	- 20 year crediting period up to 5 times renewable for a maximum of 100 years crediting period (VCS Standard v4.4). Baseline must be reassessed every 10 years. - Monitoring period must be at least 30 years, i.e. 10 years past the point of entry into the Project. - Remote Sensing is used to check all the parameters related to field boundary, field size, field coverage and management practices. - AFOLU Non-Permanence Risk Tool which determines the buffer pool. Reversals are monitored and when they occur the equivalent credits are pulled out of the Buffer Pool. Based on current assessment the buffer level equals to 20%.	- Regenerative practices that are implemented will impact the environment through improving soil health, reducing soil erosion, improving water and air quality, and enhancing biodiversity. These co-benefits are not currently measured and monitored. - Alignment with SDGs is mentioned, but no monitoring report related to the SDG's will be published.
80	Boomitra	- Soil carbon is directly measured using satellites and AI. Satellite data is used as inputs to an Artificial Intelligence (AI) system that directly measures absolute soil carbon levels and bulk density to a 10 meter resolution. This data includes ESA satellites, NASA satellites, JAXA satellites and more. This approach has undergone third-party validation in 2 large-scale carbon projects - The direct and indirect GHG emissions depend on the specific practice. If these are low relative to the carbon removal achieved, then the direct/indirect emissions are ignored. If the direct/indirect emissions may be larger (>1%) relative to the carbon	- For regulatory additionality, regulatory surplus must be established by a legal analysis in each jurisdiction. - Financial additionality is established through an analysis of financial barriers, after accounting for the financial impacts of carrying out the new practices for a	- Monitoring period: 100 years - Certification: 20 years initially, but renewable 4 times for a total of 100 years. - The projects all contribute to a collective buffer pool based on the risk level of each project, according to Verra's non-permanence risk assessment tool. Beyond the buffer pool, the carbon credit payments to the farmers undergo vesting: if farmers wish to give up on their	- As part of the third party audit, the new practices implemented are carefully studied for their environmental impacts. - All Boomitra projects work towards meeting a certain set of SDG goals that are being accomplished by individual projects as secondary goals. Beyond the SDG goals, some projects also undergo an additional Climate, Community and Biodiversity (CCB) certification

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		removed, then a Life Cycle Analysis of the practice is carried out. - Dynamic performance benchmark baseline is used through baseline control sites. Each farm has its own baseline through its corresponding baseline control site, which is selected on the basis of similarity in terms of: soil type, slope, initial soil carbon, climate zone and practices present on the project farm. - Verification involves the collection of ground truth soil samples. The data of the soil samples is compared with the satellite and AI measurements. - Soil carbon is monitored using satellite remote sensing on a monthly basis. Credits may be issued yearly, every two years or every three years depending on the observability of the carbon sequestration effect and its uncertainty level.	representative set of farmers and local ground staff. - Additionality is also directly established by the dynamic performance benchmark - the baseline control sites. Any carbon that is stored that goes beyond the carbon change occurring in a properly matched and similar baseline control site is directly additional.	new practices then they would lose their unvested payments, on the other hand the stacking of payments will provide funds to continue maintaining the new practice. - Liabilities are also addressed on a project level across all farmers that are grouped in the project. The first liability mechanism is the buffer pool itself. If the buffer is exhausted, then the broader Boomitra global portfolio of projects is tapped. Finally, replacement Verra credits may be procured from other Verra projects from other developers.	if there are tangible biodiversity benefits that can be shown.
27 + 62	CAR Soil Enrichment Protocol	- SEP uses a hybrid approach to quantify SOC and SOC change. The protocol does not prescribe a model, but lists criteria that a model must meet to receive approval. The SOC pool is either directly measured or modelled, but the SOC change is always modelled. - Direct GHG emissions include reversible and non-reversible CO2, CH4, and N2O emissions from agricultural operations. Project-related direct emissions can be modelled or calculated using Tier 2 equations in the protocol. Indirect emissions from land use change outside the boundaries of the project are accounted via estimation of 'Leakage'. - Project-specific baseline. The baseline scenario assumes the continuation of pre-project agricultural management practices. Practices applied in the baseline scenario are determined by defining an historical baseline period of minimum three years. The baseline is modelled using two approaches: Matched Baseline or Blended Baseline.	- Regulatory additionality: All projects are subject to a legal requirement test to ensure that the GHG reductions achieved by a project would not otherwise have occurred due to federal, state, or local regulations, or other legally binding mandates. - Financial additionality: SEP includes guidance for assessing the eligibility of "stacking" other payments and credits with the carbon project.	- Permanence is accounted for at project-level, while the monitoring occurs at the field-level. Given that the permanence period is focused only on protection of the SOC for which credits have been issued, when monitoring for permanence, the Project Owner must consider the following sources of reversal risk: 1) Wholesale change to an incompatible land use. 2) Physical disturbance of the soil withing the project area. 3) Unavoidable reversals. 4) Overgrazing. - The liability for unavoidable reversals is assumed by the registry (the Reserve). Each project is required to allocate a	- The SEP protocol includes no net harm provision but relies primarily on existing laws and regulatory programs to ensure community standards for such issues are met. - Monitoring of non-GHG co-benefits is not required under the protocol. The Reserve provides an Excel template for voluntary reporting of project alignment with and performance against the UN SDGs.

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		- Uncertainty is computed from the 30th percentile of the distribution of the estimated average emissions reduction, which is assumed to be normally distributed.		percentage of the CRTs issued every reporting Period into a Buffer Pool.	
60	CAR Avoided grassland conversion	- The use of specific models is not required. Default emission factors developed through a probabilistic composite modelling approach are used. - GHG emissions: Soil and fertilizer N2O emissions: default factors from IPCC - Baseline calculation: Scenario of conversion of grasslands or shrublands to croplands: Default emission factors developed through a probabilistic composite modelling approach. The baseline is valid for up to 50 years - Verification: Only ANSI-accredited verification bodies trained by the Reserve for this project type are eligible to verify grassland project reports. - Annual cadence (prior land use, grazing activities, fertilizer application, irrigation and fires).	- Regulatory additionality; Other - Performance standard test and legal requirement test (practices not required by law).	- Monitoring period: 100 years following the last issuance of credits. Note that this means that monitoring and verification for a project must continue even after the end of the project's crediting period. - No public/remote sensing - Certification period no more than 50 years - Risk of release: The Reserve has taken a conservative approach, assuming a 20% leakage effect from grassland projects. - Accounting for leakage related to displacement of livestock and sustained reductions in crop yields	- No information
32	ReGeneration Soil Carbon	- The calculation of carbon removal is based on a stratified random sampling approach for soil organic carbon. The project area is stratified via an AI model of SOC stock. A core element of the calculation is the application of the Equivalent Soil Mass method, recommended by the FAO and other respectable organizations, for reliable measurement of the soil bulk density. - The methodology calculates farm emissions and the farmer sets an emission reduction target at the beginning of the project. - Project-specific baseline. Static baseline using the SOC stock calculation, based on a soil sampling campaign in year 0. - Uncertainties related to measurement are taken into account and uncertainties related to marketing	- Regulatory additionality; - The money from the eco-contribution credit is rewarding the additional Eco-Benefits that the Project Proponent creates during the Project Timeframe. Any change from the static baseline is considered as additional. All farmers need to be accompanied by an agronomist, who generates a roadmap at the beginning of the transition, which is a central instrument of the	- Monitoring period: 10 years. - Methodology is based on physical measurement in the field. - Certification period: 10 years. - Eco-contribution credit certifies the status change of a social-ecological system and the resilience of the system contributes to the permanence of carbon removal. - 5 % of all generated eco-contribution credits from one Project Area is put into a permanent Buffer Vault, which is comparable to a buffer pool, but the Eco-Credits are locked away	- No environmental harm through an annual evaluation of farm emissions and setting an emission reduction target. Also, the support by an agronomic expert ensures that the implementation of regenerative practices does not lead to negative effects on the farming system and the surrounding ecosystem. - Co-benefits: The Methodology aims to put farms on a track to become 100% regenerative. This Methodology for crediting the increase of SOC is embedded in a set of Methodologies on crediting

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		are calculated. Increasing uncertainty results in a lower amount of carbon credits marketed. - Ground truthing is the basis for the SOC stock calculation. Calculation of carbon removal is based on a stratified random sampling approach for soil organic carbon. - There is one baseline soil sampling campaign in year 0, one in year 5, and one final sampling campaign in year 10.	demonstration for additionality.	forever and cannot be sold or used for any kind of communication.	other Eco-Benefits, held together by the eco-contribution credit.
43	Label Bas Carbone - Grandes Cultures	- The scope of the Field Crop Low Carbon (FCLC) method covers farm projects regarding cropping systems + storage/drying buildings. The calculation is made at farm level (= the whole farm) that grow field crops. ER SOC storage is estimated using soil assessment models (AMG, STICS, AqYield). Datasets and calibration are adapted to the French context. - Carbon Credits are based on direct emissions on the farm. Also include indirect emissions that are upstream or downstream GHG emissions (= indirect emissions) such as drying off-farm, or production emission factor of synthetic fertilizer. The FCLC method doesn't calculate indirect emissions from land use changes. - Hybrid baseline type. Carbon credits are quantified as the difference between a carbon project scenario and a baseline, and the baseline can be specific (farm data) or generic (database, survey, regional data). - When there are uncertainties or data with lower precision in the model, discounts are applied to the quantity of carbon credits eligible by type of carbon credits. - During the 5 years of the project, the EO shall collect annual data and write a monitoring report.	- The FCLC method applies the additionality principles. - CAP first pillar subsidies are not considered in the financial additionality. - a 20% discount is given if the financial additionality is not measured for the dedicated lever.	- Monitoring period: 5 years - Remote sensing can be a set of data used in the modelling (not used at this stage). - Certification period: 5 years - In case of occasional issues regarding risk release (climate incidents, lever discontinuation…), the monitoring report must report them. - For SOC, a 20% discount is applied on ER storage. It is reduced to 10% if the project is renewed or if the economic operator can prove that the activity is maintained.	- The FCLC method offers recommendations so the project can provide co-benefits to the different dimensions of sustainable agriculture. - List of co-benefits: Mandatory: Soil erosion Compulsory in case of moderate or strong erosion hazard, Non-renewable energy consumption, Ammonia emission, Nitrate leaching, Water consumption Mandatory in case of irrigation, Pressures from the use of plant protection products. Optional: Biodiversity, Societal demands, Territorial dynamics, Income and quality of working conditions, Phosphorus consumption.
67	Label Bas Carbone - Plantation de vergers	- Quantification is based on scientific literature, in particular the "long-term average stock method"	- Regulatory additionality: the project leader must demonstrate that the	- The monitoring period lasts 5 years.	- The decree of the Low Carbon Label constrains the methods to not induce any significant negative

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		(Verra, 2011). The computation depends on yield tables of tree species considered in the project. - Project-specific baseline. For the baseline, the agricultural activity and land use (field crops, viticulture, meadows) they would pursue in the absence of the orchard plantation. - The uncertainty related to the calculations is taken into account by applying a rebate of 15% for the calculation of conventional GHG emission reductions and indirect upstream emissions if calculation is based on average emission factors per fruit crop, or 10% systematic and permanent for the calculation of anticipated reductions in biomass to take into account variations in carbon stock due to variability in production contexts.	project goes beyond regulatory and legal obligations. - Financial additionality: the project leader must make an inventory of the public aids to which he is potentially eligible for his orchard plantation project and demonstrate that they are insufficient (e.g. available aid is insufficient and represent less than 50% of the cost of the investment.	- The certification of orchards project lasts for the duration of the project, i.e. 20 years. There is no deadline for the certification of emission reductions realised over this period. - Anthropogenic risk is considered low. The natural risk is taken into consideration. If stored carbon gets released before the audit, the emissions reductions are re-evaluated. There is no liability other than the commitment made with the funder. There is no post-audit control. This risk of loss is accounted for in the rebates applied to emission reductions.	environmental impact, under penalty of being either revised or repealed. - Co-benefits will be monitored and verified and include: • Global environmental targets (through recognized environmental certifications in organic agriculture) • Soil preservation • Preservation and introduction of biodiversity • Water quality improvement, as well as socio-economic co-benefits.
68	Label Bas Carbone - Haies	The HAIES method accounts for carbon sequestration in soils and biomass through the sustainable management of hedgerows on farms in France. Also accounts for potential emission reductions for substituting fossil energy by wood from the hedges. The direct emission reduction is the difference between the carbon sequestration in the biomass compartments under the project scenario and those under the baseline. Indirect emission reductions are also calculated for exported wood. - Project-specific baseline - It is based on the results of the Carbocage project, a project specific to the Loire Atlantique region. As there is no data for other regions, a discount has been set up for projects outside this region. - The verification is done by independent auditor, field verifications focus on the actual completion of the planned plantings between years n and n+5.	Regulatory additionality: The HAIES projects targeted are additional in terms of regulations, there are no legal obligations to plant, maintain or densify agricultural hedges. Financial additionality: A project is additional when it removes the obstacles to the implementation of the hedges. Additionality is not respected if a farmer has contracted an agri-environment-climate measures	- The duration of the surveillance period is five years, renewable twice, i.e. 15 years - If the project is not permanent, there is a 10% non-permanence rebate. - In the case of a release after the audit, the label does not provide for any sanction or penalty.	- Simple indicators to demonstrate that the possible environmental, social or economic impacts are controlled. These indicators are communicated in the monitoring report and are subject to verification by an auditor

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90	Label Bas Carbone - Carbon Agri	- Quantification of GHG emission reduction in livestock systems, which is based on the differences in the carbon intensity of the products and/or the carbon storage as calculated by the CAP'2ER® tool. - Direct and indirect emissions are taken into account. - Hybrid approach is used for baseline whereby the project developers can choose between two scenarios, a specific reference scenario or a generic reference scenario that will serve as a reference for the calculation of the emission reductions. - In specific reference scenario, the baseline scenario is based on the project-specific carbon intensity. The baseline carbon intensity is based on the diagnosis for each farm using the CAP'2ER® level 2 tool. - In generic reference scenario, the use of a generic reference may be justified if a farm undergoes changes in the type of system within the same unit, or if it does not benefit from a CAP'2ER® level 2 diagnosis in the year of project start-up. - Default data are used to ease the data collection on the farm or if the farmer does not know his specific data precisely. Default emission and carbon stock change factors are used based on the best scientific and technical elements available (including the IPCC Guidelines, 2006) and are representative of the specificities of French agricultural production.	- Regulatory additionality: Encourage farmers to reduce GHG emissions and implement increasing carbon storage on farms. - Financial additionality, e.g. through Energy Savings Certificate (CEE) scheme through which consumers who make energy-saving investments receive financial compensation. Farmers benefit by demonstrating that they use equipment and practices that can help with energy efficiency (tractor engine tuning, heated greenhouse equipment, heat recovery on milk tanks, etc.).	- The storage of carbon is monitored only during the five years of the project. - Only emission reductions resulting from actions undertaken after the start are recognised by the label. If a project has not reduced its emissions by the end of the five-year period, it loses its label. - A labelled project that has reached the end of its five-year term is renewable, provided that additionality is demonstrated. - The eligibility of projects is conditional on maintaining or increasing the carbon stock. This requirement will be monitored for the whole farm by the carbon stock change indicator, which must be positive or zero at the project scale. - The risk of non-permanence of the C sequestration practices at the end of the projects is in accordance with the Low Carbon Label reference framework.	- The organic nitrogen input of the farm should remain strictly below the regulatory threshold of 170 kg N/ha of the Nitrates Directive. - The implementation of certain practices can have positive or negative impacts on the environment. In order to monitor and control the effects on these other issues, project designers will report on several co-benefits and impact indicators, at the beginning and end of the project. The evolution of these indicators is not binding but any positive evolution can be valorised by the project developer. They will be reported in the monitoring report on the basis of the CAP'2ER® results and will be subject to verification.
49	C-farms	• Carbon removal under the baseline is assumed to be zero, while carbon removal under the project is measured by assessing changes in carbon pools over time. • The carbon pools considered include soil carbon (SOC), living biomass (LB), and harvested wood products (HWP).	• Carbon farming practices proposed by the project are considered additional and eligible for the voluntary carbon market. • A balance between time zero (t0) and time "tx" must demonstrate that	• The project duration for CO2 storage should be 5-10 years, and certified net emission reductions are considered released at the end of the monitoring period. • Certification has a duration of 5-10 years and is monitored by the Certification Body.	• Eligibility conditions are set for each carbon-farming practice to ensure minimum sustainability requirements and prevent negative externalities on environmental indicators and carbon pools. • The standard includes assessing GHG increase at the farm level,

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		• Quantification methods used are the stock difference method for living biomass and SOC, and the simple decay approach for HWP. • GHG increase is calculated by comparing direct and indirect emissions during the project period with those from the previous five. • A standardized baseline assumes zero carbon removal, while a project baseline is used to calculate GHG increase based on previous emissions from fertilizers and machinery operations. • Carbon removal is assessed through field analysis at the beginning and after five or ten years of implementing the carbon farming practice. • Carbon removal occurs at a minimum frequency of five years, but a ten-year time horizon is optimal for verifying changes in soil carbon. The five-year proposal is suitable for plantations	the project achieves a higher sink level than the standardized baseline, considering the direct and indirect GHG increase due to carbon farming practices	• The Certification Body verifies project compliance, including carbon removal estimations, field carbon estimations, and advisory services for operators. • An annual monitoring audit is conducted by the Certification Body. • A buffer is set aside as a reserve for possible carbon losses, and excess carbon release beyond the buffer leads to deduction of carbon removal units from the public sales register. • If certification is not renewed at the end of the period, unsold quantities are removed from the public registry.	considering both direct and indirect emissions • Co-benefits and negative co-effects of carbon farming practices are identified through a literature search conducted by the standard.
100	Gold Standard	- The SOC methodology is applicable for a broad range of activities, using a variety of SOC improvement approaches. The SOC methodology provides three approaches for the quantification. 1. Take on-site measurements to directly document baseline and project SOC stock levels 2. Use peer-reviewed publications to quantify baseline and project SOC stock levels 3. Apply default factors to quantify SOC changes, relating to the general methodology described in the IPCC Guidelines using tier 2 level approach - Different options are given to the project developer either to apply a standardised baseline; or develop a project specific baseline.	- Based on of CDM 'Guidelines for the establishment of sector specific standardized baselines', or 'Combined tool to identify the baseline scenario and demonstrate additionality'. - A 'positive list' of requirements that can be considered to assess additionality is also provided.	- Certification period can be between 5 years to 20 years if the project design in renewed. - Monitoring is done at least twice every 5 years - For C-storage a 20% buffer is applied. For emission reductions (e.g. due to amendments in N-input etc.), such a buffer is not applied.	- Follows a detailed safeguarding mechanism as part of the Principles and Requirements. - GS4GG mandates reporting of impacts on at least two other SDGs apart from SDG13. This is part of the protocols.
114	Nori Croplands	- Nori quantifies soil organic carbon sequestration using a model known as Soil Metrics. Soil Metrics is the commercialized version of CometFarm. To qualify for the program, a grower must have adopted regenerative practices within the last 10 years.	- Project activities must show improvement in carbon sequestration over baseline scenario based on	- 10 years - Yearly data collection and re-verification every three years. Nori also has an insurance pool that will pay for new carbon for a	The Verifier will confirm practices are in full compliance with existing laws and regulations

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
		- Data from 2000-2030 related to farming practices is collected and fed into the model, which provides a lower and upper bound. Nori uses the lower of the two for the carbon removal credit. - Also C sequestration in woody biomass and GHG emissions from soils are calculated. - The baseline is calculated using the historical practices for 10 year prior to the switch date - weather data is applied to this baseline to create a dynamic baseline. - Nori works with a third party verifier to ensure there is evidence of the switch date, continuation of practices and carbon credit ownership - Yearly data updates and three year re-verifications.	the application of new practices.	buyer if there is release of carbon prior to the 10 years.	- Evaluation of soil health and ability to retain nitrates and other ecosystem services is optional
79	Trinity NCM	• The soil carbon modelling methodology is based on the tier 2 model from the 2019 IPCC guidelines, i.e. a simplified version of the Century model. The calculations comply with the IPCC 2019 guidelines and ISO 14067 standards. • Additional methodologies and data are used to refine the model and incorporate farmer-provided management practice data. • The tier 2 model provides more accurate results and allows for larger payoffs in the early years of carbon sequestration. • Baseline assessment is conducted using carbon footprints from the past 3-5 years, complying with ISO 14064-2:2019. • Early action contracts may be issued with carbon credits retroactively dated up to 5 years. • Farmers can provide on-site measurements of soil organic carbon stocks, which are used to improve and validate the modelled soil carbon sequestration. • Mitigation plans and practices are validated and verified according to ISO 14064-3:2019 and ISO 14065:2020 standards.	• Regulatory additionality ensures that credits are not generated from practices mandated by law or already profitable without the sale of credits. Project developers must provide evidence and sign a legal attestation to verify compliance. • Financial additionality involves evaluating the estimated income and costs associated with the project. • Trinity Natural Capital Markets supports verifiers by providing information on potential income, cost savings, and expenses related to the project.	• Trinity NCM offers a minimum durability of 10 years, up to a maximum of 30 years, with the option for re-enrolment to achieve longer permanence. • Remote sensing is not used as it lacks resolution and cannot monitor various farm activities effectively, especially on small farms. • Trinity NCM manages a blockchain-based registry with a shared buffer pool for removal credits. • Liability mechanisms align with ISDA agreements, ensuring clarity and accountability. • Trinity NCM has collaborated with international law firms to develop these agreements and mechanisms, leveraging existing frameworks used in financial institutions	• Trinity NCM uses a farm biodiversity scoring system across five categories, developed by biodiversity experts • The water protection module helps farmers evaluate the impact of farming practices on water protection goals and offers decision support tools for nutrient management. • The platform provides real-time analysis of nitrogen leaching progress, historical averages, and crop-level performance. • Scenario analysis tools enable farmers to explore different management practices and assess their impact on nitrogen uptake efficiency and leaching. • Financial analysis tracks the cost of nitrate leaching at the farm level.

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
81	PanXchange Carbon	• PanXchange utilizes process-based and remote-observation models for quantifying carbon removals efficiently and robustly. • The PanXchange SOC Methodology requires approved models that meet specific criteria. • Regrow Ag's MRV tool uses the DNDC model to estimate soil carbon levels and facilitate scalable ecosystem markets for agriculture. Also COMET Farm and Perennial model could be used. This last one uses remote observation and machine learning to calculate soil organic carbon stock changes. • The methodology considers direct emissions removals and establishes a project-specific baseline. • PanXchange requests a 3-year historical baseline and uses emission factors calculated by Regrow Ag's MRV tool. • Validation and verification steps are required, with ISO-14065 certification for validation and verification bodies. • Monitoring and audits occur throughout the 5-year project timeline to support permanence.	• Under PanXchange program rules, project developers must demonstrate regulatory additionality by not implementing practices not already imposed on them by applicable law or by applicable business engagements. • The condition of financial additionality is broadly demonstrable as financial incentives for climate smart farming exist so that farmers can put the profits into further regenerative practices. It is the continued adoption of regenerative practices the prevent re-release of sequestered soil organic carbon stocks.	• The project is monitored for 5 years as a proxy for permanence, with additional audits based on carbon re-release risk. • Remote sensing and publicly available data, along with proprietary data, are used in the methodology. • Certification is valid for one year and requires re-certification for continued use of the carbon offset label. • Tools like Verra's AFOLU Non-Permanence Risk Tool can assess the level of risk in projects. • A buffer pool is used to address unforeseen shortcomings and carbon re-releases. • Landowners and project developers have legal and financial responsibility.	• A stakeholder consultation which addresses any socio-environmental concerns is required in the project design document before a project is validated and commences the monitoring and quantification phase. • No approach to monitor co-benefits
83	Australian Emissions Reduction Fund	- 3 options: 1. Model-assisted estimates (validation with soil sample) 2. Model-only estimates (validated with other CEAs sample) - complemented with one of the other two approaches at least once every 10 years 3. no model required (only soil sampling). - Default values are applied to soil GHG emissions. - Project-specific baseline, the operator's performance in the 5 years prior to the certified activity	- Project proponent must forecast a new management technique which is supposed to increase the soil C stock compared to the business-as-usual situation	- Permanence obligation period for the project (25 or 100-year) with 20% discount if permanence if only 25 years - Projects must contribute to a risk of reversals buffer (5% for 100 year period 25% for 25 year period)	- No information provided

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
		- frequency of soil sampling and of carbon removals monitoring depends on selected option			
86	Soil Capital Carbon	- The methodology uses the Cool Farm Tool (CFT) for the quantification of changes to net GHG emissions from farming practice changes. - Monitoring is conducted on each farm on an annual basis, drawing on farmers reporting and data records. Remote sensing is used to monitor practices that are more difficult to audit ex-post such as tillage practices. - Direct soil analysis is required at the beginning of the programme to provide an independent source of verification for the baseline soil organic matter which is required by the CFT and again at the end of the crediting period to provide calibration data for the model. - Each farm participating in the programme has, at the beginning of each crediting period, an individual, net GHG emission reduction and removal assessment of their historical practices. 1. Baseline 1: Any farm whose historical practices result in a positive GHG inventory ("net emissions") will use their own individual GHG inventory as their baseline. 2. Baseline 2: Any farm whose historical practices result in a negative GHG inventory ("net removals") will use an Adapted Regional Default Value (ARDV) as their baseline. This ARDV reflects the scenario when a farm stops maintaining regenerative agriculture practices and transitions back to the common farming practices of the region. The ARDV is calculated for each region to reflect regionally specific parameters (such as type of crops and soil characteristics).	For each country a regular analysis of the prevailing European, national and regional regulations and public subsidies is conducted. In case of material overlap, a financial additionality test is conducted to confirm whether the public policy is sufficient on its own to reasonably deliver the intended farming practice change. If so, exclusions are applied within the programme's eligibility criteria to ensure clear regulatory surplus. - The programme's methodology is anchored around barrier analysis. Farmers that overcome the barriers identified are judged to be additional.	- Each farmer commits to a five-year crediting period, which can be repeated a maximum of four times, followed by a 10-year retention period. Monitoring of tillage practices is to be conducted via remote sensing during the retention period. - If a loss event occurred during the crediting period, at the next verification, a final calculation of the farm's net GHG emission reductions and removals will be performed. - Follows the VCS Standard v4.1, which requires an analysis of non-permanence risk and the establishment of a pooled buffer. - 20% of all VERRs generated in the programme are held in a pooled buffer. These VERRs are not released from the buffer until 10 years after the verification period, as long as no loss event has occurred.	- An analysis of academic literature has identified only positive environmental and socio-economic impacts are likely as a result of the programme. - The monitoring data collected by the programme allows for the assessment of impact on co-benefits as and when market incentives exist to reward farmers for these co-benefits.
88	Avoided conversion of Grassland - ACR	• Biogeochemical models (e.g., DAYCENT) and empirical models are used, subject to approval and meeting specific criteria.	• Regulatory additionality; Other	• The permanence period corresponds to the crediting	• Environmental no-harm: regulatory surplus

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
		• Stratification is applied to account for spatial heterogeneity in soil type, climate, cropping, and land history. • Soil sampling is an alternative to modeling for estimating carbon stock and emissions. • Measurement includes soil carbon stock, CO_2 fluxes, N_2O emissions from synthetic and organic N amendments, optional CO_2 emissions from fossil fuel combustion, and CH_4 emissions if livestock are present. • Standardized baseline represents the performance of a representative group of operators. • The baseline considers the conversion of grasslands or shrublands to croplands and is updated every 5 years. • Cropland scenario includes various management practices and factors such as field preparation, tillage, cropping sequence, N rates, and timing of planting and harvesting. • If the conversion agent is unknown, historical rates of conversion are used to estimate the probability of conversion agents. • Monitoring is conducted annually.	• Must be additional and have to be demonstrated through: a regulatory surplus test (project activities shall not be mandated by any law and regulation) and practice-based performance standard (in a large portion of the U.S. territory, the conversion of grasslands to croplands is a very common practice, and therefore considered as business as usual. In the counties where the conversion is less common, then the project owners have to document the likelihood of conversion via an identified agent)	period: At least 5 years and no more than 40 years • No remote sensing. • Risk assessment via an ACR tool • Buffer pool (% of offsets issued for the project). The project will terminate if the reversal causes project stocks to decrease below baseline levels.	
111	Esca factor - EU Renewable Energy Directive	• Dedicated calculation model taking into account soil development and sustainability - adjusted soil carbon accumulation via improved agricultural management (Esca) in terms of g CO_2eq/MJ. This is part of the GHG saving calculations for the Renewable Energy Directive. The procedure can be certified according to the ISCC criteria. • The calculation of SOC stock (reference 'CSR' and actual crop management 'CSA') is based on measurements. The measurement of CSR shall be carried out at farm level before the management practice changes (baseline), followed by regular measurements (minimum every 5 years).	• Regulatory additionality • Rules to establish additionality: evaluation of soil biodiversity	• Monitoring period: 10 yrs • Certification period: 5 yrs • Liability: improvement of soil biodiversity, organic matter and quality of soil • Long-term commitment by the farmer or economic operator to continue applying the improved management practice for a minimum of 10 years required by voluntary schemes in order for GHG emission savings to be taken into account.	• The improvement of the soil biodiversity is a rule included into the procedures and it is the first principle of ISCC as well. • At least a 3-crop rotation • Sowing of cover/catch crops using a locally appropriate species mixture with at least one legume. • Prevent soil compaction; • No burning of arable stubble • Reduce tillage/no tillage

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
		• Hybrid baseline: after measurement of the baseline, increase estimated based on experiments or soil models. From the second measurement, measurements shall constitute the ultimate basis for determining the actual values of the increase in soil carbon stock.		• Risk assessment - Identifying areas with high risk of soil quality decline helps prevent these risks and focus on areas with the greatest impact.	
113	SNK Blijvend Grasland (Permanent pasture)	- the methodology estimates the carbon sequestration over a 10 year period by modelling (RothC model), and the projection is verified by soil measurements: difference in organic matter (OM) between year 0 and year 10. The OM in year 0 is the baseline. - project specific baseline - hybrid system: the amount of carbon certificates is based upon model calculations and soil sampling is used to address uncertainties.	- Regulatory additionality: in some regions of the Netherlands permanent pasture (no tillage) is mandatory. These regions cannot apply for this methodology - financial additionality: SNK demands that farmer does not get another financial compensation specifically for permanent pasture (no tillage)	- monitoring period: 10 years - satellite data are used to check whether the soil is covered the whole year (to prove 'no tillage') - certification period: 10 years - 50% of the certificates is kept in a buffer and paid when soil samples verify the projected carbon removals - The contract with the farmers will include a statement of intent to retain organic matter after the end of the contract period	none
117	Carboneg	- Relies only on direct soil carbon measurement. No modelling scheme is used. - Soil carbon is measured directly as Cox or in certified laboratories. - Soil carbon level is measured at beginning of cooperation with farmer to establish a baseline level and then every 1-3 years for measuring soil carbon increase which leads to the issuing of carbon removal credits -project specific baseline: first measurement of soil carbon to set up the soil carbon baseline level takes place when the Farmer joins the Project and starts implementing or improving the regenerative farming practices. - based on BCarbon Soil Carbon Protocol V2 - The soil sampling process and soil samples analyses are available for follow-up audits and verification.	- regulatory and financial additionality on global (whole project) and local level (each farm). - Regenerative agriculture practices are perceived additional only if they are voluntary, not imposed as mandatory by local legislation. - One area of land can be part of one or more soil carbon sequestration projects for a maximum period of 10 years. The 5 year contract with the Project Owner can be	- monitoring period: 10 years. - during period of soils sampling and carbon credits issuance standard monitoring once per year, minimum every 3 years. - on-site monitoring and satellite monitoring focused on plant health, biomass, soil cover and humidity. - Remote sensing for monitoring and verification purposes - Certification period: 1-3 years. - Project Owner will allocate 10% of all issued but not sold carbon credits to a buffer pool. - Probability of the risk of reversals after the monitoring	- The impacts are not directly measured. Among the major co-benefits of regenerative farming are healthier food, higher biodiversity, less soil erosion, support of small water cycles, higher resilience to drought and heavy rains, cleaner drinking water, less pollution from chemical inputs and higher profits for farmers.

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
			renewed only once and only after termination of the first 5 year contract	period will be annually revised and estimated using data of reversals from the Project and other public data (e.g. similar projects and scientific studies).	
118	Climate Farmers	- The methodology is designed to calculate the carbon sequestration potential through modelling based on the RothC model. - direct and indirect GHG emissions - project specific baseline, two approaches to identify baseline: 1) The relevant baseline scenario is the continuation of the historical land management practices that were followed in the 3 proceeding years before the project start date. Defined with CDM A/R Methodological tool and 2) baseline values for the CO2eq Emission Balance are calculated as an average of obtainable values from the preceding years. - Conservative approach, in line with marked standards. - Monitoring and verification rounds serve as a tool to quantify and document the effects of project activities on: 1) CO2eq emission changes (CO2 and N2O); 2) Stock changes of soil organic carbon and carbon sequestration in woody perennials; 3) Co-Benefits - Monitoring, reporting and verification (MRV) processes are implemented on a yearly basis	- regulatory additionality: Currently, there are no EU laws that legally obligate farmers to farm regeneratively. - financial additionality: During onboarding, farms are evaluated on a case by case basis to ensure that no EU subsidies, or other programs are already incentivizing farmers to implement regenerative practices on the basis of carbon sequestration. - The demonstration of additionality and the definition of the baseline scenario is performed through the identification of alternative land use scenarios and a consecutive barrier and common practice analysis.	- monitoring period: over course of 1 year. - Relies on SentinelOne to verify implemented practices and the co-benefits of water retention and vegetation productivity - crediting period: farmers can enrol for 10 years, eligible to renew for 30 year project duration -permanence is ensured by a share of credits are allocated to buffer pools - 5% of the total amount of credits are stored in a permanence buffer in case farmers renege on their agreement. 15% is stored in a project buffer to account for any risk of reversal. The project buffer credits are sold at the end of the 10-year period.	- No environmental impact assessment is carried out. However, project activities are selected on the basis of scientific evidence. The effects are therefore extensively understood and can be classified as positive - Three co-benefits are monitored on a yearly basis using remote sensing and the Cool Farm Tool: 1) Vegetation Productivity (EVI) (SentinelOne); Water Retention (NDMI) (SentinelOne); Biodiversity (Cool Farm Tool)

3.2 Coverage of QU.A.L.ITY criteria

3.2.1 Quantification

Approach

There is a large variety of methodologies related to agricultural land management and therefore also different approaches used in the quantification. Some methodologies are solely focussed on soil carbon removals by soil carbon sequestration, whereas other methodologies also include the emissions from agriculture. Some methodologies take only the N_2O emissions related to soils into account whereas others also look at emissions from livestock (mainly methane) and CO_2 emission from fossil fuel use. Besides, in some methodologies also the carbon sequestration in biomass, e.g. for agroforestry (e.g. Soil Capital and Climate Farmers), planting of orchards (Label Bas Carbone - Plantation de vergers) and hedges (Label Bas Carbone - Haies) is taken into account.

For soil carbon sequestration, there are roughly four approaches that can be used:

1. Use of default factors based on literature (e.g. IPCC stock change factor approach)
2. Use of a soil carbon model
3. Use of remote sensing to derive soil carbon stock changes
4. Use of soil sampling over time

Based on the survey of all methodologies, all four approaches are used in practice or a combination of approaches (see Figure 9). Most methodologies involve the use of models, some in combination with soil sampling or remote sensing and others are only model based. The overall methodologies, like VERRA and Gold Standard, do not prescribe the use of a specific (soil) carbon model, but have guidelines on the use of models (e.g. VERRA VMD0053 - Model Calibration, Validation, and Uncertainty Guidance for the Methodology for Improved Agricultural Land Management, v2.0). A range of models is used in the different methodologies, the soil organic carbon model RothC is mentioned in several methodologies (AgreenaCarbon, Dutch permanent pasture, Climate Farmers), the US COMET-Farm model (Nori, PanXchange Carbon), as other models derived from the Century model (Trinity NCM) and the French AMG model (LBC Grandes Cultures). Soil sampling can be used not only to improve the models (calibration, e.g. Soil Capital), but also to verify the projected changes in soil carbon. E.g. in the Dutch SNK permanent pasture scheme, the model is used for the calculation of the projected increase in soil organic carbon, but 50% of the certificates are kept in buffer and are paid at the end of the certification period, if the results from the soil sampling at the start and end of the certification period confirm the projected increase in soil carbon. Another interesting approach (Esca factor under the Renewable Energy Directive) is that model outcomes are only used for the first certification period, as there are often no good historic soil samples available, but that for the following certification periods only the soil measurements are used.

Few methodologies, e.g. Boomitra, only rely on remote sensing, for which Artificial Intelligence is used to create relationships between soil carbon measurements and information derived from satellite images. The benefit of this approach is that it can be used at large scale and reduces monitoring costs, but the uncertainty might be high and there is no verification involved. The current status of measurements through remote sensing seems still not to be accurate enough for detecting small changes in soil carbon, and probably can only be used as indication for large regions.

On the other hand, some methodologies, e.g. ReGeneration Soil Carbon, fully rely on soil measurements, where certificates are based on the difference between a measurement at the start and at the end of certification period. Using techniques as stratified random sampling optimises the number of soil sampling points. However, there are also considerable uncertainties in the measurement of soil carbon, due to spatial variability, a small change compared to a large carbon stock and the accuracy of the laboratory analysis. This uncertainty can be reduced by have more soil samples, both in space and in time, and by improved analysis methods. For example, the company AgriCarbon developed a fully automated analysis, which would increase the accuracy. One important aspect in the measurement of soil carbon is the effect of soil bulk density, which is required to convert the carbon content that is measured, to a stock. Soil bulk density is often not measured, as it is quite laborious. Sometimes full soil cores are taken, from which the bulk density can be calculated. The ReGeneration Soil Carbon methodology also comprised the concept of Equivalent Soil Mass, which is recommended by e.g. the FAO, for reliable measurement of the soil bulk density.

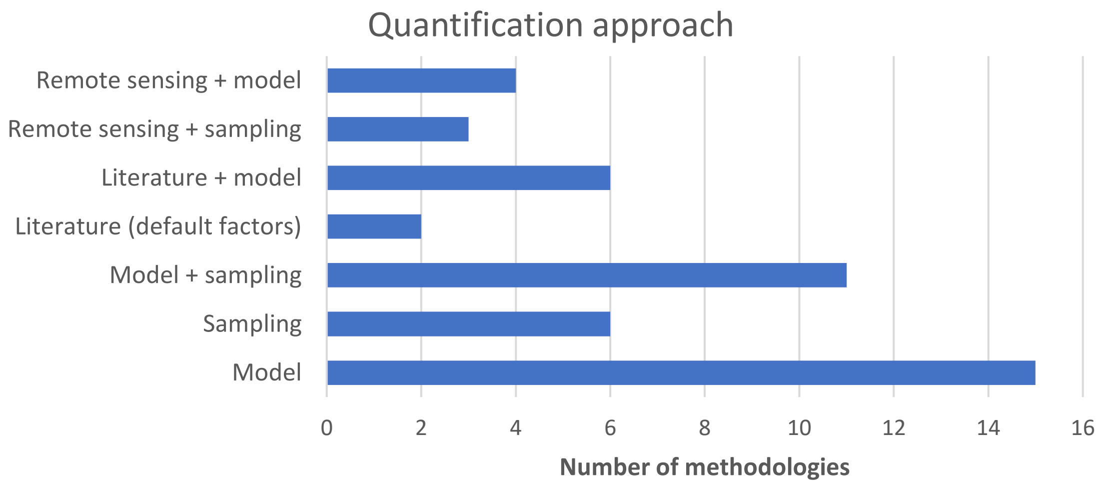

Figure 6 Number of methodologies per type of quantification approach (based on all methodologies)

Baseline
Most baselines are activity-based (i.e. the operator's performance at the beginning of the certified activity), and in case the option for both the activity - based baseline and standardised baseline is provided, the activity based is often preferred (e.g. Label Bas Carbone). Verra allows the use of a performance benchmark (regional average) if one is approved by Verra, but currently there are none approved due to lack of data. For the activity based baselines, often a period of 3-5 years is used to represent the pre-project management (historical activity data). Some methodologies also make use of dynamic baselines, e.g. Boomitra has baseline control sites to which farms are matched on the basis of similarity in terms of biogeographical conditions and farm management. Some methodologies provide information about how a standardised baseline could be constructed, e.g. C Farms and Soil Capital, but often the data is still lacking. E.g. C farms for now assumes carbon removal under the baseline to be zero on the assumption that conventional practices are sources of emissions, which means that all increase in soil carbon is considered as additional.

3.2.2 Additionality

Most methodologies consider both regulatory and financial additionality. Regulatory additionality often requires to demonstrate that the practices are going beyond the legal obligations, coming from EU, national or regional legislation. In some methodologies specific tools are available for such an assessment, e.g. Verra (VM0042), which contains three steps: the i) regulatory surplus, ii) barrier analysis and iii) the Common Practice Test (based on the CDM Methodological Tool).

For financial additionality there is more diversity in approaches, some methodologies have a reasoning that their suggested practices are additional as they are currently not taken up by the farmer, whereas others clearly have to demonstrate that the practices are having a higher cost that cannot be paid from other public sources, e.g. subsidies. Methodologies aimed at system change, e.g. conversion to regenerative agriculture, often consider their practices as additional, as currently few farmers are using these practices. Some methodologies require the involvement of an agronomist who should help with the implementation of the practices and demonstrate the additionality.

3.2.3 Long-term storage

The duration of the certification period is quite variable amongst the different methodologies. More than half of the methodologies have a certification period of 10 years or less (Figure 10), and only a few have certification periods of more than 20 years. Certification period of less than 10 years seem too short to ensure long-term storage of carbon in soil and biomass. A period of 10 years also would be a minimum to detect changes in soil carbon with sufficient certainty, as small increases compared to a large carbon stock will be difficult to measure on a short term. Longer certification periods would be favoured, but might make it difficult for farmers to participate, as they often cannot foresee how they will manage their land 20 years ahead, as there will likely be a successor.

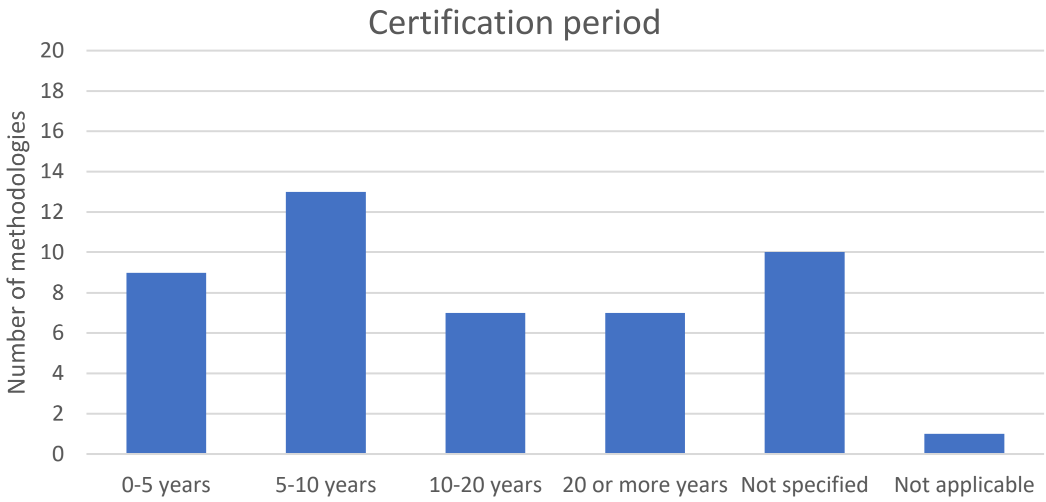

Figure 7 Classification of certification period for all submitted methodologies

Most projects have buffer approaches to account for potential reversals or for not reaching the projected soil carbon removals. The size of the buffer varies from 5% to 50%, but most methodologies use a discount of about 20% following Verra's VM0042. The Australian Emission reduction fund has a buffer which depends on the certification period, with a larger buffer for shorter duration (25% for 25 year period) and smaller buffer for long term certification (5% for 100 years). This might incentivise farmers to sign up for longer term certification periods, which would lower the risk on non-permanency.

Several methodologies are making use of remote sensing for monitoring the activities to ensure the practices are being continued. In 7 methodologies remote sensing is used for monitoring the storage of carbon, and in 4 methodologies it is optional. All methodologies seem to make use of public remote sensing data sources, which would allow to scale up. Besides remote sensing, also geolocated/geotagged photos can be used for monitoring, e.g. the Trinity NCM method is including this, and it has also been introduced as a part of CAP Area Monitoring System.

3.2.4 Sustainability

In general most methodologies make use of the no-harm principle, although not all mention it very explicitly. These are mostly focused on environmental aspects, while social safeguards are in most schemes not explicitly addressed. Co-benefits are mentioned, but this is mostly based on literature and stakeholder involvement, and often not monitored. Several methodologies also mention that they contribute to the Sustainable Development Goals (SDGs), but this is often very general and reporting is on a voluntary basis. Only few methodologies seem to have active monitoring of biodiversity or other related indicators:

- Trinity NCM does monitor biodiversity, following a scoring systems, and water quality, especially nitrogen leaching
- eAgronom mentions that biodiversity and soil improvements are monitored
- The ReGeneration Soil Carbon Methodology for crediting the increase of SOC is embedded in a set of methodologies on crediting other eco-Benefits, held together by an eco-contribution credit.
- Climate Farmers use the biodiversity module of the Cool Farm Tool to monitor biodiversity co-benefits
- Label Bas Carbone, based on CAP2ER modelling, includes several environmental indicators.

3.3 Overview of potential elements relating to the QU.A.L.ITY criteria that will be further elaborated on in the scoping papers

The survey shows that a range of different approaches for quantification are used. In the scoping paper we will discuss the pros and cons of these approaches in more detail. A hybrid approach, in which both soil sampling and modelling is used would be the preferred approach, where remote sensing could be used for monitoring activities, but also for feeding the model. This hybrid approach was highlighted by several of the participants at the Expert Group meeting in June. The models and remote sensing need to be validated with soil sampling, and models be verified by independent actors. The use of a standardised baseline, as put forward in the Commission proposal, is in the current methodologies hardly used, mostly because of lack of regional data to determine such a standardised baseline. Simply using average data on literature seems not sufficient to set such a baseline so hybrid approaches integrating models and remote sensing could be explored. Regarding additionality, there seems to be ample consensus on the criteria: regulatory additionality, financial additionality, baselining of local practices, and barrier analysis with thresholds. However, there may be challenges regarding how to apply these criteria in practice. For example, how to deal with the eco-schemes under the CAP or how to get the information regarding local practices for the baseline.

The duration of the certification period is quite variable amongst the different methodologies. Certification period of less than 10 years seem too short to ensure long-term storage of carbon in soil and biomass. Longer certification periods should be favoured. The timeframe of certification depends also to the extent to which the soil carbon sequestration practices are considered a temporal or permanent climate solution, e.g. biochar could be considered as a solution with long-term storage. Liability is commonly handled through the creation of a buffer pool of carbon credits, but there is quite some variation in the size of the buffer pools among the methodologies.

Sustainability criteria, mainly related to the no harm principle, are included in most methodologies, but only few go beyond and require also improvement for other environmental indicators, of which biodiversity and water quality are the main ones. Some methodologies go further than others in ensuring that the agronomic impact of the practices are accounted for and that the farm is considered holistically when conservation agriculture practices are applied.

Some methodologies, e.g. the frequently used VM0042 of VERRA and the Label Bas Carbone, are covering a lot of aspects and are described in great detail. However, according to the registry of VERRA, there are still only limited projects under this methodology of which the majority is in development. Also the French Label Bas Carbone has so far only a limited number of soil carbon projects in the agriculture sector. There seems to be a clear trade-off between complexity of the methodology, versus uptake in projects by farmers. Often the methodologies are too complex for a farmer and intermediaries/advisors are required for setting up such a project. This trade-off between on the one-side complexity and accuracy versus low cost and uptake by farmers will be an important aspect to elaborate further in the scoping papers.

4 Certification methodologies forestry

4.1 Overview of methodologies for the forestry sector

Forests

Most methodologies for carbon farming in forests have an international coverage (9). Three methodologies were given for the Netherlands and Spain and two for Germany and Sweden. Finland, France, Italy and New Zealand have methods that only cover their country (Figure 4).

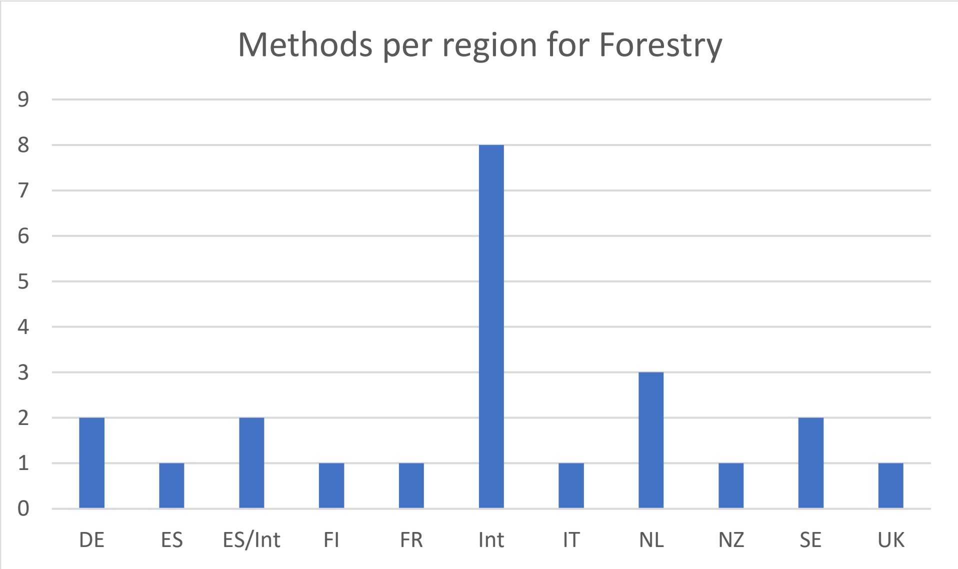

Figure 8 Methodologies per region for forests included in the survey

4.1.1 Survey responses and additional methodologies from other reviews

Table 5 Overview of certification methodologies forestry

ID	Short name	Development level:	Geographical focus	Validated against standard:	Eligible practice(s)	Included in further analysis
	Provided by EU Survey respondents:					
2	Carbon Capture Company	In development	SE		• Boreal and boreonemoral forests • Net carbon sink in managed forest estates	Not to be included in review: in development
8, 30, 75, 82	Label Bas Carbone	Applied at scale	FR	*Low carbon label standard (decree n°2018-1043 and order of November 28, 2018)*	1) Afforestation on abandoned overrun lands or croplands 2) Reforestation on degraded forests and after natural disturbances 3) Conversion of coppices into high stands • The GHG eligible is Carbon dioxide (CO2), through sequestration (Measurement of additional carbon sequestered through forest plantation relative to a baseline scenario), Storage in Harvested Wood Products and Substitution effect to fossil materials and fuel	https://label-bas-carbone.ecologie.gouv.fr/la-methode-boisement https://label-bas-carbone.ecologie.gouv.fr/la-methode-reconstitution-de-peuplements-forestiers-degrades https://label-bas-carbone.ecologie.gouv.fr/la-methode-balivage
9	CDM	Applied at scale	Int	Clean Development Mechanism and Verra's Verified Carbon Standard (VCS)	• This methodology allows afforestation and reforestation of any land that does not fall into the category of wetland. This includes agroforestry. • GHGs eligible for certification are CO2 sequestered both in above-ground and below ground biomass. Optional carbon pools, for which the CO2 sequestration can be claimed for, are dead wood litter and soil organic carbon.	Not to be included in review: was temporary / not relevant
12	LIFE Wood for Future	Pilot	ES/Int		The methodology is applicable to sustainable management of forests that meet the following eligibility criteria: •definition of forest adopted for the Kyoto Protocol •the land is considered as Forest Land (FL) •is adapting to the species Populus GHG: CO2	Not to be included: still pilot phase
16	The Forest Solution	Pilot	SE	ISO14064:2	Focus on fertilizing practices in Nordic young boreal forests. The added sustainable nutrients stimulate the incremental growth in the forests and consequently increase the carbon stock. As a result, the	Not to be included: still pilot phase

ID	Short name	Development level:	Geographical focus	Validated against standard:	Eligible practice(s)	Included in further analysis
					project results in net additional removals of CO_2 that are considered real, measurable and give long-term benefits to the mitigation of climate change. The methodology demonstrates that the project is not a likely baseline scenario.	
19, 76	LIFE FOREST CO2	Pilot	Int		The methodology is applicable to the sustainable forest management of forests that meet the following eligibility criteria: • definition of forest adopted for both the Kyoto Protocol and Paris Agreement • the land is considered as Forest Land (FL) • is applicable to the species Pinus halepensis or Pinus pinaster GHG: CO_2	Not to be included: still pilot phase
24	VERRA	In development	ES/Int	VCS	The certification methodology is developed for afforestation, reforestation, and revegetation activities. This may include direct (e.g. manual planting, broadcast seeding) and indirect activities (e.g. activities that permit or facilitate natural regeneration, like herbivory exclosures).	The final methodology document is not yet public because it is in the final review phase.
31	LIFE Climate Positive	Pilot	Int		• Afforestation/reforestation • Sustainable forest management • CO_2	Not to be included: still pilot phase
34	FSC Ecosystem Service Procedure	Applied at scale	IT	FSC which is ISO-compliant	• Ecosystem Service Procedure (FSC PRO 30 006) • The procedure verifies quantifiable positive impacts from management activities on forest carbon stocks, including conservation, avoided deforestation and degradation, improved forest management practices, and afforestation/reforestation/revegetation. Eligible carbon pools include live biomass, dead biomass, soil, and harvested wood products (HWPs).	Included
35	The Global Tree C-sink	In development	Int	Will be validated against an external entity, namely "Carbon	• Based on a state of the art digital monitoring reporting and verification (dMRV) applications are capable of quantifying, reporting and verifying the current carbon sequestration service of any tree planting project.	Not included: The methodology is currently in the final stage of development and will be finalized and operational in June 2023.

ID	Short name	Development level:	Geographical focus	Validated against standard:	Eligible practice(s)	Included in further analysis
				Standards International" (CSI)		- no weblink present
40	SILVACONSULT (Tree.ly)	In development	Int	ISO 14064-2:2019	• Increase of the biological sequestration of CO2 in the forest through obligatory adapted forest management and/or obligatory non-use (forest reserves).	Included
45	SNK Climate Smart Management	Pilot	Int	Stichting Nationale Koolstofmarkt (SNK) (Dutch domestic voluntary carbon market)	1) Maintaining the CO2 sequestration capacity of forests by creating resilient forests; and 2) Increasing CO2 sequestration in forests and the wood chain.	Not to be included: no certificates issued yet
46	SNK Planting of New Forest	Pilot	NL	SNK	Planting of new forest, tree meadows and/or tree rows outside forests (e.g., trees in agroforestry type systems, Trees Outside Forest): In principle eligible for planting trees outside forest for both mineral and organic soils provided it does not lead to increased emissions from soils.	Included
50	SNK Ash Forests	Pilot	NL	SNK	Revitalizing forest sections affected by ash dieback yields climate benefits. Revitalize means here the replacement of dead and less vital ash forests that do not or hardly grow anymore with one mixed, young and vital plantings that increase the long-term carbon sequestration capacity of the forest is reinforced. The planting also increases the diversity of tree species, which also increases the (future) resilience of the forest.	Not to be included: no certificates issued yet
98	Ecosystem Value – Waldwiederaufbau (EVA)	In development	DE		Eligible sites: -Climate change induced calamity sites without wet- and peatlands. Eligible carbon pools and GHG emissions: -The selection and justification is provided according to IPCC AFOLU GPG	Included

ID	Short name	Development level:	Geographical focus	Validated against standard:	Eligible practice(s)	Included in further analysis
					For this methodology; woody below- and above-ground biomass are the only carbon pools selected Eligible project activities: -Planting of seedlings, assisted natural succession and sowing of tree seeds are eligible project activities Eligible targeted stocking has to proof increased climate resilience: -Min. 3 tree species -Site adapted species mixture according to scientific recommendations	
101	Gold Standard – method for Afforestation / reforestation	Applied at scale	NL		• Afforestation, reforestation and IFM. Includes i) Conservation forests (no use of timber) ii) Forests with selective harvesting iii) Rotation forestry. Also can include agroforestry and / or silvopastoral activities and mangroves. • Associated GHGs: CO_2	Included
105	(Spanish carbon footprint registry)	Applied at scale	ES	Gold Standard	• Afforestation - CO_2 in living biomass • Restoration of burned forest areas - CO_2 in living biomass	Included
106	Hiilinieluntuottajat	Applied at scale	Int		Specific models for: - forest growth by tree species, site types and thermal sums, - natural loss and mortality by activity, - thinning and regeneration by tree species, site types and thermal sums Calculation tools for: - carbon content in trunks, other biomass and soil - carbon sequestration and emissions per year Simulation systems for: - baseline and verifiable real results	Missing weblink; not a certification method but creator of models and calculation tools
115	Zertiforest	Applied at scale	ES		Forest: Analyze of minerals in trees; Fertilizing + continuous growth; Postponed final cut; Using mixed forests; Better thinning model; Forest wise tree planting; Combinations; End stage: storing wood in wood products.	Included

ID	Short name	Development level:	Geographical focus	Validated against standard:	Eligible practice(s)	Included in further analysis
					Peatland: Forestation of peatlands for increased carbon storage.	
122	ECS Climate Forest	In development	FI	ISO 16064-2 (final audition June 8-9th)	Sustainable Forestry: 1. CO2 carbon capture: active additional carbon capture and storage through individual management concept: optimization of forest management, adapting forest to climate change and optimizing stability and diversity. 2. CO2 emission reduction: reducing the planned reduction of high stocks in stable forests, keeping carbon stocks of forest high and at same time make them more resilient to climate change. 3. additional increase of dead wood, CO2 storage	Included
	Added from other sources:					
f1	Woodland Carbon Code	Applied at scale	UK		Woodland creation on soils which are not organic	Included
f2	New Zealand ETS	Applied at scale	NZ		Afforestation/reforestation, forest management	Not to be included: not comparable
f3	Trees	Applied at scale	Int			Not to be included - requires national government involvement, forest protection programmes

4.1.2 Selection of methodologies to be included in the assessment

Eleven methods were included in the assessment of the QUALITY criteria. Please refer to the last column of the overview table above for comments on inclusion of the methodologies in the further assessment.

4.2 Coverage of QU.A.L.ITY criteria

Table 6 Assessment on QU.A.L.ITY criteria - certification methodologies forestry

Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
Label Bas Carbone	-The calculations of CO_2 storage are based on scientific literature, in particular, on long-term average stock method (Verra 2011) and depend on the yield tables of the considered tree species considered in the project. - These data on the evolution of the growth of each species and on the uses of the wood are used to calculate: 1) the reductions in emissions linked to the forest carbon sink, 2) the reductions in emissions linked to storage in the wood products, 3) the emissions avoided by substituting wood products for fossil fuel products. - Different baselines are applicable. They are representative of usual scenarios of agricultural or forestry development - Uncertainty is addressed by buffers on each identified risk (e.g. fire, stand yield, general hazards). - Ex ante certification at year 1, and field verification at year 5	- Regulatory and financial additionality - Reglementary (assessment of practices under the forestry code) and economical additionality (public incentive < 50%, Net Present Value demonstration)	-monitoring period: lasts 5 years, from the start of the reforestation project until the audit, which is the only planned verification of the actual carbon storage achieved. -Certification period: 30 years - Discounts are applied to the estimate carbon removals: systematically 10% to integrate the risk of non-permanence; 0 to 15% for fire risks, depending on local fire protection plans; 5% if fertility and yield uncertainty	-Some practices are forbidden. Furthermore, there is a system of co-benefits accounting (bonus) about 4 topics: socio-economic, preservation of soils, biodiversity and water. - Photographs of the plantation, co-benefits documentation (map…), biodiversity survey
VERRA	- area-based and census-based quantification approaches - area-based approach scales biomass per hectare estimates to the project level using an area multiplier. Plot-based sampling is used to quantify project Project Emission Reductions or removals (ERR). The crediting baseline is set using a dynamic performance benchmark. A control area is selected at the start of the project, and a stocking index for the project area and control area is monitored using remote sensing at every verification event. - The census-based approach scales biomass per planting estimates to the project level using a census and can be appropriate where a full census of plantings is practical. A crediting baseline is assumed to be null where projects can demonstrate that establishment of trees would not have occurred without project intervention. ERR are quantified using direct measurement sampling designs. -calculates direct and indirect emissions	- Regulatory additionality - This methodology uses either a performance or project method for demonstrating additionality. Regulatory surplus must be demonstrated in accordance with VCS Methodology Requirements. - Additionality is demonstrated through a performance benchmark or project method. Investment barriers must be demonstrated, and the project activity must not be common practice without carbon finance. The geographic domain is identified, and a representative sample is surveyed to calculate	- 20 years for monitoring and crediting period. Renewable up to 4 times: 100 years. - specifies minimum criteria for spatial and temporal resolution. This approach allows for additionality and crediting baselines to be reassessed at every verification period, ensuring that only high-quality removal credits will be issued - non-permanence risk tool to determine the number of credits to withhold in a buffer pool.	- requirements related to safeguards to ensure that the certified activities do not harm other environmental objectives. - requirement of project proponent to identify potential negative environmental and socio-economic impacts and take steps to mitigate them. - project proponent shall provide evidence that project activities do not impact local stakeholders at validation and each verification - Projects can seek certification under the Climate, Community

Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
	- uncertainty by quantifying sample error and addressing measurement error through QA/QC procedures	the percent adoption of the project activity not financed with carbon revenue. If the percentage adoption is below 15%, the project activity is deemed not common practice and is additional. Relevant government statistics may be used as an alternative, provided they are derived from data collected within 5 years of the project's start date.		& Biodiversity Program or the Sustainable Development Verified Impact Standard Program to demonstrate their contribution towards achieving other environmental and social objectives beyond carbon reductions.
FSC Ecosystem Service Procedure	- verification framework that demonstrates the links between forest management practices and positive impacts on multiple ecosystem services - for carbon the procedure requires that forest managers measure changes in carbon stocks across their entire management units, integrating stock losses or carbon sources from harvesting, thinning, and other treatments -baseline: Forest managers may use either a previous measurement of forest carbon stocks in their management unit (project-specific) or refer to a regional reference level such as a recent national forest inventory (performance or standardized baseline) - Field audits by third-party certification bodies are required on an annual basis to verify activities and impacts.	- regulatory and financial additionality - additionality tests for certain types of impact claims. Over the revision process, legal and financial additionality tests will be required for claims to be eligible for use by companies or governments to meet climate targets, including: Analysis of legal, regulatory, and institutional contexts; Investment barrier analysis; Common practices analysis and Land-use and management trend factors	-carbon storage monitored annually according to duration forest management certificate. -in-depth audits every 5 years or whenever new measurements, impacts, or changes to the methodology are proposed -remote sensing methodologies are pre-approved in the guidance document and include: LULC classification by Sentinel-2; LANDSAT, NDVI measurements - Annual field audits address significant changes in stored carbon, both positive and negative. In addition, the revision of the procedure will include a registry and mitigation bank where FSC retains a certain percentage of claimed carbon impacts (tCO2e) in the event of unforeseen losses in carbon stock	- The FSC Ecosystem Service Procedure has specific management requirements and eligibility criteria to minimize or eliminate the risk of trade-offs with other environmental objectives] - verification framework includes five types of ecosystem services - biodiversity, carbon storage and sequestration, watershed services, soil conservation, and recreational services - with cultural services to be included in the upcoming revision
SILVACONSULT (Tree.ly)	- works along the United Nations Framework Convention on Climate Change (UNFCC, 2008): Simplified baseline and monitoring methodologies for small-scale afforestation and	Regulatory additionality: additionality is examined in accordance with the CLEAN	- monitoring for adapted forest management for 30 years - no remote sensing	- Certification according to a recognised standard such as PEFC, FSC or an equivalent

Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
	reforestation project activities under the clean development mechanism implemented on grasslands or croplands AR-AMS0001. - The Baseline Scenario is calculated according to forestry parameters based on yield tables and scientifically validated conversion factors from tree biomass to carbon, including aboveground and below ground - Projects based on adapted forest management are generating ex-post credits. Projects that are based on forest reserves or afforestation generate ex-ante credits. -hybrid. four parameters for calculating baseline: tree species distribution; yield tables per tree species and sub-project area; site productivity; climate related factors	DEVELOPMENT MECHANISM TOOL01 Tool for the demonstration and assessment of additionality Version 07.0.0. The additionality of the projects lies in the voluntary commitment made by a forest owner to reduce forest use and thus increase the amount of stored wood. The alternative to the project is to not make any commitment. - financial additionality: 100% of the proceeds needs to be reinvested into the adapted forest management of the project area. The use of proceeds is specified by contract and includes measures to improved CO2-storage and resilience of the forest.	- certification for adapted forest management 30 years for forest reserves 50 years - The specifications of the ISO-standard are supplemented in this methodology by the use of the CDM AR-AMS0001 methodology (Ref. 1) to quantify the CDM Additionality Tool (Ref. 2), to verify additionality and to observe the risk determination according to VCS (Ref. 3).	procedure can also be used as evidence of environmental and social compatibility. - Co-benefits (e.g. biodiversity) are specified and reported. There is no mechanism in the current methodology in place but they are working on better quantification, monitoring and reporting with research institutes.
SNK Planting of New Forest	- Calculating change in C in living tree biomass can be calculated in three ways: 1) Biomass Expansion method, 2) Allometric equation method, 3) Other methods with equal statistical accuracy (e.g., LIDAR) -hybrid. Baseline methodology; 1) Describe current land use and occurring vegetation, 2) Description / determination of soil type (the latest version of the 'National soil map' can be used for this purpose), 3) Description of expected development in the project area (e.g., both planned/manmade developments linked to spatial and management plans, and expected natural developments).	- Regulatory additionality: Additional to regulations and existing policy incentives. In some circumstances a combination of carbon certificates and other incentives may be possible but that depends on the nature of the policy design - No baseline revisions/renewals and re-evaluations of additionality during project period.	-monitoring period is aligned with project duration -certification process includes 1) verification of project implementation – no later than 2 years after start date; 2) verification of effectiveness – no later than 6 years after start date; 3) verification of C-build up in new forest, tree meadow, tree row - parts 2 and 3 have to be done minimally once each 12 years. -project owner commits to conservation of trees for a period of 50 years	- no environmental harm only indirectly: Soil C stocks should be preserved, only max 10% of land surface may be disturbed, etc. So any significant negative land use/management change impacts are mitigated.

Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
			-no remote sensing by design by alternative quantification/monitoring tools can be introduced - Only when use of made of ex-ante issuance of carbon certificates a risk buffer will be held - 15% for forests - 20% for tree rows/meadows	
Ecosystem Value – Waldwiederaufbau (EVA), German Forest climate standard	- Method based on AR CDM, incl. woody above and belowground biomass. Parameters from German forest inventory data. Input parameters regionalized models subject to ground truthing via 3rd party auditors. Projected removals are verified by remote sensing MRV scheme by 3rd party for all areas under German FSC that use remote sensing data No indirect emissions (field work, Hybrid baseline, quantified via different approaches: common practices, historical developments, management plans, natural succession or legal provisions. - Model is based on same regionalized tree specific growth models as project scenario Uncertainty: methodologies follow a conservative approach, overestimation baseline and underestimation of project gains Methodologies are subject to improvement cycles of 2 years to adjust to latest developments.	- regulatory additionality: based on the question if the government is on-track in terms of meeting its science based UN climate goals with governmental tools (e.g. law enforcement, substitutions, etc. currently not the case. As long as the scientifically required conversion rate (of 95,000 ha/year) is not achieved through the legal framework alone, projects that accelerate the implementation towards climate-resilient forests in Germany will be recognized as "regulatory additional" under the German FCS - financial additionality: is audited by a project specific financial analysis where project related costs are compared to incomes on the project area (incl. public subsidies) within the crediting period.	- monitoring and crediting period is related. For reforestation periods ranging from 20-30 years. - risk mitigation: Avoidance of sites exposed to high forest fire risks based on the WBI-Index; Required professional project and quality forest management; The use of adapted & climate resilient tree species according to crediting third party scientific institutions - the standard permanence buffer approach consists of a fixed buffer pool of 15% - Initial verification conducted 5 years after start. For method '01 Forest Restoration' verification interval is 3-5 years.	- In a few aspects the German FCS goes beyond the requirements of PEFC and FSC; e.g. with its requirements of minimum 3 tree species and the silviculture objective of a climate resilient forest. Minimum of 3 tree species are also monitored throughout the crediting period through the certification scheme
Gold Standard – method for afforestation / reforestation	Total carbon removals are based on above and below ground biomass of standing trees based on forest inventory. SOC is optional. Long-term CO_2 removals depend on the silviculture practices (selective harvesting or rotational forestry).	Regulatory additionality; Financial additionality; Other "Shall apply the latest version of the A/R CDM 'Combined tool to	Minimum is 30 years and maximum is 50 years. Special condition for mangroves for a minimum 20 years period as well.	All Gold Standard projects have to adhere to the Principles and Requirements,

Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
	Indirect: Leakage arising from the following are accounted: a. collection of wood (for firewood, charcoal, etc.), b. timber harvesting, c. agriculture (crop cultivation, shrimp cultivation, etc.), d. livestock. Project emissions arising from the following are accounted: a) Land preparation, b) Fertilizer input c) Fossil fuel combustion. Project-specific baseline: determined by estimating the 'tree' and 'non-tree' biomass that is present in the eligible planting area prior to the planting start. Validation and verification by technical auditors, includes mandatory site visits. RS-GIS analysis requires either ground truthing of land or high-resolution images.	identify the baseline scenario and demonstrate additionality in A/R CDM project activities'. The CDM specific terms of the A/R CDM additionality tool (tCERs, A/R CDM project, etc.) shall be interpreted in the context of Gold Standard. The 'Guideline on the assessment of investment analysis' and the 'Guidelines for objective demonstration and assessment of barriers' can be used. Gold Standard also provides a 'Positive List'; and if the project meets the requirements mentioned in the positive list; it is deemed eligible. "	No public data/remote sensing used. For projects applying the LUF Requirements, 20% of the issued PERs and GSVERs shall be transferred into the Gold Standard Buffer. This is based on Gold Standard product requirements and Performance Shortfall Guidelines of Gold Standard. Any shortfall event is to be reported in the annual report to GS, the registry and the buyer. Any shortfall should be replenished either from the buffer credits or using other GSVERs.	which includes social and environmental safeguards. In A/R projects, the Project Developer shall maintain a buffer zone of 15 meters for water bodies in which: (a) All existing native trees shall be kept, AND (b) No fertilizer and pesticides shall be used, AND (c) No logging activities shall take place, AND (d) No heavy machinery shall be used, AND (e) No cropping is allowed, AND (f) In case trees are being planted, these need to be native tree species. GS4GG mandates reporting of at least two SDGs apart from climate action (SDG 13). These are part of the monitoring protocols and have to be reported during monitoring cycles.
Spanish carbon footprint registry	Simplified calculation methodology, which provides estimates for all forest tree species in Spain, distinguishing between two management intensities. Two types of calculations: - Ex-post: calculations based on actual data (CO2 removals that have actually taken place in the project. - Ex-ante: future calculations based on estimates of the growth. Projects may have an amount not exceeding 20% of the ex-ante absorptions, to incentivise action. Indirect: not considered, carbon stock changes in living biomass.	Not applicable The study of the general situation at national level allows to conclude that there are no obligations derived from regulatory or financial framework for the eligible activities. Specific circumstances (e.g. mine area restoration, etc.) are assessed on a case by case basis.	At least 30 years, maximum 50 years. Public data/remote sensing not yet considered. Certified removals are generated at any time that they occur during the monitoring period (30-50 years). A code is given to every CO_2 ton of certified removal indicating the year in which it was generated.	Applicable National law and existing monitoring systems in this regard are considered to be sufficient. It is up to the operators to indicate if it the project/activity brings additional co-benefits, in which case, related information must be

Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
	Prior cover must be different from forest and only carbon stock changes in living biomass are considered, gross-net accounting of removals is considered a sufficient approach, yet cost-effective for operators. Information on status presented at least every 5 years. If new removals are generated, a forest inventory of stocks must be submitted with updated real data for ex-post removals (validated by the scheme operator). Permanence period: 30-50 year.		Management plans must contain all measures to mitigate the risk of release, monitoring of the activity ensures that those measures are actually taken place. All registered projects contribute 10% of their certified removals to a guarantee reserve. Any new situation to be communicated immediately. If "disappeared" absorptions have already been used for offsetting if their loss has been due to force majeure, and if they are not restored by any other means, the guarantee reserve will cover the offsetting.	presented in order to be able to confirm/assess that info by the scheme operator. A more methodical system to reflect co-benefits is currently being studied.
Zertiforest	Scanning of forest biomass by drone flights before (baseline) and during project. Nationally generated growth model of forests is applied based on scientific studies. Hybrid baseline: determined by activity based digitalization of forest. The baseline scenario determined by scientific studies and statistically generated model for forest growth Addressing uncertainties / indirect emissions based on ISO 14064-2 The calculations are based on long term studies of forest growth and forest carbon binding models based on these studies. Quality control of the drone digitalization of forests by cross-checking the results by man-made measurement. Cadence: typically 5 years unless the project requires shorter interval.	Financial additionality if/when the bound carbon units have been certified and transferred to CO2e-unit markets for business purposes. ISO 14064-2 itself does not address additionality. However, it requires that the project operator demonstrates how the additionality is/has been reached. ISO 140642 requires that claimed additionality must be demonstrated in a reliable and trackable way.	Forests: as long as the forest grows (as per ISO 14064-2), or minimum 40 years. Project operator argues for storing the carbon in long term wood-products after the end of the CO2-binding project. No publicly available data of each CO2-storage projects, only summary of achieved. Possible to certify the long term storage of CO_2 in wood products (separate certificate), as e.g. In FSC or PEFC certification projects. In ISO 14064-2 projects if the risk of forest destruction materialises project cannot be any longer certified. Forest projects in private owned forests do not offer liability mechanisms without regulation.	There are general strict laws for NOT harming preserved nature types and forests. Private forestation is already heavily regulated and preservable nature types are well under preservation by laws and authorities. Finland has well known laws and regulations to preserve environmental values in Finnish forests. Thus the additional environmental values can be easily included in carbon binding projects in Finland.

Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
ECS Climate Forest	Precise, project specific forest inventory, done by third party. Remote sensing only as add-on. Data otherwise too unprecise, especially in multi-level forests. Massive underestimation of carbon capture effects from project - buffer against potential additional related GHG Emissions. No additional emissions are caused by optimised sustainable forest management. If actions would cause relevant GHG emissions, they would be calculated by gasoline consumption and subtracted from carbon capture. Project-specific baseline.	Regulatory / Financial additionality. Effects of project have to be additional to high Austrian regulatory standards, e.g. reafforestation is mandatory, only additional effects of advanced afforestation are taken into account. Zones of forest under contractual protection and preserved (e.g. special biotopes, protected forests, very old trees) have to be subtracted from project. Factual/financial additionality: reason for increase in carbon stock has to come only or primarily from project. If forest increases in stock without project, that means baseline is growing and hence only additional growth on top of growing baseline can be valid.	Mon. period 30 years minimum No public data / remote sensing, too unprecise to prove additionality in Austria Certification period 30 years Mitigation of risk of release: massive underestimation of true CCS. Robust multilayer risk management yearly, ex post creation of carbon credits 25% buffer minimum decrease of risky / unstable tree species during projects increase of resilience. Strict contracts. if release is caused by wilful negligence, project partner has to pay for compensation of corresponding amount, plus contractual fines	Strict rules on leakage focus on increase of biodiversity. Measures to bolster biodiversity are monitored and documented.
Woodland Carbon Code	Uses 'WCC Carbon Calculation Spreadsheet to' calculate CR. Indirect emissions are included. The net carbon sequestered to date and carbon sequestered in the current vintage/monitoring period shall be confirmed in the Monitoring Report. At year 5, this is based on the projected carbon sequestration. From year 15 onwards, this is based on field survey measurements	Regulatory additionality. The Legal and Investment tests shall be passed to demonstrate additionality. Legal test: There is no legal requirement specifying that woodlands should be created. Compensatory planting is not eligible. Investment test: Projects shall demonstrate that without carbon finance the woodland creation project is either not the most economically or financially attractive use for	Projects should be reviewed at year 5 and then at least every 10 years after the project start date (for single projects) or the group start date (for groups). For site description: Appropriate maps, photographs or remotely sensed images to indicate previous land cover. Woodland Carbon Guarantee ('WCaG') contracts will only cover carbon sequestered for the first 30-35 years of the woodland's life. The	Projects shall demonstrate whether or not an Environmental Statement/EIA Report is required under the Environmental Impact Assessment Forestry Regulations. They shall provide: - the Environmental Statement/EIA Report if one was required; or - other evidence that environmental impacts of

Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
		that area of land or is not economically or financially viable on that land at all.	actual contract length will be determined by the starting year with all contracts ending in 2055/6 Projects or group schemes must be regularly monitored and either third party verified or Self-Assessed at least at year 5 and then every ten years by an independent validation/verification body.	the project are likely to be positive if no EIA is required. The validation/verification body will check there is no evidence of non-conformance with the UK Forestry Standard.

4.2.1 Quantification

Most methodologies quantify based on measurements, be it specific project forest inventories (e.g. ECS Climate forest, Woodland Carbon Code) or remote sensing (e.g. Zertiforest). Field measurements come from NFI's (e.g. EVA) or independent third parties (e.g. ECS Climate forest). Not all methodologies mention which exact method is being used, field or remote sensing, to measure the stock (e.g. SNK). Also combinations of field measurements and remote sensing are being used to ground truth the data acquired through remote sensing (e.g. Gold standard). Yield tables from literature or models are also sometimes used (e.g. Label Bas Carbone, Zertiforest and SILVACONSULT) to predict growth of the forest and hence quantify carbon storage. Control areas are also used to establish the baseline (e.g. VERRA). Of the carbon pools mentioned in the CRCF proposal multiple methodologies (e.g. EVA and Gold standard) mention to take into account above and below-ground biomass. Gold Standard and FSC also mention other carbon pools like soil organic carbon. FSC includes all carbon pools mentioned in the CRCF proposal. Other methodologies do not mention other carbon pools apart from biomass.

Most methodologies include direct and indirect emissions (e.g. VERRA, Spanish carbon footprint registry and ECS Climate forest). Some do not include the indirect emissions (e.g. EVA) or do not specify doing it or not (e.g. Zertiforest).

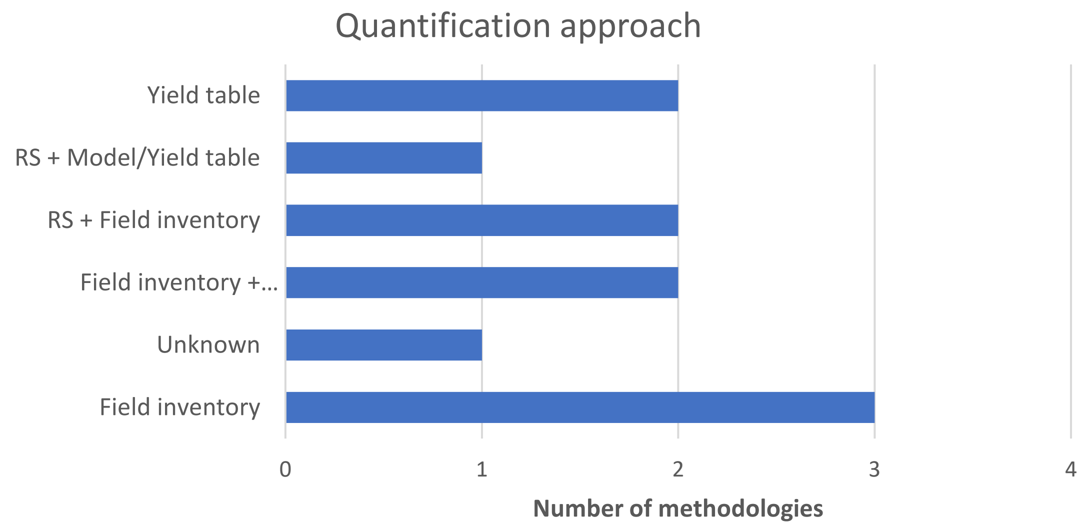

Figure 9 Types of quantification approaches in the assessed certification methodologies

4.2.2 Additionality

Most methodologies ensure that the project should not be common practice (e.g. VERRA, SNK and EVA) in order to be considered additional. Regulatory additionality is needed for all methodologies, financial for most (9) methodologies. Some methodologies also revaluate what is common practice to shift the baseline used for calculating the additionality (e.g. ECS Climate Forest or VERRA) or do not revaluate the baseline (e.g. SNK). Some methodologies also require a specific reporting or test to show additionality (e.g. Zertiforest or FSC).

4.2.3 Long-term storage

Certification periods range from 30 years (e.g. Label Bas Carbone, SILVACONSULT, Gold standard and ECS) to 100 years after renewing a 20 year certification period (e.g. VERRA) or let it be dependent on the time a certain type of management is applied (e.g. FSC or SNK). Most methodologies require monitoring of carbon stocks during the certification project ranging from yearly (e.g. FSC) to 5 year intervals (e.g. EVA) or 10/12 years interval (e.g. Woodland Carbon code or SNK). Label Bas Carbone monitors the first 5 years after which a field verification is done and the monitoring stops.

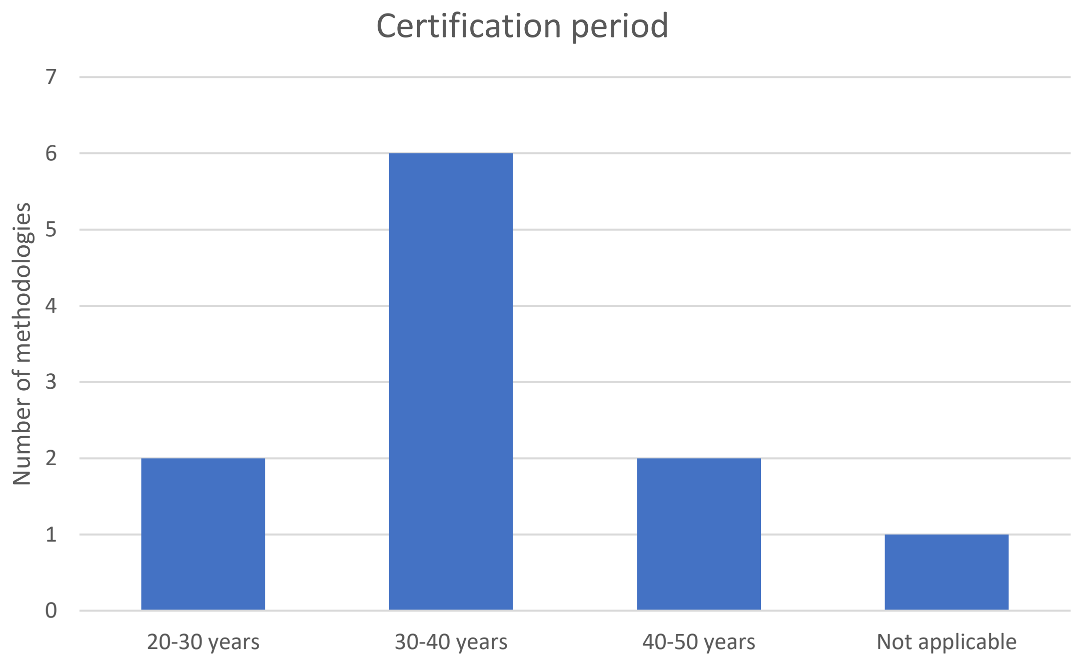

Figure 10 Length of certification period in the assessed methodologies

Most methodologies take a buffer into account (e.g. SNK, FSC and VERRA), ranging from 10% (e.g. Label Bas Carbone) to 25% (e.g. ECS), to mitigate the risk of non-permanence due to natural disturbances (e.g. wind or fire). These buffers are sometimes put in a bank or pool (e.g. FSC, VERRA and EVA). The buffers can be used in other projects to cover losses of carbon due to disturbances. Also sometimes high fire risks sites are avoided (e.g. EVA) and climate resilient tree species are used (e.g. EVA and ECS) to mitigate the effect of climate change. ECS lets project partners pay for lost carbon when this occurs due to negligence.

4.2.4 Sustainability

Most methodologies specify a “no harm” principle (e.g. VERRA, Zertiforest and SNK) on other environmental objectives e.g. climate, soil, community/culture (e.g. Label Bas Carbone), biodiversity (e.g. VERRA, FSC, ESC) or sustainable development goals (e.g. VERRA and Gold Standard). Also most methodologies need to report on potential (negative) co-benefits (e.g. Label Bas Carbone, VERRA, SILVACONSULT, Gold standard and Woodland Carbon code). Label Bas Carbone specifies that certain practices are forbidden and has a system to account for co-benefits.

4.3 Overview of potential elements relating to the QU.A.L.ITY criteria that will be further elaborated on in the scoping papers

The survey shows that different approaches for quantification are being used. In the scoping paper we will discuss the pros and cons of these approaches in more detail. Probably a combination of literature and models to project future carbon stocks, combined with field measurements (project forest inventory combined with remote sensing) at set intervals would be considered best practice also when considering costs. GIS applications might become an important part of this development as indicated during the expert group meeting in June 2023. In addition questions were raised on which carbon pools are incorporated in the different methodologies as most only focus on (living) biomass as carbon pool, whereas forest management can have an effect on other carbon pools, especially soils. Also questions were raised on which practices can be included in the certification and what the possibilities for certification would be when forest management is already at a good level and additional removals are difficult to realise. These elements will be further elaborated in the forestry scoping paper.

Not all methodologies adhere to the requirement of baseline updating set out in the proposal for CRCF. While the proposal promotes the idea of a standardised baseline, in practice almost all methodologies apply activity-specific baselines. Clear definitions on assessing additionality were asked for in the expert group meeting, at the project and the country level.

Duration of the certification period differs per methodology but is generally considerable, at minimum 30 years, which is favourable to ensure carbon storage. Questions were asked on what would be a best minimum for this crediting period.

Almost every methodology uses a pool/bank to store buffer amounts of carbon used to mitigate non-permanence of carbon from its own or other projects of the certification methodology. Questions were raised in the expert group meeting on the usage of buffers to manage liability, and which percentage would in this case be sufficient. Discussion also focused on which disturbances should be taken into account regarding liability and mitigation.
Some methodologies mitigate climate risks by avoiding risk sites or using climate resilient tree species. The no harm to other environmental objectives principle is included in most methodologies but could be developed further to also report this, as is already done by several other methodologies. Questions were raised in the meeting on what exactly encompasses “no harm” and which co-benefits need to be included.

5 Certification methodologies Peatland

5.1 Overview of methodologies for peatland

Peatland

For peatlands there are 3 methods that cover international methodologies and 3 that cover only their own country (Germany, Netherlands and UK).

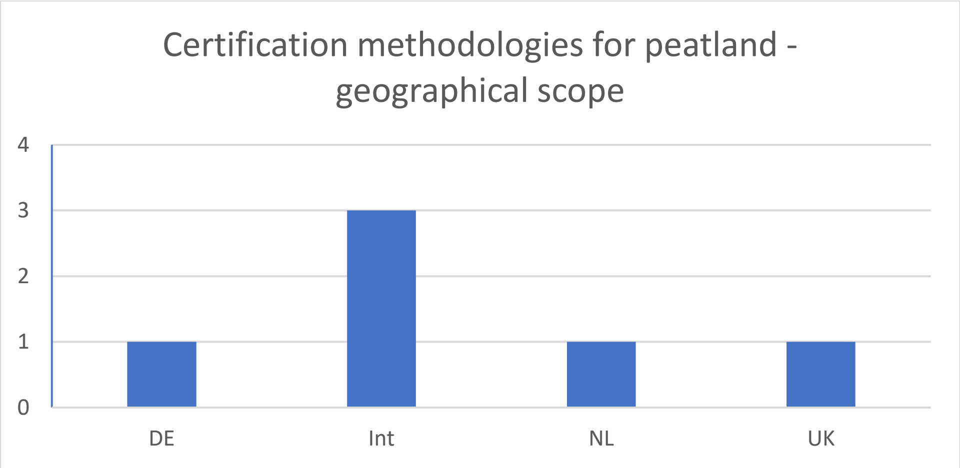

Figure 11 Methodologies per region for peatland included in the survey

5.1.1 Survey responses and additional methodologies from other reviews

Table 7 Overview of certification methodologies for peatland (EU Survey and review studies)

ID	Short name	Development level:	Country/ Geographical focus	Validated against standard:	Eligible practice(s)	Included for further review
	Provided by EU Survey respondents:					
1,54	MoorFutures	Applied at scale	DE	ISO 14064, VERRA VM0036	Rewetting of drained peatlands reduces emissions of greenhouse gases (GHG). MoorFutures are carbon credits that map these emission reductions. Net carbon removal by new peat accumulation is also possible, but in a much smaller scale and conservatively not yet included in the credit.	Yes
18	Wetlands4climate	pilot	Int	*No*	Carbon components considered are soil (especially fossil carbon accumulated in peat), aboveground and belowground biomass, and optionally deadwood and litter. Greenhouse gases considered are CO_2, CH_4, and N_2O. Individual stocks and gases may be omitted from the calculation, provided that it is shown that this is conservative (i.e., that the emissions reductions from the project are underestimated)	Yes, see next paragraph
48	LIFE OrgBalt	Pilot	Int	*No*	Paludiculture; Semi-natural regeneration; Agroforestry; fast growing species in riparian buffer zones; Conversion of cropland used for cereal production into grassland; legumes in conventional farm crop rotation; Strip harvesting in pine stands; Forest regeneration (coniferous trees) without reconstruction of drainage systems; Continuous cover forestry on peatland; Shifting to continuous cover forestry on peatland. GHGs: CH4, N2O, CO2.	Yes, idem
55	SNK Currency for Peat	Applied at scale	NL	SNK	Specific practices: restoration, management of vegetation, management of soil, management of water (like re-flooding)	Yes
121	ECS KlimaMoor	Applied at scale	Int	ISO 14064 (by end 2023)	GHGs eligible for certification: CO_2 and CH_4	Yes
	Added from other sources:					
p1	UK Peatland Code	Applied at scale	Int	ISO/IEC 14065 and EA-1/22 Peatland Code v1.2 (v2.0 under review)	Restoration of blanket bog or raised bog with an associated baseline condition of: actively eroding, draining, modified bog, drained cropland, in- and extensive grassland. Fens with an associated baseline condition of drained cropland, in- and extensive grassland and modified fen. GHG emissions used in the calculation of emissions factors include carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), dissolved organic carbon (DOC) and particulate organic carbon (POC).	Yes

5.1.2 Selection of methodologies to be included in the assessment

With regard to the two criteria in chapter 1 it should be noted the LIFE OrgBalt project is not (set up for the development of) a certification scheme. Since it does however include relevant elements with regard to GHG accounting methods and verification of results we have still included it in the review.

5.2 Coverage of QU.A.L.ITY criteria

The following table contains a summary of the responses (full results of the survey are provided in Annex A) for the respective scheme from the EU Survey (methodologies 1 to 5) and information from the website with regard to scheme 6, the UK Peatland code. The latter has been verified by a representative of the IUCN UK Peatland Programme.

Table 8 Overview table coverage Quality criteria

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
121	ECS KlimaMoor	- Measuring area of denatured peatland with at least 50 cm of peat. - measuring density of peat (OC%) - external verification of further disturbance and denaturation of the area (third party expert) - conservative approach: only top 50 cm of peat are taken into consideration as being in danger of being lost in the next 50 years. - calculation of amount of C in danger of being lost. (roughly 800-1.100 t CO_2 per ha on average) - if renaturation and rewetting is successful, this amount of CO_2 can be prevented from emitting. <u>Baseline</u> is the specific density of peat in relevant 50 cm (project specific).	Regulatory and financial additionality: Verification of successful renaturation / improvement of peatland by third party	- Monitoring: 50 years - Certification period: 50 years -strict contracts will ensure the long-term storage	- Peatland restoration is planned together with third party experts, NGOs and state. - co-benefits are recorded and documented
48	2. LIFE OrgBalt	- Soil CO2, CH4, and N2O balances are calculated for specific site types. - Soil CO2 balance estimated using the chambers-based measurement technique -Annual soil CO2 balance is formed by using (1) summarised CO2 flux data over the year in monitoring and (2) data on mass-based C stock changes, such as C inputs and decomposition as litter aboveground and belowground.	Not considered under the current scope of the project.	- monitoring and certification period is not in scope of study - uses depth-to water map for the Baltic States and a map of peat layer thickness class for Latvia.	- monetization of the environmental services of particular climate change mitigation scenarios based on the TEEB database is included in the modelling. - The methodology includes characterising soil microbial communities in forested sites (whole microbiota - fungi, archaea and bacteria).

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
		- For methane (CH4) and nitrous oxide (N2O), there is no guidance on how living vegetation presence or litter dynamics should be taken into account in flux measurements, except that vegetation presence can be reported for CH4 monitoring locations (IPCC, 2014). Baseline Not currently calculated. Standard baseline could be used.			
1, 54	MoorFutures	- Direct emissions estimated using GEST approach (Greenhouse gas Emission Site Type), based on vegetation and humidity level - project specific baseline - ex-ante calculations of GHG emissions for duration of project, based on expected changes in water level and vegetation cover - Conservative calculation of baseline (underestimated) and project scenario (overestimated) are reviewed after 3-5 years after measure and then every 10 years to address uncertainties - For unforeseen changes a buffer of min. 30% of the remission reductions are set aside Baseline: Project specific baseline (i.e. the operator's performance at the beginning of the certified activity)	Regulatory additionality: - scientific research institutes perform monitoring and verification - Calculations are monitored over whole duration of project to assure it stays additional. - the avoidance of emissions is calculated based on the emission factors, presented in the catalogue.	- Monitoring: 30-50 years: before rewetting; 3rd year after rewetting and then every 10 years. Certification period: min. 30-50 years -permanence is guaranteed by adequate legal, planning and contractual instruments that vary from region to region	Standard sets up the rules, the criteria and principles including overall sustainability. Peatland rewetting generates a lot of co-benefits (biodiversity, water purification, microclimate). Overall the socio-economic and ecological conditions in the region should not be worsened. Compliance with the prohibition of deterioration will be presented in the project documentation.
55	SNK Currency for Peat	Quantification differs per type of project : -peatland rewetting while retaining its agricultural function - Peatland rewetting in combination with wet crops - peatland rewetting with nature development Baseline: hybrid A water level that is customary for the province/water board is chosen as a baseline. The baseline may differ per province/water	General SNK standards for verification apply: There are roughly three options for level of verification: 1. Reasonable assurance: 'everything has been checked and it is correct' (This option, which provides 95% reliability, is the most expensive (> €10,000).	- Monitoring: 10 years for ongoing projects, for which additionality and baseline are determined. After the 10-year period, additionality and baseline are reassessed for another 10-year period. - Certification period: at least 10 years is maintained for areas with an agricultural function and a maximum	Not directly considered

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
		board. Carbon certificates can only be obtained for water levels from the baseline and above; • The actual height of the groundwater level in the initial situation is determined by monitoring beforehand or on a reference plot	2. Limited assurance: (i.e. it has not been found that there is anything wrong). costs are estimated between €5,000 and €10,000. 3. Report of specific testing (SNK itself determines whether the results of this testing of the monitoring report provide sufficient certainty for the issue of certificates). This option is the least detailed and therefore the cheapest (up to €5000).	of 50 years for areas with a nature function	
18	Wetlands4-climate	- New method, awaits approval - evaluates the carbon sink capacity, as well as the global warming potential based on CO_2 and CH_4 emissions -direct and indirect CO_2 and CH_4 emissions - The actual rates of water-air exchange of GHGs (CO_2 and CH_4) are determined both ex-situ from intact sediment cores and in situ using closed chamber method which provided complementary results to better understand mechanisms of carbon flux between wetland and atmosphere.	Financial Additionality: - The projects submitted must have robust mechanisms in place to verify the monitoring of carbon sequestration and storage. -The following are suggested verification mechanisms: Management mechanisms: Third-party verification; Fiscal documentation. Impact mechanisms: - Direct carbon measurements -Satellite images - Predictive models Biological indicators: Biological indicators can be used as an indirect way to measure the amount of carbon stored	- Monitoring not in place - envisioned that the certification period will be min. 30 years with extension to 50 - To ensure that wetland management/ restoration projects maintain the permanence of justified CO_2 equivalent removals, it is necessary to perform a non-permanence risk analysis to identify the risk of possible emission leakage and issue buffer credits accordingly.	- The assessment of the ecological status of the wetland should be carried out following the criteria established in the legislation relative to the protection and conservation of ecosystems: the Water Framework Directive and the Habitats Directive - Proposed to use ECLECTIC index to assess its conservation status, in terms of its structure, functions and typical species
	6. UK Peatland Code (p1)	Calculates the net change in GHG emissions (tCO_2eq) as a result of the project, relative to the baseline and adjusted for leakage, using the Peatland Code Emissions Calculator, which is well established and supported by scientific research. - Validates ex-ante emissions reductions (but verifies ex-post emission reductions) and therefore only restoration actions that result in	Regulatory and financial additionality Projects demonstrate additionality by meeting the requirements of a series of additionality tests. Test 1 Legal compliance: A peatland restoration project passes the legal test when there are no laws, statutes, regulations, court orders,	- regularly measured and monitored over the lifetime of the project (minimum 30 years) - Certification period is minimum of 30 years.	- wider benefits of peatland restoration projects are 'bundled' with the carbon unit when they are sold (the landowner sells the carbon unit with the other benefits 'attached')

ID	Criterion Methodology	Quantification and baseline	Additionality	Long-term storage	Sustainability
		an immediate condition category change are eligible, with exemption of “modified bog”.	environmental management agreements, planning decisions or other legally binding agreements that require restoration, Test 2 – Financial Feasibility The financial feasibility test aims to determine whether the project would be financially feasible without carbon finance. The assumption is that cost and revenue are decisive factors in the decision to restore.		

5.2.1 Quantification

A crucial point for quantification for peatland methodologies concerns whether carbon removals are quantified or whether the methodology is fully targeted at quantifying the avoided release of carbon. The UK Peatland Code, MoorFutures and SNK Currency for Peatland methodologies take both elements into account. The MoorFutures methodology distinguishes between the two types; new peat accumulation is conservatively not yet included in the credit. The GEST approach (Greenhouse gas Emission Site Type), providing estimates of the balance of greenhouse gases based on the forecasts of vegetation dynamics and of water tables / water conditions, is broadly applied in certification schemes that are applied at scale including the MoorFutures and VERRA VM0036 Methodology for Rewetting Drained Temperate Peatlands.
Most of the certification methodologies for peatland included in the review provide starting points for the calculation of indirect emissions (these are included in the Wetlands4Climate methodology, and emissions caused by re-naturing activities are considered in ECS KlimaMoor).

There are considerable differences in the range of types of practices that are included under the methodologies and in the level of detail in which these are described and incorporated. An example of a scheme providing a high level of detail in this respect is the SNK Currency for Peat methodology. This methodology is describing the quantification and baselines in great detail for three specific practices: (1) peatland rewetting while retaining its agricultural function; (2) peatland rewetting in combination with wet crops and (3) peatland rewetting with nature development. Clear and detailed examples are provided of how to quantify and provide baselines for these three types of activities.

Other notable elements with regard to quantification and baselines in the certification methodologies pertaining to peatlands:

- UK Peatland Code has developed and applies a dedicated tool for their calculations, the Peatland Code Emissions Calculator, which is well established.

- The methodologies for peatland include a variety of approaches to address uncertainties, e.g. underestimation (KlimaMoor), buffer of 30% (MoorFutures) and project specific uncertainty and risk assessment (LIFE OrgBalt, SNK).
- The certification methodologies that are applied at scale all provide for a verification through a form of third-party verification. The SNK Currency for Peat scheme provides different levels of verification, that can be applied depending on the level of assurance required for the specific type of project.

Point of attention:

- The methodologies evolving from the survey generally apply project specific baselines (whereas SNK includes a standardised element in the form of information on water table levels per province/water board). Further standardised baseline elements were not mentioned.

5.2.2 Additionality

Four out of the six methodologies in the review have a form of additionality verification incorporated (for LIFE OrgBalt this is not in scope, for Wetlands4Climate it is not in place yet, but includes interesting mechanisms towards verifying additionality). Two of the methodologies (KlimaMoor and UK Peatland Code) include regulatory as well as financial additionality.

Several methodologies are applying various additionality tests, for instance the UK Peatland Code which provides a detailed example of ensuring regulatory and financial additionality.

5.2.3 Long-term storage

Certification period: all certification methodologies included in the review provide for certification periods (during which the activities are monitored at regular intervals and verified) of a minimum of 30 years, in most cases this can be extended up to 50 years – four of the methodologies in the survey provide for certification periods up to 50 years (MoorFutures, Wetlands4Climate, ECS KlimaMoor, SNK Currency). For the latter, a maximum of 50 years for areas with a nature function and at least 10 years for agricultural function). SNK Currency for Peat is hence also in this respect distinguishing between different types of activity, for rewetting in combination with regular agricultural practices 10 years of monitoring will take place. After the 10-year period, additionality and baseline are reassessed for another 10-year period.

Mitigation of risk of reversal: a variety of approaches to address this risk is shown in the different methodologies:

- Buffer methods: UK Carbon Code has a risk assessment in place that each project will include 15% in a buffer (Peatland Code Risk Buffer). It can be drawn upon should unintentional reversal of post-restoration condition category occur. UK Peatland Code shows excellent practice for mitigation of risk of release: includes everything from impact of livestock of deer, bare peat revegetation progress, reprofiled haggs and if any further erosion, dam success or any significant failures (assessed through ‘Peatland Code Risk Assessment’). SNK Currency for Peat also includes a reserve buffer.

- Wetlands4Climate is planning on including a non-permanence risk analysis and designing of a non-permanence risk plan.
- MoorFutures refers to legal, planning and contractual instruments that may vary by location.

Increasing water table levels as part of rewetting of peatland often involves approval from / action by local authorities (e.g. in The Netherlands the 'Water Boards' are the competent authority) and stakeholder consultation. The public-private partnership approach (see NL Valuta voor Veen / "Currency for Peat") may improve the long-term impact of the projects.

Public data/remote sensing: none of the methodologies use public data/remote sensing as no such public monitoring is available yet. The pilot project LIFE OrgBalt provides starting points in this respect by using a depth-to-water map for the Baltic States and a map of peat layer thickness class for Latvia.

5.2.4 Sustainability

All methodologies include a type of 'environmental no harm' mechanism to ensure that the measures taken in view of GHG emissions do not cause a deterioration of other environmental aspects. The project documentation should address this, in some cases including opinions of external stakeholders and experts.

MoorFutures has a standard available for other ecosystem services (including biodiversity) in its carbon credits scheme. Co-benefits are quantified in several projects. An initiative is ongoing on including characterising soil microbial communities in forested sites (LIFE OrgBalt project).

Point of attention:

- The valuation of co-benefits appears to be not well-developed yet in most methodologies.

5.3 Overview of potential elements relating to the QU.A.L.ITY criteria that will be further elaborated on in the scoping papers

In comparison with agricultural soils and forests, certification methodologies for carbon sequestration in peatlands are sparse in number and of mixed quality, but innovations take place in the development of the methodologies and in related scientific work and EU funded demonstration projects. Important points of attention that were discussed during the Expert Group Meeting on carbon farming in June 2023 where the complexity of setting (standardised) baselines and the issue of (distinguishing between) reducing emissions versus achieving removals. It is hence of importance to assess to what

extent it is possible to apply standardised baselines in future methodologies: what type of innovation would still be needed to enable standardisation– what are the anticipated timeframes?
In order for peatlands to become persistently ‘climate cooling’, water levels need to be increased continuously and methane reduction needs to be managed further through managing hydrology/hydrochemistry and vegetation. It was further mentioned during the meeting that developing paludiculture, which is currently being trialled under the Peatland Code, is of importance for productive use.

Regarding quantification and baseline setting, it is furthermore to be noted that considerable experience is available on applying the GEST approach (Greenhouse gas Emission Site Type), providing estimates of the balance of greenhouse gases based on the forecasts of vegetation dynamics and of water tables / water conditions. During the Expert Group meeting in June 2023 it was mentioned that this approach has been successfully applied in the MoorFutures methodology, and will now need to be complemented with methodologies to assess co-benefits. Considerable certification periods are foreseen for the methodologies related to peatlands. Certification (and monitoring) periods up to 50 years are applied in several methodologies (four of the six methodologies provide for certification of at least 50 years). In some cases, recertification takes place periodically (e.g. each 10 years), in one case (SNK Currency for Peatland) monitoring and certification periods are coupled with the type of usage (rewetting in combination with regular agricultural practices, respectively in combination with wet crops and in combination with nature development). Enabling the certification at different levels of verification (as is provided for by SNK) is considered an interesting pathway to address balancing between costs and level of assurance.

The methodologies included in the review provide different methods to address uncertainty, e.g. underestimation, buffering and including a project specific uncertainty/risk assessment. While the latter may have the potential to be the most accurate it could also be the most complex from a procedural certification perspective.

The methodologies included have different ways of assessing additionality. Through its system of additionality tests, the UK Peatland Code has a clear system in place to assess whether requirements are met as regards to additionality by assessing legal requirements and financial feasibility (including share of the project that is financed through carbon funding).

Various approaches are opted for to mitigate the risk of release, ranging from application of buffers, incorporating regulatory instruments and project-specific risk assessments.

‘Environmental no harm’ elements are included in all certification methodologies included in the review, but options for valuation of co-benefits are scarce. In various certification methodologies steps are being taken towards valuation of in particular the environmental co-benefits, however further development appears to be required to assess these in a coherent manner and enable incorporation of the value of these co-benefits into the certification.

A Detailed results of the survey

Please refer to separate Excel file containing an export of the anonymised results of the survey.

B Sources

Study reports providing information on certification methodologies that were not included in the EU Survey results include the following:

a) McDonald, Hugh et al. 2021, “Certification of Carbon Removals. Part 2: A review of carbon removal certification mechanisms and methodologies”, Environment Agency Austria;
b) Scheid, Aaron et al. 2023, “Carbon farming co-benefits: Approaches to enhance and safeguard biodiversity”, Ecologic Institute, IEEP;
c) Ministère de la Transition Ecologique France, Direction Générale de l’Energie et du Climat, 2022, “Etude comparée des standards de compensation existants”, DGEC;
d) Oldfield, E.E., A.J. Eagle, R.L Rubin, J. Rudek, J. Sanderman, D.R. Gordon. 2021. “Agricultural soil carbon credits: Making sense of protocols for carbon sequestration and net greenhouse gas removals”. Environmental Defense Fund, New York.

C Respondents per type of carbon farming

Short	In full
DMS	Developer of a methodology or standard
EMCS	Entity managing a certification scheme and/or a registry of certificates
PP	Pilot project (e.g. LIFE, Horizon, national/regional project…)
I	Intermediary (entity providing consulting services to a group of operators to help them obtain certification)
CB	Certification body (entity conducting audits or developing methodologies / tools for audits)
EO	Economic operator (entity carrying out a carbon farming activity, e.g. individual farmer, forester, etc.) or association representing those operators (e.g. cooperative, industry association)
Oth	Other
UoC	User of certificates (entity using carbon farming certificates for scope 3 reporting or impact finance, e.g. agro-industry, financial operator)

Agriculture

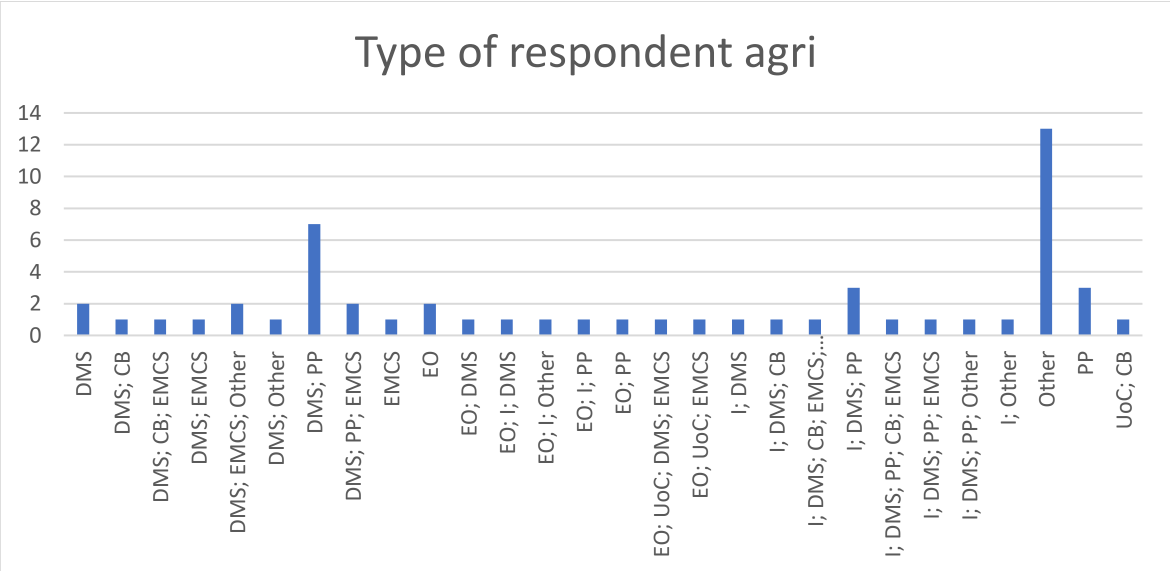

Figure 12 Type of respondent for agriculture methodologies

'Other' respondents for agriculture include respondents that have indicate to be:

- Measuring services;
- Developer of carbon farming projects, and offering technological tools to monitor the positive impacts of the transition to a regenerative farming model;
- Researcher;
- Advisory service to farmers;
- MRV Service Provider;
- Non-profit association;
- Ministry of Energy;
- Institute for Agricultural Research and Development;
- Platform developer and operator: an all-in-one platform (framework-methodology-guidelines-templates, MRV, marketplace, financial & legal service provider for closing matches between carbon farmer and carbon credit buyer);
- Carbon removal marketplace.

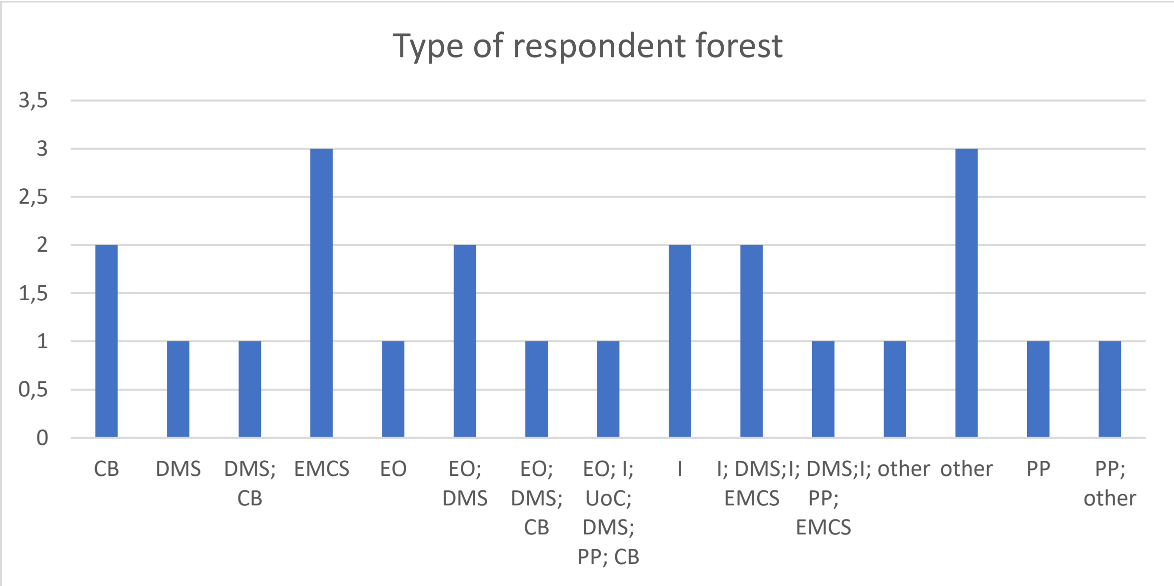

Figure 13 Type of respondent for forests methodologies

'Other' in forestry includes:

- Ministry of Energy transition, guarantor of the low carbon label, in charge of its development, implementation and evolution;
- Researcher;
- Non-Governmental Organization;
- Research Organisation.

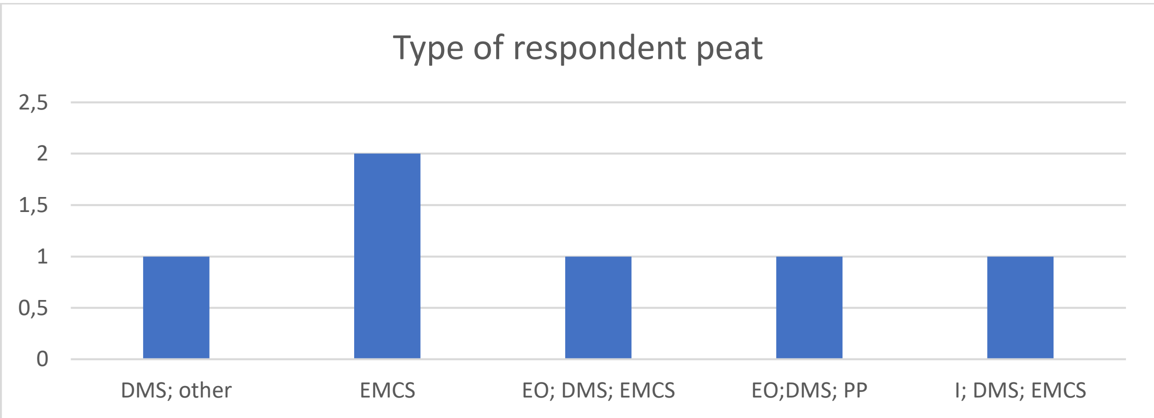

Figure 14 Type of respondent for peatland methodologies

'Other' in peatlands: consortium of scientific institutions.