World-Climate Farm

Standard and guideline for the calculation, validation and verification of greenhouse gas balances on farms and farm communities.

Developed by Carbon Standards International AG and Ithaka Institute for Climate Strategies - Version 4.0 (March 2025).

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1. Summary

The World Climate Farm Standard (WCFS) enables the calculation of climate balances for farms and farm communities, as well as the comparison of balances between different farms and farm communities. It is used to analyse emission sources and locations of carbon storage and thus to identify potential for reducing emissions or increasing carbon storage with the help of measures. The procedure is based on ISO standard 14064-1 to 3 and the GHG Protocol and takes into account the applicable requirements of the Intergovernmental Panel on Climate Change (IPCC).

To this end, the standard defines the most important climate-relevant processes, as well as their calculation bases and system limits.

In order to create the carbon footprint, additional farm-specific data is required in addition to the general farm data (e.g. area, zoning, production direction, livestock, yield and performance data). The greenhouse gas balance is then calculated for the farm as a whole and for specific products (plant crops, milk and meat in the case of cattle) and presented graphically. The farm should also set targets for improving its greenhouse gas balance and introduce specific measures, which are supported by a catalogue of measures integrated into the World-Climate Farm Tool. Both the calculation and the implementation of measures to reduce greenhouse gases are awarded with the corresponding World Climate Farm certificate. Depending on the status of the farm, three different forms of the certificate are used:

- "CO_2 evaluated" - if the balance has been calculated and is positive.
- "CO_2 reduced" - if the balance has been calculated and is positive, but the farm applies a certain amount of measures to reduce greenhouse gases.
- "Climate neutral" - If the farm achieves a balanced greenhouse gas balance.

The calculation procedure is designed to be as efficient as possible for the farm or farm communities. The project partner carries out the data collection on site or online together with the farm. Existing data records can be imported in advance. The data is then checked by an approved validation and verification body of Carbon Standards International (CSI) in the World Climate Farm Tool (WCFT) and adjusted if necessary after consultation with the farm. After successful calculation, the certificate is issued.

The World Climate Farm certification system consists of a four-part structure with the following three units: (1) farm or farm community; (2) label; (3) project partner; (4) validation and verification body.

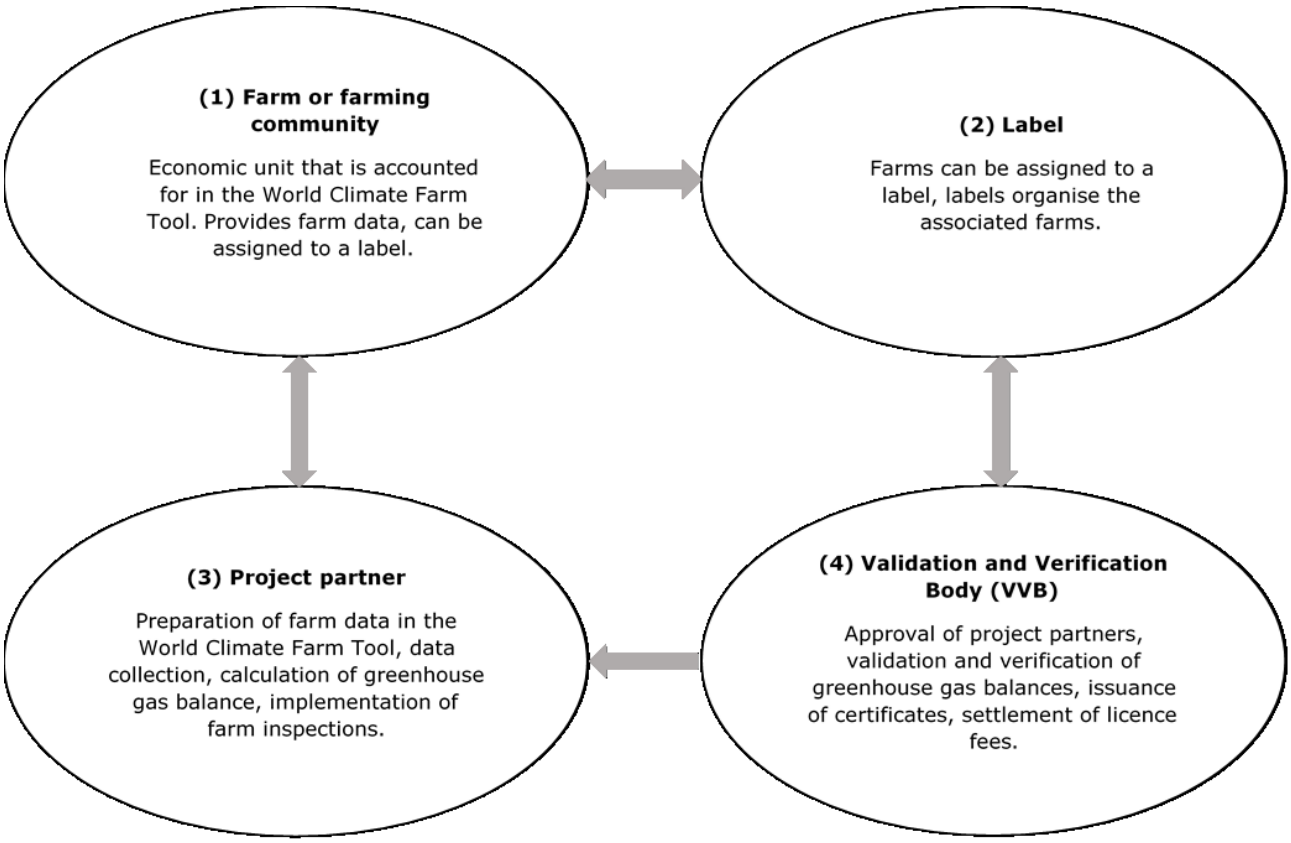

Figure1 : Certification structure

2. Glossary

The glossary contains a description of the terms used in the standard:

Table1 : Glossary

Term	Description
Business/ Farm	Economic unit of an agricultural enterprise with one or more locations. The farm management is identical for this economic unit.
CSI	Carbon Standards International AG
C-sinks	Carbon sinks describe natural or artificial systems that absorb more carbon dioxide from the atmosphere than they release. Carbon sinks can be used to compensate for greenhouse gas emissions.
Comparison metrics	The WCFS uses two different comparative metrics for the conversion of individual greenhouse gases into CO_2e: • GWP100: Global Warming Potential 100, describes the cumulative radiative forcing of a gas in the atmosphere over an observation period of 100 years compared to CO_2. In

	simple terms, this means how many times more the gas contributes to the greenhouse effect compared to $CO_{(2)}$. Methane (CH_4) has a factor of 27, nitrous oxide (N_2O) a factor of 273. GTP100: Global Temperature-Change Potential 100, describes how much a gas actually contributes to the temperature rise after 100 years compared to CO_2. Methane (CH_4) has a factor of 5, nitrous oxide (N_2O) a factor of 233.
Data	Data" refers to climate-relevant operating data that is required to calculate a carbon footprint with the WCFT (e.g. amount of fuel, number of animals, yield per crop, etc.).
Emissions Carbon dioxide (carbon dioxide emissions, CO_2)	CO_2 is a climate-relevant gas. Climate-relevant CO_2 emissions result primarily from the combustion of fossil fuels. In agriculture, this includes emissions from agricultural machinery and vehicles. In a holistic climate balance sheet, emissions from journeys with vehicles not belonging to the farm, from the recycling of waste of fossil origin and many other processes must also be taken into account.
Emissions Nitrous oxide (laughing gas emissions, N_2O)	N_2O is a climate-relevant gas. Nitrous oxide emissions are largely produced during the storage of farmyard manure, during the application of N-containing fertilizers and in the soil after N input. Although this emission is small in terms of mass compared to the other gases, it is highly relevant due to its higher global warming potential (GWP100 metric) - 277 times higher than that of CO_2 over a 100-year period.
Emissions Methane (methane emissions, CH_4)	CH_4 is a climate-relevant gas. The majority of methane emissions on farms are produced in the digestive tract of ruminants and during the storage of farmyard manure. The outgassing of unfermented farmyard manure, methane has a higher greenhouse gas potential than CO_2: If the period of 100 years after the emission is considered and the metric GWP100 (Global Warming Potential) is applied, a climate effect can be observed which corresponds to 27 times the corresponding CO_2 emission.
Farm/business	Economic unit of an agricultural enterprise with one or more locations. The farm management is identical for this economic unit.
Farm/Farming community	Describes the agricultural production unit in the WCFS, which consists of several farms and uses the WCFT.

FPCM	Fat-protein corrected milk. The milk ingredients per farm vary. The milk quantity is converted into FPCM (4.2% fat, 3.4% protein) to ensure comparability between farms. Depending on the ingredients, the corrected milk quantity is higher or lower.
GHG declaration	The GHG statement consists of the linking of assumptions, methods and restrictions with the climate-relevant data of the farm.
Greenhouse gas balance	According to ISO 14064-1, a greenhouse gas inventory is a list of GHG sources and carbon sinks, as well as their quantified GHG emissions and quantities of GHG removed.
ISO 14064	The ISO 14064 standard consists of 3 guidelines and was developed for the accounting of greenhouse gas emissions and the development of measures to reduce them. The standards can be applied to various systems, organizations and events. ISO 14064-1 requires the user of the standard to describe the assumptions, calculation methods and their limitations on the one hand, and to provide the input data and information for the assessment on the other. The data basis is validated during the on-site inspection. The description of the reduction targets is verified by the VVB. The WCFS is based on this ISO standard and is specified for use on farms.
Label	Calculated farms can be assigned to a label. The label describes an affiliation to a common, superordinate organization. These can be food processing companies, brands, regions or other stakeholders.
Long-term C-sinks	Long-term C-sinks are those carbon compounds, such as biochar, which have a persistence of 1000+ years.
Net emissions	GHG emissions reduced through (a) specially realized carbon sinks
Project partner	The project partners look after the farm or farm community and are responsible for preparing the farm data in the World Climate Farm Tool. They calculate the greenhouse gas balance and carry out farm inspections. The project partner is approved and qualified by the VVB for this work and receives regular training.
Reduction measures	Greenhouse gas (GHG) emissions can be counteracted with various reduction measures. These include emission-reducing measures, C-sinks and external compensation.
Standard developer and standard designer	The World-Climate Farm Standard was developed by Carbon Standards International AG (CSI), bio.inspecta AG, and the Ithaka Institute for Climate Strategies (Ithaka) and is being continuously developed by them. The World-Climate Farm Standard is the

	property of Carbon Standards International AG and can only be used by recognized validation and verification bodies (VVB) and project partners with a license agreement. Carbon Standards International AG organizes the approval process for the VVB.
Short-term C-sinks	Short-term carbon sinks (C-sinks) consist of the storage of organic material in the soil (humus), forests, trees and hedges. Carbon is stored in the organic material. The sink capacity is only given if more is stored than is released. As the above-mentioned methods of carbon storage can be lost again very quickly (e.g. through plowing, burning, etc.), these are so-called short-term carbon sinks.
THG	Greenhouse gases (GHGs) are the gaseous components of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the Earth's surface, the atmosphere itself and clouds. This property causes the greenhouse effect. Water vapor (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the most important greenhouse gases in the Earth's atmosphere. In addition, there are a number of greenhouse gases in the atmosphere that are exclusively man-made, such as halogenated hydrocarbons and other substances containing chlorine and bromine, which are dealt with under the Montreal Protocol. In addition to CO_2, N_2O and CH_4, the Kyoto Protocol also deals with the greenhouse gases sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs).
Tons of CO_2 equivalents ($t\ CO_2$)	Standardized unit of mass for the climate impact of greenhouse gases: It provides information on how many tons of CO_2 it takes to have the same climate impact as one ton of another greenhouse gas (methane or nitrous oxide in agriculture). The conversion factor depends on the metric chosen.
Validation and Verification Body (VVB)	The validation and verification body is responsible for the approval and training of project partners, the validation and verification of greenhouse gas balances, the issuing of certificates and the settlement of license fees. The validation and verification body is approved and qualified by the CSI for this work and receives regular training.
WCFL	World-Climate Farm Label - is the logo and brand that can be used for labeling farms and labels if they have a valid license agreement

	with CSI and a valid certificate from a validation and verification body accepted by CSI.
WCFS	World-Climate Farm Standard - this standard with the associated guidelines for calculating the greenhouse gas balance.
WCFT	The World-Climate Farm Tool is a cloud-based IT solution that collects the data for the climate assessment, calculates the results and summarizes them for analysis.

3. Introduction

The consequences of advancing climate change can be observed in various areas around the world. In the context of climate change, agriculture plays an ambivalent role, acting as both, a victim and a cause, but also as part of the solution.

Agriculture is directly affected by the consequences of climate change. Increased extreme weather conditions are associated with rising temperatures. These include heavy rainfall, heat waves, periods of drought and hail. These factors place an additional burden on soils, crops, animals and farms.

Greenhouse gas (GHG) emissions from agriculture include methane (CH_4), nitrous oxide (N_2O) and carbon dioxide (CO_2). The gases are released during various processes. Methane is mainly produced during the enteric fermentation of ruminants and during the storage of farmyard manure. Nitrous oxide emissions are produced in animal husbandry (stables, manure storage and spreading), during the spreading of nitrogenous fertilizers and crop residues. Sources of carbon dioxide are the combustion of fossil fuels such as diesel or natural gas.

Sequestering carbon on the farm creates short- or long-term carbon sinks (C-sinks). By capturing these sinks, existing greenhouse gas emissions within the production process can be partially offset.

3.1 Purpose and objective of the World Climate Farm Standard

The "current" human-made climate change has its origins in various cultural techniques, and agriculture also makes a contribution. On the one hand, the quantification of greenhouse gas emissions from individual farms has become the focus of the climate debate in recent years. On the other hand, food processing companies are endeavouring, or legally obliged, to obtain information on their GHG emissions along the value chain of their products. With the help of the WCFS, farms gain a deep insight into the processes that cause emissions in their operations. A scientifically based standard provides the farm with information about its carbon footprint, which gases are produced in which quantity and in which process. At the same time, the carbon sinks in various processes at the farm are recorded. In addition, the World-Climate Farm Tool (WCFT) includes a catalogue of measures for reducing GHGs and storing carbon on the farm. These comprehensive tools should enable the farm to gain a deeper understanding of agriculture in relation to climate change. Through the deeper understanding and the prepared emission-reducing measures, the farm can easily and specifically reduce emissions or build up carbon sinks and thus make a contribution to a climate-friendly future.

The food industry and food retailers are also increasingly interested in the climate performance of their suppliers. It can be assumed that prices for agricultural products will also be based on the quality criterion "climate footprint" or that customers will take this into account when making their purchasing decisions in future. This gives farmers the opportunity to generate additional revenue

with targeted climate protection measures. In addition, there are private sector initiatives and legal framework conditions that require sustainability reporting.
The WCFS aims to create a knowledge base for the farms and stakeholders and to identify potential. Where do emissions occur, in what quantity and how can processes be intervened in order to further reduce emissions. In this sense, the aim is to support a site-specific circular economy. In which external inputs are minimized as far as possible and outputs are efficiently maintained at a high level.

3.1.1 Fulfillment of reporting obligations

One aim of the WCFT is to fulfill the requirements of various legal bases and private law initiatives with regard to sustainability reporting. The WCFS is based on the ISO standard ISO 14064 and follows the GHG Protocol in its main features. The calculation of greenhouse gases follows the IPCC methodology and is recognized by the GHG Protocol. This means that the WCFS can be used for sustainability reporting initiatives that recognize the GHG Protocol.

4. Validation and verification

The validation and verification consists of data collection together with the project partner on site, re-verification of the data by a CSI-approved VVB and subsequent calculation of the carbon footprint. The observation period for the carbon footprint is the last completed year (actual energy consumption etc. known). Once this process has been successfully completed, the farm receives a certificate from an approved VVB, which is valid until December 31 of the following year. For the label, the certificate is valid until December 31 of the following year, after project completion.
The VVB can choose a project partner who can take on the following tasks in particular: Preparation of operational data in the WCFT, operational checks (compliance with submitted measures), data collection and calculation of greenhouse gas balance. The project partner is contractually bound to the VVB and to confidentiality.
The companies are obliged to disclose and keep appropriately detailed records of the scope 1, 2 and 3 data collected in the WCFT and to submit them during data collection. During data collection, the accuracy and plausibility of the data provided in the WCFT is checked for the first time. All information disclosed by the companies is treated confidentially by the VVB, the project partner and the CSI. The joint collection and initial review of the data with the project partner and a second review by the VVB leads to a high level of data security and minimizes inaccurate results due to poor data quality.

4.1 Validation and verification process

The validation and verification process is carried out according to the scheme below:

1. Assumptions, methods and restrictions are specified in the WCFS and WCFT and verified by the VVB.
2. Existing operating data is recorded by the project partner and imported into WCFT.
3. The farm receives a checklist in advance with the necessary data to be prepared. The project partner comes directly to the farm or contacts the farm online and the missing data is completed together.
4. The VVB checks the data for completeness and plausibility and issues a certificate.
5. The farm receives the result of the carbon footprint and the certificate.
6. The farm has the option of selecting reduction measures and thereby undertakes to apply them. If enough measures are applied, the certificate changes.

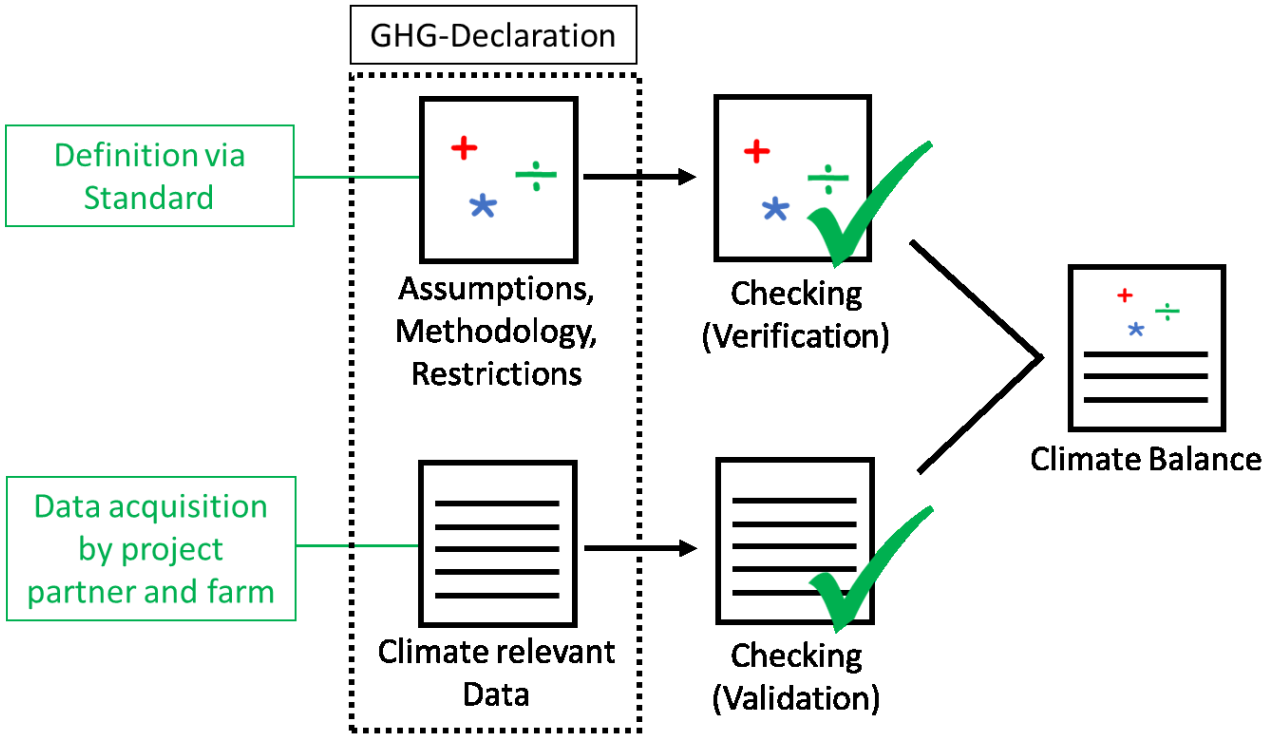

Figure2 : The path to the carbon footprint, verification and validation

The climate balances are calculated as part of a joint project with the VVB. In this project, a duration and the frequency of the balancing of the companies are defined. For example, in the case of a multi-year project, the farm can define measures after the first year and be assessed again in a subsequent year in order to show the reduction in emissions. The certificate issued by the VVB is also available for the farm as proof of quality. The certificate is awarded in different ways depending on the result

of the carbon footprint. If the balance is positive (more CO_2e is emitted than stored), the farm receives the "CO_2 evaluated" certificate. If the balance is balanced or negative (more CO_2e are stored than are emitted), the farm receives the "CO_2 neutral" certificate. If the "CO_2 evaluated" certificate is issued and the farm selects sufficient reduction measures that it undertakes to apply, it receives the "CO_2 reduced" certificate.

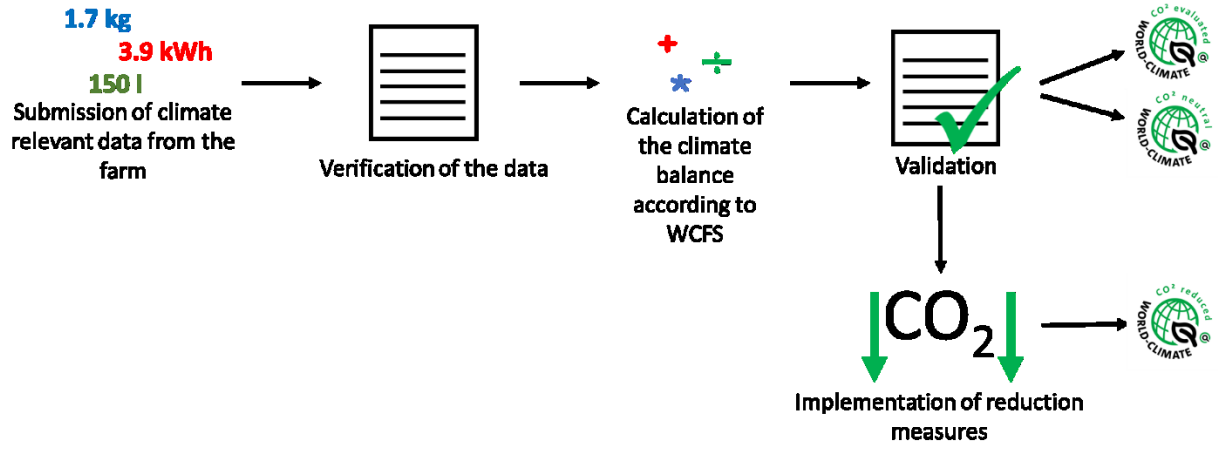

Figure3 : Reduction targets, tests and labels

4.1.1 Label validation and verification process

Calculated operations can be assigned to a label. The label describes an affiliation to a common, superordinate body. These can be food processing companies, brands, regions or other stakeholders. With the agreement of the farms, the label is given access to the farms' carbon footprints and the measures they have taken. The label also receives a certificate. This can be "CO_2 evaluated" or "CO_2 reduced", as is the case for the individual farms. The "CO_2 reduced" label is awarded when the average climate points of the farms exceed the threshold value of climate points.

4.2 Farm/Farming communities

Farming communities can also be certified. For an audit, it must be determined together with the project partner and the VVB whether the farms in the farm group are to be verified and validated separately or together. If the group of farms is certified together, it is regarded as one farm in the WCFS. If they are calculated separately, they are regarded as independent operations. A prerequisite for separate accounting is a good delimitation of the use of operating resources for each farm in the joint operation.

4.3 Procedure for violations and sanctions

The VVB decides on the severity of the violation and the corresponding sanction level. The weakest sanction is a warning with a deadline for remedying the defect. The strongest sanction is the revocation of an operation or termination of the contract with payment of a contractual penalty and any damages, as well as publication of the decision. Appeals against VVB decisions must be addressed to the VVB. Appeals against WCFS enforcement decisions are dealt with by the CSI's independent appeals office.

4.4 Contractual and control obligations

Companies that wish to be verified and validated in accordance with the WCFS must participate in the verification and validation process and can be checked for compliance with the guidelines. For this purpose, the operations conclude an agreement with a CSI-recognized VVB. If the operation is assigned to a label, the agreement can also be concluded via the label. In this case, the label regulates the agreement with the farm and the VVB. The farms and the label are authorized to use the World-Climate Farm Label through the agreement with the VVB. The agreement also regulates the use of the label in sales and trade. Anyone wishing to use the label in any other way must conclude a separate brand usage agreement with the CSI.

4.5 Validation and verification bodies (VVB)

The authorization of VVB is based on a contract with CSI. VVB must be authorized by CSI to offer their validation and verification services. The authorized VVB are published on the CSI website. The VVB is trained by CSI for the implementation of the standard specifications and audited annually. The basis for the authorization of the VVB is the accreditation according to 14064-3 and 17029/14065 (currently valid version) by a recognized accreditation body. The VVB can also be in an ongoing accreditation procedure for approval.

5. Basis of the GHG declaration

The GHG declaration is made up of a combination of the following areas:

- Assumptions, methods and system limits: These are regulated by this standard and are checked and recognized in advance by the VVB.
- Climate-relevant data: This relates to the climate-relevant data described in chapter "6. Processes". They are recorded by the farms and project partners and checked by the VVB.

The result of the GHG statement is the farm's carbon footprint. The various areas of the GHG statement are discussed in more detail in the following chapters.

5.1 System boundaries

When selecting the processes, the scopes of ISO 14064-1 were taken as a basis and presented in more detail (Annex 1). When calculating the carbon footprint, the GHG emissions and C-sinks that occur on the farm up to the farm gate are shown, i.e. along the farm's value chain. The emissions are broken down into Scope 1, 2 and 3 emissions. Scope 1 emissions describe all emissions from controlled resources on the farm. Scope 2 emissions describe all indirect emissions associated with the provision of energy. Scope 3 emissions include all emissions that occur indirectly within the value chain and do not fall under Scope 2. On the farm, this includes purchased operating resources and services.

The system boundary extends to the ideal farm gate of the farm and covers unprocessed products (yield of arable crops, live weight of animals, raw milk). The further treatment and processing of products is not recorded. The private consumption of energy and other processes is also excluded from the carbon footprint.

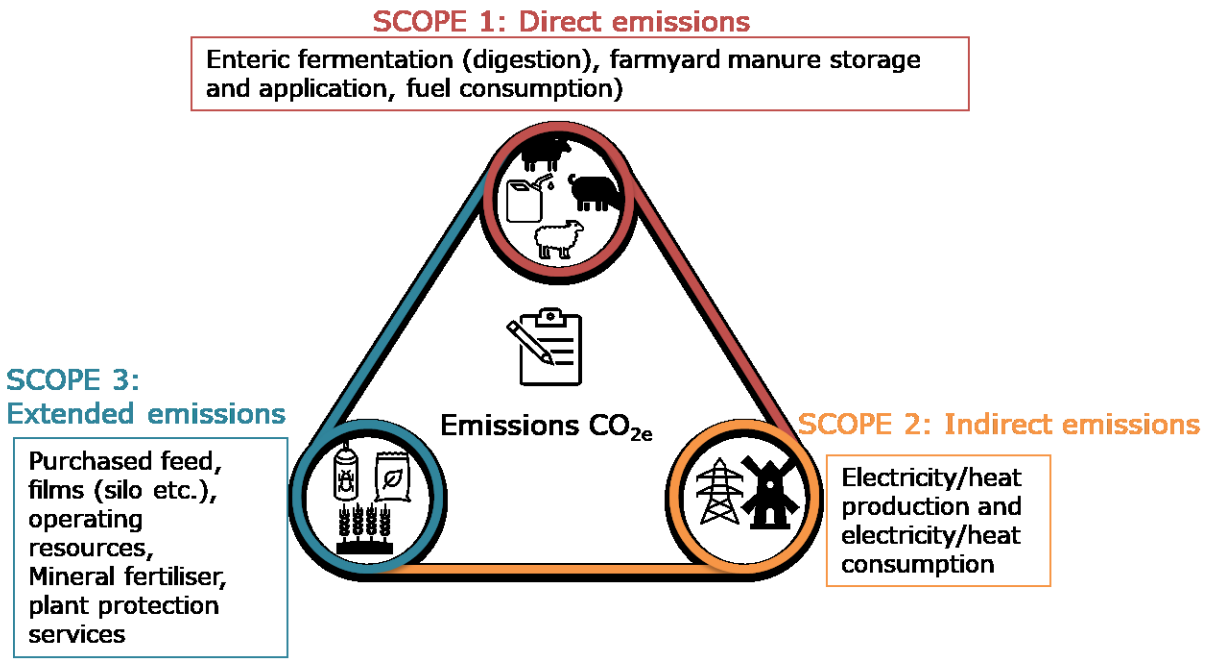

Figure4 : System boundaries of the WCFT

5.1.1 Special cases in the system boundary

In terms of the comparability of results, a uniform system boundary is important, which was defined as the farm gate. The processing of products is not included in the system boundary. Special cases within this system boundary nevertheless exist and in the WCFS these concern the drying of cereals, root crops and pulses, storage or other energy-intensive processes in connection with plant and

animal production after harvest. As a rule, energy expenditure (diesel/electricity etc.) used for drying and storage is excluded from data collection. This means that the results of farms that sell products from the field can be compared with those, who do the drying, or further processing on their own. If the transportation of the goods from the field to storage/processing is carried out externally, this must be recorded and listed under contract work in the WCFT. In consultation and agreement with the VVB, energy-intensive processes in animal husbandry and crop production can also be included. In this case, the farm must expect higher emissions than other comparable farms.

Forests represent a special feature in the climate accounting of agricultural operations. On the one hand, the forest is a separate system that is not directly linked to food production. On the other hand, many farms and farm communities own and manage forests. According to WCFS, the forest is taken into account in the data collection and the balance is calculated with and without the forest. In WCFT, the farm can include or exclude the forest in its balance sheet by clicking a button. In the product carbon footprint, the forest is not included as a carbon sink

5.2 Non-quantified processes

The agricultural business is a complex system with many different processes that cause emissions. The system boundary in the WCFT therefore does not include all processes. For example, buildings and structures as well as machinery are not taken into account (emissions generated during production). Similarly, carbon stored in plants (including wood for heat production) and animal products (including the animal itself) is not included in the system boundary due to the short conversion phase. It is assumed that the amount of CO_2 absorbed by plants during growth corresponds to the amount of CO_2 released during respiration. Hot water generated by solar energy and other processes are also not recorded, as their climate performance is reflected indirectly by the lower amount of energy purchased. CO_2 from the mineralization of organic material in the soil is also not included.

5.2.1 Degree of

The degree of certainty is made up of the data of the farms required for the balancing and the uncertainties of the calculation models.

5.2.1.1 Security Data origin

During the validation of the operational data, the accuracy, reproducibility and origin of the data are checked. The degree of certainty of the climate-relevant data is determined on the basis of the type

of data procurement and defined by the VVB. It is assumed that the data collected is correct. A distinction is made between three levels:

- High level of security: verified data from traceable sources, e.g. invoices, delivery bills or already certified data.
- Average degree of certainty: Measured values, e.g. yield of plant crops, milk quantity
- Low safety level: Estimated values if measurements are not available

5.2.1.2 Uncertainty Calculation models

Here, classification is based on the Tier System, which is also used by the IPCC, and on the data sources of the emission and sink factors. The Tier classification represents a level of methodological complexity. As a rule, there are three levels. Tier 1 is the simplest method, Tier 2 is the intermediate and Tier 3 is the most demanding in terms of complexity and data requirements. Levels 2 and 3 are sometimes referred to as higher quality methods and are generally considered to be more accurate. For uncertainties from data sources, low uncertainty is assumed for emission factors from the Ecoinvent database and emission factors from government institutions. For emission factors from scientific publications, the uncertainty is taken from the publication itself. The method according to animal classification, as well as the degree of uncertainty of the emission and sink factors, is stated in the corresponding model description for the respective process. The model description is a separate document and is issued by CSI on request

5.3 Calculation models and emission factors

The preparation of the greenhouse gas balance is based on calculation models that are filled with climate-relevant data from the farms. Equations from the Swiss Greenhouse Gas Inventory (FOEN 2023), the Agrammon model (Kupper T. 2022), the German Greenhouse Gas Inventory (Umweltbundesamt 2023) and, in some cases, our own calculations are used as a basis. Own calculations are simple, where a factor is multiplied by an emission factor. The emission factors are based on values from the Ecoinvent database (Wernet et al., 2016), scientific publications or publications from government institutions. The CSI keeps the emission factors up to date. It receives support from the Ithaka Institute. Detailed documentation of the calculation models can be found in chapter "6 Processes" and in the model description.

5.4 Conversion to CO_2 equivalents

The effect of all greenhouse gases on the climate (climate impact) is indicated by the unit of measurement "t CO_2e" (e=equivalent) (Table 3). The greenhouse gases considered here are carbon

dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O). The WCFS uses two conversion metrics, GWP100 (Global warming potential 100) and GTP100 (Global temperature change potential 100)
The GWP100 indicates the cumulative warming effect over a period of 100 years caused by one emission pulse of a greenhouse gas. The GWP is expressed in relation to the same amount of CO_2 emissions. This means that the GWP factor of CO_2 is always 1 and that of methane is 27, which means that methane warms the climate 27 times more than CO_2. The GWP100 has long been established in science and climate policy.
The GTP100 indicates the effect of an emission pulse of a greenhouse gas on the average global temperature change after 100 years. The GTP100 is expressed in relation to the same amount of CO_2 emissions. Thus, the GTP100 factor of CO_2 is always 1 (as a reference value) and of methane about 5. In this case, methane is 5 times more climate-effective than CO_2. The GTP100 goes beyond the GWP100 and takes into account not only the radiative effect, but also the temperature change. By considering the time after 100 years, short-lived greenhouse gases, such as methane are assessed lower.

Table2 : Conversion factors CO2e

Greenhouse gases	**GHG potential GWP100 (CO_2e)**	**GHG potential GTP100 (CO_2e)**
Carbon dioxide (CO_2)	1	1
Methane (CH_4)	27	5
Nitrous oxide (N_2O)	273	233

5.5 Preparation of results and product allocation

The WCFS calculates a corporate carbon footprint and a product carbon footprint. In the corporate carbon footprint, emissions are broken down by process. The product carbon footprint shows the share of the various processes in the product. The emissions are allocated to the respective animal and plant products. The results are presented by structure in Table 3.

Table3 : Gradation of emissions to product across different reference units.

Animal husbandry	**Crop cultivation**
All animals (All dairy cows)	Total ha (total area of wheat)
1 animal (1 dairy cow)	1 ha (1 ha wheat)
1 kg product (1 kg FPCM, 1 kg live meat weight)	1 kg product (1 kg wheat)

6. Processes

The processes are subdivided into Scope 1, Scope 2 and Scope 3. Short-term and long-term C-sinks are also listed. A detailed description of the calculation models used and their sources can be found in the document "World-Climate Farm - Model Description".

6.1 Scope 1 - Direct emissions

In this chapter, all greenhouse gas emissions generated directly on the farm are accounted for.

6.1.1 Energy

6.1.1.1 Fuel, heating oil, natural gas

For the calculation of emissions from energy in Scope 1, fuels (fossil and organic), heating oil and natural gas consumed on the farms are taken into account. The private share is excluded. In order to provide these values with a high degree of certainty, they should be supported by documents (invoices, delivery bills, logbook, etc.) that allow conclusions to be drawn about actual consumption. If it is not possible to differentiate between private and business fuel consumption on a farm with the help of documentation, a realistic estimate by the farm manager is necessary.

6.1.2 Animal husbandry

In animal husbandry, the emission processes are subdivided into enteric fermentation and farmyard manure management. The emission processes from animal husbandry are preceded by the energy intake in gross energy (GE) via the feed. These are calculated separately for dairy cows and suckler cows and take the following parameters into account:

- Milk yield
- Milk fat
- Milk protein
- First calving age
- Births in the year
- Age at slaughter
- Slaughter weight
- Summering days per year
- Grazing days per year
- Grazing hours per year
- Summer feed ration
- Winter feed ration

For pigs and poultry, the GHG emissions were derived from scientific literature; for the other animal groups, standard values from the Swiss Greenhouse Gas Inventory (FOEN 2023) were used.

6.1.2.1 Enteric fermentation (CH_4)

In the livestock sector, the enteric fermentation (digestion) of ruminants and other farm animals produces significant quantities of methane. For this reason, the average number of all animals on the farm over a year should be recorded. CO_2 emissions from the animals' respiration are considered climate-neutral. Feeding has a significant influence on emissions, which is why it can be adjusted for cattle and pigs.

6.1.2.2 Farmyard manure management (CH_4 and N_2O)

Emissions in the form of CH_4 and N_2O are produced during the storage of farmyard manure. These are specific to the different types of livestock and to the respective storage system. In the WCFT, a distinction is made between liquid manure, solid manure, deep litter manure, compost, biogas slurry, biogas manure and the proportion of manure and urine produced on the pasture. Other parameters that influence emissions are also included in the calculation. These include Manure cover, manure storage, frequency of slurry stirring, stable system, exercise yard/run, and for pigs and poultry, exhaust air purification. The manure removal system is also taken into account for poultry.

6.1.3 Soil emissions

Soil emissions are induced by the application of nitrogenous fertilizers, crop residues and lime.

6.1.3.1 Crop residues (N_2O)

Harvest residues contain nitrogen and remain on the field; even when the harvest residues are removed, a certain amount remains on the field and enters the soil. Some of the nitrogen is released as N_2O emissions.

6.1.3.2 Fertilization Mineral fertilizer (N_2O)

Synthetic N fertilizers are widely used in conventional agriculture. When the fertilizer is applied to the field, some of the N is released as nitrous oxide emissions. The amount of emissions depends on the quantity and N content of the fertilizer. Nitrification-inhibiting fertilizers are not yet widely used and are therefore not taken into account.

6.1.3.3 Fertilization Biofertilizer (N_2O)

Biological N fertilizers are widely used in livestock-free, organic farming. When the fertilizer is applied to the field, some of the N is released as nitrous oxide emissions. The amount of emissions depends on the quantity and N content of the fertilizer.

6.1.3.4 Fertilization Urea (N_2O)

Urea is widely used as an N fertilizer in conventional agriculture. When the fertilizer is applied to the field, some of the N is released as nitrous oxide emissions. The amount of emissions depends on the amount and N content of the fertilizer, which is different from synthetic N fertilizers, which is why urea is listed separately and calculated according to a separate scheme.

6.1.3.5 Urea fertilization and liming (CO_2)

Due to the chemical structures of urea and carbonic acid lime, CO_2 emissions are also produced during fertilization and subsequent decomposition.

6.1.3.6 Fertilization Farmyard manure (N_2O)

Just like crop residues and nitrogenous fertilizers, farmyard manure and fermentation residues also contain nitrogen. When the fertilizer is applied to the field, some of the N is released as nitrous oxide emissions. In the WCFT, the N quantities of the animals and the N quantities in the purchased farmyard manure and fermentation residues are considered as a whole and are included in the calculation. If the farm sells farmyard manure, the amount of N is deducted proportionately. The spreading technique, the time of spreading and the incorporation of the fertilizer have an influence on the emissions from farmyard manure spreading.

6.2 Scope 2 - Indirect emissions

All processes listed in Scope 2 summarize those GHG emissions that arise from the provision of energy for agricultural operations.

6.2.1.1 Electricity consumption

Electricity generated by the farm's own solar and wind power plants, pyrolysis plants and biogas plants is recorded as climate-neutral. However, no additional emissions saved (e.g. by replacing coal-fired electricity) are included in the carbon footprint. Only the CO_2 footprint of the purchased electricity is recorded in the balance sheet of the agricultural business.

Electricity consumption includes the greenhouse gas emissions caused by the consumption of purchased electricity. These depend on the respective mix and can be composed very differently. If the information on the CO_2 footprint of the purchased electricity is not provided by the supplier (e.g. invoice, business documents, etc.), an average value for the respective country is assumed.

If it is not possible to differentiate between private and business electricity consumption on a farm with the help of the documentation, a realistic estimate by the farm manager is necessary. In this case, the private consumption must be deducted from the total consumption and a justification for the assumption must be provided. If it is not possible to check using existing documentation, a low degree of certainty is assumed.

6.2.1.2 Heat consumption

Heat production from biomass and solar energy does not cause any emissions relevant to the balance sheet and is therefore not taken into account. Heat production from the farm's own solar and wind plants, pyrolysis plants and biogas plants is not directly included in the carbon footprint. Generation using the above technologies is considered climate-neutral. Heat production from renewable energy is deducted from total heat consumption, thus reducing the amount of heat that is purchased or generated by burning fossil fuels. Only the CO_2 footprint of purchased heat and heat generated using fossil fuels is recorded in the farm's balance sheet. Heat consumption includes the greenhouse gas emissions caused by the consumption of purchased heat. These depend on the respective mix and can be composed very differently. If the information on the CO_2 footprint of the purchased heat is not provided by the supplier (e.g. invoice, business documents, etc.), an average value for the respective country is assumed.

If it is not possible to differentiate between private and business heat consumption on a farm with the help of the documentation, a realistic estimate by the farm manager is necessary. In this case, the private consumption must be deducted from the total consumption and a justification for the assumption must be provided. If it is not possible to check using existing documentation, a low degree of certainty is assumed.

6.3 Scope 3 - Other indirect emissions

Includes all other indirect greenhouse gas emissions caused by operational activities. If the resulting emissions/CO_2 footprints of the upstream supplier are known (e.g. emission-reducing or climate-neutral production), these values should be applied. This can be adjusted accordingly in the WCFT.

6.3.1 Wage labor

If some machines and equipment are not available on the farm, the corresponding work can be carried out by neighboring farms or contractors. The emissions generated in the process are charged to the farm using the service. The WCFT lists all common contract work in the agricultural sector. If a work is not listed, the work that is most similar to the actual work must be selected and a note added.

When goods are transported within the system boundary (e.g. to the farm´s own storage and processing facilities) by transport companies, the greenhouse gas emissions of the transport company are included in the calculation.

6.3.2 Purchased operating resources animal husbandry

Almost every livestock farm purchases various operational resources. The corresponding emissions are attributed to the farm that consumes the inputs. If inputs are purchased on stock, only the quantity consumed in the calculation year must be stated. Inputs in animal husbandry include feed, straw and silage films

6.3.3 Purchased operating resources crop production

The inputs taken into account for crop production are seeds, seedlings and planting material, as well as plastics used in the field and peat. If inputs are purchased on stock, then only the quantity that is consumed in the calculation year must be stated.

6.4 C-sinks

WCFS distinguishes between short-term and long-term C-sinks (see also Appendix 1). Short-term C-sinks are defined as growing biomass (forests, trees, hedges) and the build-up of organic material in the soil (humus). The application of biochar is regarded as a long-term C-sink.

6.4.1 Growing biomass

The operation must provide information on its growing perennial biomass. In this regard, the number of high- and lowstem trees, the forest area and the hectares (ha) of hedges must be stated. In addition, the use of the growing biomass must also be submitted to the VVB.

6.4.2 Humus balance

By building up the soil carbon stock, which is often bound in the form of humus, the farm has another option for building up short-term C-sinks. For this purpose, the WCFT offers the possibility of selecting various measures that have been scientifically proven to lead to a change in the soil carbon content. Information must be provided on the following points:

- Arable land that was converted to permanent grassland in the previous year
- Use of green manure on the farmland
- Arable land with catch crops
- Arable land with undersown maize and/or cereals
- Areas in which cereal straw and/or rapeseed straw have been incorporated

If the farm is involved in an existing humus cultivation project, it has the opportunity to provide information about these measurements.

6.4.3 Biochar as a C-sink

The amount of biochar used on the farm is required here. It is not taken into account whether it was used as an additive in the silage, feed additive, manure additive, in the compost or mixed with fertilizers. It is important to specify the dry matter of biochar applied. It is also relevant to state the biochar produced on the farm (in dry matter) and the certified C-sink potential by the Global Biochar C-Sink Standard of CSI in %. The C-sink can be certified and credited by the VVB. It is important that the Csink has not already been used elsewhere, which would result in double counting.

7. Reduction of GHG emissions

Agricultural businesses have a number of techniques at their disposal that can be used to reduce or avoid emissions in the production process. Alternatively, it is possible to store carbon on the farm. In the WCFT, this is recognised with a catalogue of measures that is made available to every certified farm after certification has been completed.

The measures can be selected in the WCFT and submitted to the VVB. The selection of measures has a direct impact on the recognition of the certificate. Some measures are directly preselected by the WCFT, which means that the farm has already applied these measures. By selecting certain other measures, the farm commits to apply them in the same year. The VVB reserves the right to monitor this and to impose sanctions in the event of violations (non-application of selected measures). The farm is supported by the project partner in the selection of measures.

7.1 Reduction measures

GHG emissions can be reduced through various emission-reducing measures. In addition to the reduced use of operating resources, the reduction or replacement of fossil materials and energy sources with renewable alternatives helps to improve the carbon footprint. There are also working practices and techniques that can specifically reduce emissions

7.2 C-sinks

There are various options for creating carbon sinks on farms. These include the management of forests, trees and hedges, as well as the creation of carbon reservoirs in the soil with humus or biochar.

A distinction is made between short-term and long-term C-sinks. In short-term C-sinks (humus, forests, trees and hedges), the bound CO_2 can be released again quickly over a period of a few years. The CSI's Global Biochar C-Sink certified biochar, which can either produced on site or purchased externally, is suitable as a long-term C-sink.

7.3 Selection of reduction measures

When selecting the reduction measures, the farm must prioritize working with emission-reducing measures and C-sinks within the borders of the farm itself in the first instance. Only if the processes for this are not technically or economically feasible, an acquisition of external certificates can be considered as a reduction measure.

7.4 Purchase of emission certificates

It should be possible to make operations climate-neutral by offsetting emissions externally. This is achieved by purchasing certified emission reductions or C-sinks. Only purchases of certificates from the Global C-Sink Registry are permitted for offsetting.

8. Exclusivity

The World Climate Farm Standard is an open system in which the farm can participate in various compensation projects. Both in the area of realized carbon sinks and in the area of reducing greenhouse gas emissions, various financial incentives and compensation options will be available today and in the future.

As part of the annual declaration of farm data, the farm or farming community must state which offsetting projects they are participating in and which measures are financially compensated each year and at what value.

In order to avoid double counting, these values are still shown in the World Climate Farm carbon footprint, but can no longer be certified as emission reductions or carbon sinks. VVB checks participation in such offsetting projects and ensures that only those services are certified that have not already been claimed and compensated for elsewhere.

9. World-Climate Farm Tool

Carbon Standards International (CSI) offers the World Climate Farm Tool (WCFT) for optimal and simple application of the WCFS. The data collection and calculation of the carbon footprints are carried out as follows:

1. The project partner prepares the operation in WCFT for data collection; as a rule, data already verified by external bodies is used (cantonal offices, control bodies, externally validated calculations on a verified data basis).

2. The project partner collects the data together with the farm. This can be done online or on site. In consultation and agreement with the VVB, data can also be collected independently by the farm (Figure 6). In this case, the farm receives an invitation and independently completes the missing data in WCFT online. The project partner sets a deadline by which the data record must be completed (Figure 7).

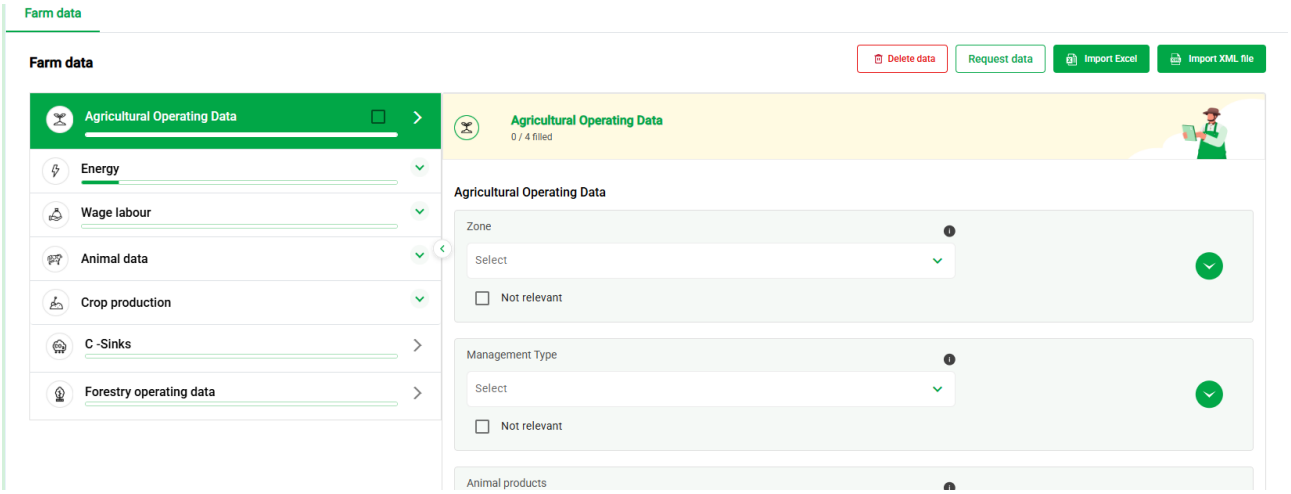

Figure5 : Illustration of the deadline

3. The data is then checked again, verified and the carbon footprint calculated. After successful completion, a certificate is issued. If the farm has entered the data independently, the data collection is completed with the "Submit data" button and the order is returned to the project partner and the VVB, where the verification is carried out.

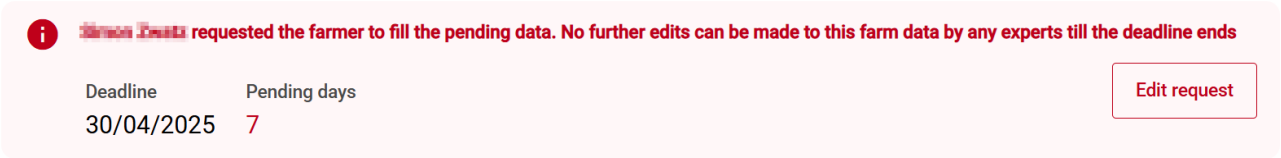

Figure6 : World-Climate Farm Tool

4. The farm receives its access to the WCFT by email. There they can view their results and download the certificate. Results are presented in tabular and graphical form and, in addition to highlighting potential for improvement, also allow anonymized comparisons between farms. Furthermore, the farm selects various measures and submits these in WCFT to the

VVB via the "Submit measures" button. A report of the selected measures is also available for download.

5. A new certificate is issued when a certain number of climate points are exceeded, immediately after the measures have been submitted (Figure 8).

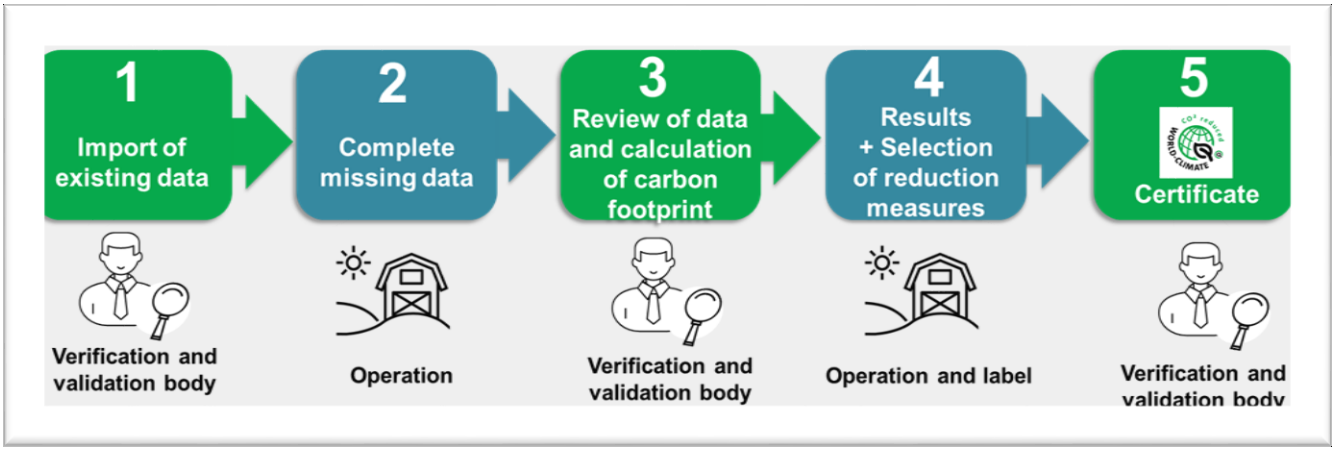

Figure7 : Climate balancing process

10. Greenhouse gas report

The GHG report consists of the carbon footprint and the indicators.

10.1 Carbon footprint

The result of the GHG declaration is presented in the carbon footprint. The carbon footprint is the result of the entire process. It consists of emissions on the one hand and carbon sinks on the other. The difference between them forms the balance. The certification is awarded differently depending on whether it is positive or negative and the measures applied.

The carbon footprint is presented in several tables and graphs, providing a high level of detail and information. This is done both, for the overall corporate carbon footprint and for the product carbon footprint. In the overall balance sheet, the emissions for the entire farm are presented according to various GHG, scopes, processes, etc. In the product carbon footprint, the emissions from the overall balance sheet are allocated properly to the animal and plant groups using an allocation key. The carbon sinks are also allocated proportionally

10.2 Performance indicators

In order to be able to compare the carbon footprint of different participating farms, performance indicators are calculated based on the results of the assessment. These include

- Net emissions from the calculated carbon footprint (in t CO_2e/year)

- Net emissions per agricultural area (in t CO_2e/ha/year)
- Net emissions per food produced (in kg CO_2e/kg/year)

The performance indicators are published in WCFT in anonymized form. The median value of all farms is also indicated. For each performance indicator, the calculated values of the farms are presented as a table and histogram.

11. Certificates and report

The verification of the WCFS, as well as the validation of the input values of the farms, are carried out by a CSI-recognized VVB. The certificates and balances issued by the VVB can be viewed directly in WCFT and exported as a report if required.

12. Certificate recognition

If the farm has been successfully verified, it can use the corresponding certificate to advertise its business or the products it manufactures, depending on its status. The farm can do this independently of the associated label.

Table4 : Labels

Label	Description
	The farm achieves the status "CO_2 evaluated" after a carbon footprint has been calculated and verified.
	The farm can achieve the status "CO_2 reduced" after a defined threshold of climate points has been reached through the application of measures. (By applying the measures, the farm undertakes to apply them. This can be controlled by the VVB and sanctions imposed in the event of non-compliance.
	A farm achieves "climate-neutral" status if its carbon footprint is ≤0 t CO_2e.

12.1 Label recognition

The use of labels and trademarks must comply with the CSI design manual published on the website.

The WCF label can be used for processing and trading operations and in the retail trade if the farms or farming communities are certified in accordance with the WCFS. As a rule, ≥ 75% of the label's farms must balance and be certified in accordance with the WCFS. By agreement with CSI and VVB, the number of farms can also be agreed individually. The basis for awarding the certificate are the certified farms of the regarding year. Respectively the total of all certified farms over the duration of the project. As with the individual farms, the label is initially awarded with the "CO_2 evaluated" certificate. If the farms of the label submit measures and the average climate points per farm exceed the threshold value, the "CO_2 reduced" certificate is awarded. If no measures are submitted by the farms, then no "CO_2 reduced" certificate can be issued. If the project runs over several years, roughly the same number of businesses should be calculated each year until all of them have been calculated in the final year.

Example: Project duration: 4 years, 100 farms, 25 farms are certified each year.

1. Year: 25 farms certified, total: 25 farms→ Label certificate based on these 25 farms.
2. Year: 26 farms certified, total: 50 farms→ Label certificate based on these 50 farms.
3. Year: 27 farms certified, total: 75 farms→ Label certificate based on these 75 farms.
4. Year: 28 farms certified, total: 100 farms→ Label certificate based on these 100 farms.

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Appendix 1

System boundaries

Greenhouse gas emissions

	Source	Gas	Explanation
Scope 1	Energy: fuels, heating oil, natural gas	CO2	emissions directly associated with agricultural activity. Private consumption is estimated and deducted
	Animal husbandry: Enteric fermentation	CH_4	Emissions from digestion
	Farmyard manure management	CH_4, N_2O	Emissions from the storage of farmyard manure
	Harvest residues	N_2O	emissions from nitrogen input from crop residues into the soil.
	Fertilization Mineral fertilizer	N_2O	emissions from nitrogen input from mineral fertilizers into the soil.
	Fertilizing urea	N_2O	emissions from nitrogen input through urea into the soil.
	Urea fertilization and liming	CO_2	Emissions from degradation of substances in the soil.
	Fertilizing farmyard manure	N_2O	Emissions from nitrogen input from farm manure into the soil. Includes biogas manure and biogas slurry, as well as purchased farm manure.
Scope 2	Power consumption	CO_2	emissions from purchased electricity. Own consumption from own production is deducted. Private share is excluded.
	Heat consumption	CO_2	emissions from the purchase of heat. Self-consumption through biomass and solar energy is considered CO_2-neutral. Private share is excluded.
Scope 3	Wage labor	CO_2	Emissions from contract work through use of the farm. Includes transportation of goods.
	Purchased operating resources Animal husbandry	CO_2	emissions during production from the purchase of inputs such as feed, straw and silage film.

	Purchased resources production	operating Crop	CO_2	emissions from the purchase of inputs such as seeds, seedlings, seedlings, plastics and peat.

Carbon sinks

	Source	Gas	Included?	Explanation
Baseline	Long-term C-sinks	CO_2e	Yes	The use of EBC-certified biochar can be regarded as a long-term C-sink. Long-term C-sinks are shown in the C-sink portfolio.
	Short-term C-sinks	CH_4	Yes	Woody biomass (forest, individual trees, hedges, etc.) and humus build-up can be regarded as short-term C-sinks. Short-term C-sinks can be used to compensate for methane emissions. Short-term C-sinks are also very important from a global warming perspective and are shown in the C-sink portfolio.