Carbonsafe carbon farming project – South region

PROJECT DESIGN DOCUMENT

FOR REPORTING OF REMOVED GREENHOUSE GAS EMISSIONS CARBON DIOXIDE (CO_2)

PROJECT TITLE	CARBONSAFE CARBON FARMING PROJECT – SOUTH REGION
PROJECT DEVELOPER	CARBONSAFE
PROJECT ID	CSBG-BG-S
COUNTRY	BULGARIA
SECTORAL SCOPE	AGRICULTURE
PROJECT TYPE	CARBON REMOVAL – SOIL ORGANIC CARBON (SOC) SEQUESTRATION
PROJECT START DATE	17/01/2023
CREDITING PERIOD	2023 - 2063
VERSION	1.0
DATE (DD/MM/YYYY)	05.11.2025

CONTENT:

1. PROJECT OVERVIEW

The Carbonsafe carbon farming project in the South region is developed and managed by Carbonsafe JSC, a company dedicated to advancing sustainable agriculture and climate solutions. Implemented in the Republic of Bulgaria, the project operates within the agriculture sector and is designed as a carbon removal initiative focused on the long-term sequestration of Soil Organic Carbon (SOC).

The project officially commenced on 17 January 2023 and is structured under a 40-year crediting period (2023–2063), during which its activities will generate verified climate benefits and carbon credits linked to measurable increases in soil carbon stocks.

Project Stakeholders:

- Carbonsafe JSC – project aggregator and manager
- Participating Bulgarian farmers
- Accredited Soil Sampling and Analysis Partners
- Independent Validation and Verification Bodies (VVBs)
- Methodology Developer
- Balkan Carbon Credit Standard (BCCS)

Grouped Project Structure:

The project is structured as a regional grouped project in which each farm represents a sub-project. Farms can be added progressively over time, provided they meet predefined eligibility criteria (land use, management practices, and ownership verification). This allows national scalability, cost efficiency, and standardized monitoring.

Project Developer Data:

CARBONSAFE JSC is a company registered in the Commercial Register at the Registration Agency on 17.11.2022 with UIC 207162188 and was transformed into a joint-stock company on 19.03.2025 with UIC 208222962

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2. PROJECT OBJECTIVES AND DESCRIPTION

2.1. Project Description & Activities

Synopsis.

Carbonsafe is a national carbon farming project that quantifies and issues high-integrity SOC removal credits based solely on direct, geo-referenced soil measurements taken annually on every enrolled plot. The project accelerates adoption of regenerative practices (reduced tillage, diversified rotations, cover crops, optimized nutrient management, and organic amendments) across Bulgarian croplands to remove atmospheric CO_2 and store it as stable organic carbon in soils. Credits are issued ex-post only after measured SOC gains are independently verified by an accredited VVB and registered on BCCR with full plot-level traceability.

2.1.1. Grouped project architecture.

The PDD covers South region in Bulgaria and operates as a grouped project. Each participating farm is a sub-project with its own geo-boundaries, baselines, monitoring records, and issuance ledger. New farms may join over time if they meet predefined eligibility and additionality criteria. This architecture enables scale while preserving per-farm accountability, transparency, and serial-number traceability.

2.1.2. Measurement and MRV.

Carbonsafe applies a standardized sampling design implemented by a specialized field team. Each farm is divided into smaller plots (cells) ≤25 ha. Within each cell, 25 drills are performed in a diagonal/zig-zag pattern, at three depth layers (0–30, 30–60, 60–90 cm), collecting in total 75 soil cores. These are then composited into one representative soil sample for each depth. Samples are taken every year on the same geo-referenced cell using an automatic GPS-enabled probe. Sampling tracks (ATV traces) are logged digitally. Samples are analyzed by ISO/IEC 17025-accredited laboratories with a QA/QC protocol. SOC stocks are computed using bulk density and depth-explicit compositing. All field, lab, and issuance data are managed in a secure ERP/digital MRV system with audit trails and role-based access.

2.1.3. Baseline and additionality.

The baseline reflects prevailing conventional practices absent carbon-farming incentives (e.g., conventional tillage, limited cover cropping). Adoption of the project's regenerative measures is not business-as-usual in the regional and national context and faces financial and behavioral barriers. Additionality is demonstrated through practice change documentation, management history, and farmer contracts committing to new or strengthened regenerative measures beyond baseline norms.

2.1.4. Quantification boundary and gases.

The GHG accounting boundary includes net CO_2 removals via SOC stock change in agricultural soils to 90 cm.

2.1.5. Issuance and buffers (durability risk management).

Credits are issued ex-post after verification. To prudently manage year-to-year variability and potential reversals, Carbonsafe applies a conservative issuance policy: by default, 25% of verified net removals are issued, while 75% are retained in a sub-project reserve. Subject to positive farm balance in next monitoring period, reserve is released; conversely, reserves are used to cover negative results in the sub-project's balance in the final year of its crediting period. Reversal liability, response actions, and make-good provisions are defined contractually and operationalized through the reserve and monitoring system. Additionally, a 5% buffer pool on all credits is collected to cover for climate and force majeure incidents.

2.1.6. Leakage, non-permanence, and risk.

Because the project changes on-farm practices without reducing production area, activity-shifting and market leakage risks are low. Non-permanence risks (e.g., drought, erosion, management reversion) are mitigated through annual re-measurement, farmer training, agronomic advisory, and both the reserve and the buffer pool.

2.1.7. Stakeholders, safeguards, and justice.

Upon initiation, the project strives to avoid or mitigate any impacts on marginalized or proximate communities or culturally/ecologically significant lands. Benefit-sharing is transparent; farmers receive carbon credits revenue, complemented by annual agronomic recommendations derived from the full soil panel (macro/micro-nutrients, pH, etc.), improving yields, input efficiency, and resilience.

2.1.8. Data integrity, transparency, and registry.

All credits are traceable to the exact farm, and vintage on BCCR, with public-facing serials and issuance logs. The digital MRV stack supports information security best practices, and comprehensive auditability (field tracks, GPS points, chain-of-custody, lab Certificate of Analysis (COAs), QC records, calculation workbooks, and VVB findings).

2.1.9. Project management capacity (Project developer/sub-projects)

Management capacity

The management capacity in the Carbonsafe project is presented in two aspects: the management capacity of the developer (the organization that manages and coordinates the project) and the management capacity of the individual farms participating in the project.

- ✓ Developer Management Capacity: Project developer Carbonsafe has strong leadership and an effective organizational structure to support the implementation of the program. This includes specialized experts in agriculture, climate and sustainable development to provide the necessary scientific expertise and advice to project participants. The developer must also have a data and information management system in place to support the collection, analysis and reporting of carbon sequestration data and other relevant parameters.
- ✓ Farm/sub-project management capacity: To successfully participate in the program, farms must have management skills and the ability to implement/improve new farming practices. They are able to extract and analyze their soil and plant data and apply the project's proposed methods and technologies to increase carbon sequestration. Developer support, including training, consultancy and financial incentives, is essential to strengthen farm management capacity.

The successful management of the Carbonsafe project requires cooperation and synergy between the developer and the participating farms, and both stakeholders must have the necessary capacity and resources to achieve the overall objectives of the project.

Project developer ISO certification

Quality Management Systems

Certificate No: GIBP-0157-QC

Services for sampling, measuring, improving and reporting the level of carbon sequestered in soil, in the agricultural sector. Preparation of agronomic recommendations and individual strategies to improve agricultural practices. Maintenance of documentation for the implementation of projects under the carbon farming program, for the issuance of carbon credits.

ISO 14001:2015

Environmental Management Systems

Certificate No: GIBP-0157-EC

Services for sampling, measuring, improving and reporting the level of carbon sequestered in soil, in the agricultural sector. Preparation of agronomic recommendations and individual strategies to improve agricultural practices. Maintenance of documentation for the implementation of projects under the carbon farming program, for the issuance of carbon credits.

2.1.10. Project developer and sub-projects operating costs

Project developer

A team of qualified specialists, specialized software and technical equipment are used for the implementation of the activities.

- ✓ Personnel costs: Includes salaries for developer staff, including managers, agricultural and climate specialists, administrative staff, etc.
- ✓ Administrative costs: Reflect the costs of administrative services, office rent, utilities, office equipment, etc.
- ✓ Transportation costs: Includes the costs of transporting personnel, materials and equipment, as well as organizing meetings and events.
- ✓ Marketing and Public Relations: Covers the cost of marketing and PR activities that help promote the project and attract new farm participants.

Sub-projects/farms

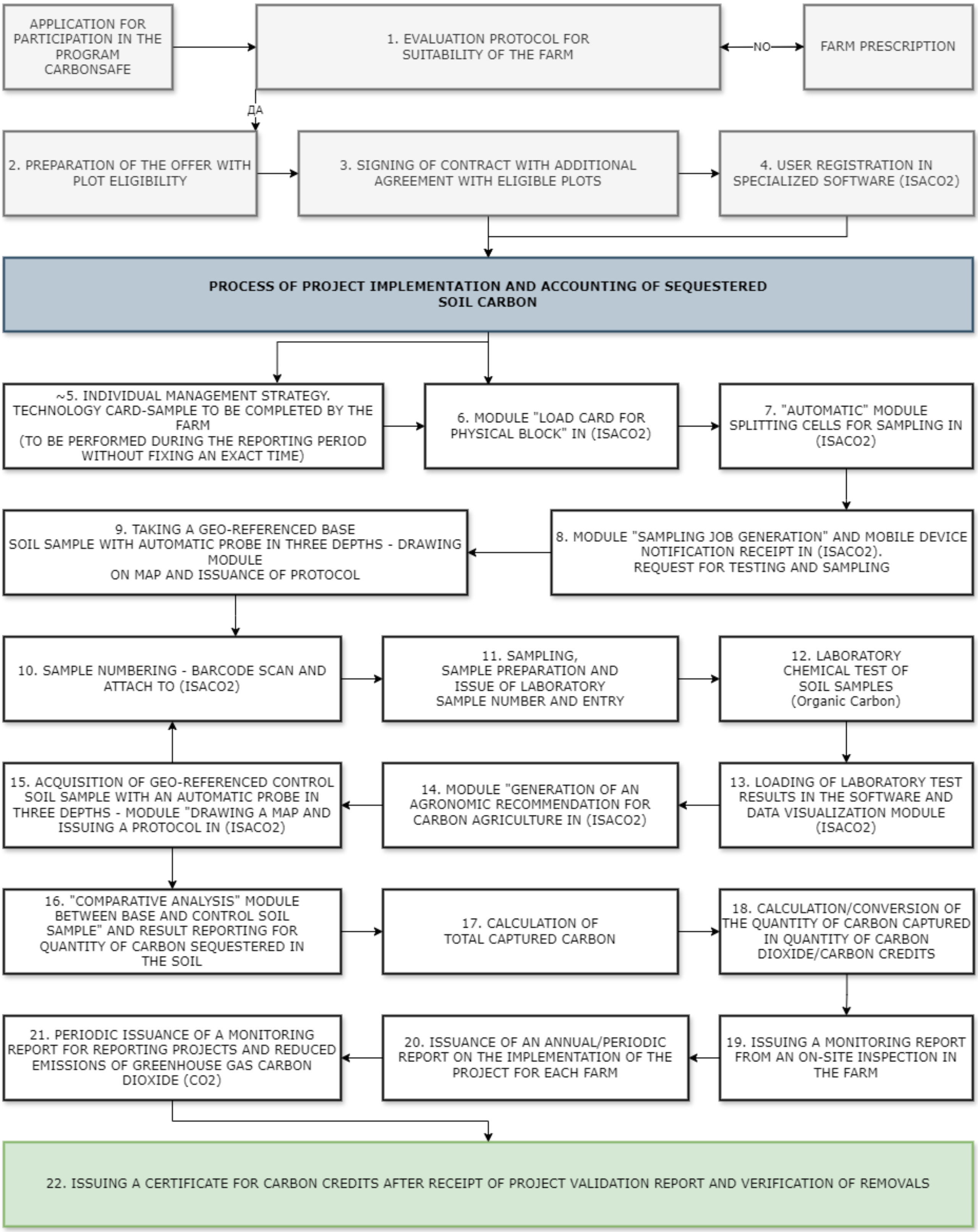
For the implementation of the activities, farms' equipment and labor need to be considered.

- ✓ Materials and equipment: Includes the cost of purchasing materials such as seeds, fertilizers, soil additives and specialized equipment to implement/improve the new sustainable farming practices.
- ✓ Labor costs: Cover labor costs associated with the implementation/improvement of new agricultural methods and technologies, including wages for workers and farm owners.

2.1.11. Expected outcomes.

The project is expected to deliver verifiable net CO_2 removals and measurable co-benefits: improved soil health and biodiversity, increased water retention and drought tolerance, reduced fertilizer and pesticide use, and enhanced farmer livelihoods.

2.1.12. Process Flowchart



2.1.13. Summary of Project Risks and Mitigation Strategies

Risk Category	Risk Description	Potential Impact	Mitigation Strategy
1. Climate & Environmental Risk	Droughts, floods, or erosion may reduce SOC gains or cause reversals.	Loss of sequestered carbon and lower credit issuance.	Annual SOC measurement and remeasurement; 75% performance reserve; 5% project-wide buffer pool; adaptive agronomic guidance; erosion control via reduced tillage and cover crops.
2. Agronomic Risk	Transition from conventional to regenerative farming may cause yield fluctuations or management failures.	Temporary income loss or project withdrawal.	Tailored agronomic support; annual soil diagnostics; flexibility policy for temporary tillage or rotation changes; carbon revenues as financial buffer.
3. Market and Price Risk	Volatility in voluntary carbon market prices or demand.	Revenue uncertainty for farmers and project.	Conservative issuance (25% ex-post); potential offtake contracts; alignment with international standards; transparency to buyers.
4. Data & MRV Risk	Sampling errors, lab inconsistencies, or data corruption in digital MRV system.	Over/underestimation of removals; loss of credibility.	Accredited ISO/IEC 17025 labs; 5% uncertainty deduction; QA/QC at field, lab, and data levels; secure ERP with audit trails; third-party verification.
5. Permanence & Reversal Risk	SOC losses due to land-use change, poor management, or force majeure.	Carbon re-emission; reversal liabilities.	Sub-project performance reserves; reversal coverage; annual monitoring; contractual penalties for dropout; empirical detection via MRV.
6. Leakage Risk	Activity shifting (new land cultivation elsewhere) due to	Net emissions increase beyond project boundary.	Yield-protective agronomy (nutrient optimization, residue cover); monitoring of

Risk Category	Risk Description	Potential Impact	Mitigation Strategy
	yield drop.		yield and land-use data; compliance with land-use regulations.
7. Financial & Behavioral Risk	Lack of capital, short leases, or farmer reluctance to change practices.	Low adoption or discontinuation of regenerative practices.	Aggregation model reduces costs; revenue-sharing; tenure verification; behavioral incentives through direct income; targeted training.
8. Operational & Organizational Risk	Land tenure disputes, farm ownership changes, or poor coordination.	Contractual breaches; loss of traceability.	Land-rights due diligence; legally binding 5-year renewable contracts; sub-project register with unique identifiers; due diligence on ownership changes.
9. Social & Community Risk	Community conflicts, access restrictions, or nuisance from field operations.	Reputational damage; stakeholder opposition.	FPIC and voluntary participation; grievance mechanism (5-day response, 30-day resolution); annual engagement meetings; route planning to reduce nuisance.
10. Health, Safety & Labor Risk	Accidents during soil sampling or unsafe agrochemical use.	Worker injury or legal non-compliance.	OHS plan with PPE, ATV training (contractors), IPM adoption recommendations; adherence to ILO Core Standards; confirmation of adherence to H&S and Labor laws by farmers
11. Legal & Regulatory Risk	Non-compliance with land, CAP, or Natura 2000 regulations.	Project suspension or loss of eligibility.	Compliance screening at enrolment; internal compliance audits; alignment with national law.
12. Data Privacy &	Unauthorized access or misuse of	GDPR violations; loss	Role-based access in ERP; defined

Risk Category	Risk Description	Potential Impact	Mitigation Strategy
Integrity Risk	personal/farm data.	of trust.	retention limits; GDPR-compliant data processing; registry transparency balanced with privacy.
13. Corruption or Conflict of Interest Risk	Potential collusion between project entities or misuse of funds.	Reputational and financial loss.	KYC controls; disclosure of conflicts (developer, verifier, registry); grievance mechanism; contractual duties.

2.2. Climate Objective.

The overarching climate objective of the Carbonsafe project is to contribute to the global effort of mitigating climate change by delivering measurable, durable, and verifiable carbon dioxide removals from the atmosphere. The project achieves this by increasing the stock of Soil Organic Carbon (SOC) in agricultural soils through the implementation of regenerative agricultural practices across Bulgaria. By systematically replacing conventional, input-intensive farming practices with regenerative approaches such as reduced tillage, cover cropping, diversified crop rotations, and the use of organic amendments, the project enhances the natural capacity of soils to capture and store atmospheric carbon in a long-term and stable form.

The project is designed as a large-scale, regionally distributed initiative, structured as a grouped project under a single Project Design Document (PDD). Carbonsafe, acting as the project developer and aggregator, coordinates the participation of multiple farms across South region, Bulgaria. Each farm is treated as a sub-project with its own boundaries, monitoring, and issuance records. This structure ensures that removals are quantified and attributed with precision at the farm level while maintaining the efficiency of a unified monitoring and reporting framework.

The climate benefits of the project are quantified through a measure–remeasure approach based entirely on physical soil sampling. Carbonsafe applies a 100% sampling protocol, under which every farm is divided into plots of no more than 25 hectares. Within each and every plot, geo-referenced soil samples are collected annually, following a zigzag or diagonal pattern, and composited into representative samples for three distinct depth layers. Laboratory analyses are carried out in accredited facilities, producing results that measure SOC content and other relevant soil parameters with full scientific reliability. The annual repetition of this process on the same geo-referenced plots ensures methodological rigor and comparability over time.

The project issues only ex-post credits, meaning that credits are generated solely for removals that have already been achieved, monitored, verified, and certified by an independent third-party Validation and Verification Body (VVB). This principle guarantees that buyers receive only high-integrity credits backed by actual removals, thereby avoiding risks associated with forward-looking or model-based crediting. In addition, the project applies a conservative issuance policy. In this way, the project not only safeguards permanence against the risk of reversal but also builds additional credibility in line with best practices and high-quality carbon credit criteria.

In addition, the project contributes to multiple Sustainable Development Goals (SDGs), including SDG 13 (Climate Action), SDG 15 (Life on Land), SDG 12 (Sustainable Consumption) and SDG 2 (Zero Hunger). Co-benefits include improved soil fertility and water retention, enhanced biodiversity through diversified cropping systems, reduced reliance on synthetic inputs, and strengthened resilience of rural communities. Farmers receive direct financial rewards from the sale of carbon credits, creating sustainable livelihoods and incentivizing long-term adoption of regenerative practices.

The minimum projected removals are estimated at an average of 3–10 tonnes of CO_2 per hectare per year, depending on baseline soil conditions, crop types, and management practices. The permanence of stored carbon is expected to last decades under continuous regenerative management, supported by the contractual obligations of participating farmers and Carbonsafe's agronomic advisory services. Monitoring is carried out annually throughout the renewable crediting period of five years, which may be extended upon re-validation.

The climate objective of Carbonsafe is to deliver scientifically robust, transparent, and socially inclusive carbon removals from agriculture in the Region of South, Bulgaria. Through its rigorous design, reliance on 100% direct measurement, conservative issuance practices, and integration with regional and international standards, the project ensures that every issued credit represents genuine, additional, and durable climate impact.

2.3. Agronomic Objective.

The agronomic objective of the Carbonsafe project is to fundamentally improve the long-term productivity, fertility, and resilience of agricultural soils in Bulgaria through the systematic adoption of regenerative farming practices. By prioritizing the restoration of soil health, the project not only achieves measurable climate benefits through carbon sequestration but also delivers immediate and sustained agronomic co-benefits to farmers. These benefits directly support food security, optimize resource use, and improve the economic viability of farms engaged in the project.

At its core, the project seeks to reverse the trend of soil degradation that has resulted from decades of intensive, conventional agricultural practices characterized by frequent plowing, monocropping, and heavy reliance on synthetic fertilizers and pesticides. Such practices have depleted soil organic matter, reduced biodiversity, disrupted soil structure, and diminished water retention capacity, leaving farms vulnerable to droughts, floods, and yield variability. Carbonsafe addresses these challenges through regenerative approaches that rebuild soil organic matter, restore microbial activity, and enhance nutrient cycling, thereby transforming soils into living, resilient systems.

The agronomic objectives are operationalized through the following project activities:

1. Soil Health Restoration and Fertility Enhancement.

The project increases soil organic matter and improves soil nutrient availability through practices such as reduced or no tillage, use of cover crops, diversified crop rotations, and organic amendments (e.g., compost, manure, and crop residues). These practices enhance the natural capacity of soils to retain and cycle macro- and micronutrients, reducing the dependency on synthetic fertilizers while improving crop yields. Carbonsafe's unique feature of annual soil sampling provides a full nutrient profile (N, P, K, S, Ca, Mg, and trace elements), enabling the delivery of precise, site-specific agronomic recommendations for each 4-25ha plot to each participating farm.

2. Water Management and Drought Resilience.

By improving soil structure and organic matter content, the project enhances water infiltration and retention. Soils under regenerative management exhibit higher porosity and moisture-holding capacity, reducing the risks of erosion and runoff while strengthening resilience to climate extremes. This directly improves farm stability and reduces risks associated with water scarcity, a growing challenge under the impacts of climate change.

3. Yield Optimization and Input Efficiency.

Participating farmers benefit from optimized fertilizer and input use, as annual soil analyses allow precise nutrient management. Early project data and global best practices suggest that regenerative practices can improve yields by 5–15% over the medium term, while simultaneously reducing fertilizer costs by 10–50% due to improved nutrient-use efficiency. This dual benefit of increased productivity and reduced input costs significantly improves farm economics.

4. Soil Biodiversity and Ecosystem Services.

The project fosters soil biodiversity by promoting microbial diversity, earthworm populations, and root-soil interactions. These biological processes are essential for long-term soil fertility, organic matter stabilization, and pest and disease suppression. By integrating biodiversity into soil management, Carbonsafe enhances ecosystem services beyond the carbon metric, contributing to the overall sustainability of agriculture in Bulgaria.

5. Farmer Capacity-Building and Knowledge Transfer.

Carbonsafe provides farmers with science-based agronomic recommendations derived from laboratory results and project monitoring. These recommendations are communicated annually and are tailored to each 4-25 ha plot, ensuring actionable guidance for improving soil fertility, reducing inputs, and optimizing crop rotations. Farmers also receive training in regenerative practices, which enhances their agronomic knowledge and empowers them to become active stewards of soil health.

The agronomic objectives of the project are fully aligned with broader European agricultural and environmental strategies, such as the EU's Common Agricultural Policy (CAP). By combining carbon sequestration with direct agronomic benefits, the project delivers a synergistic model in which climate goals and farm productivity reinforce one another.

Furthermore, the project ensures that the agronomic benefits are equitably distributed among farmers, strengthening local food systems and promoting sustainable livelihoods. Farmers retain ownership of their carbon results and receive financial rewards through the sale of credits, while simultaneously benefiting from improved soil health and lower production risks. This dual reward system — agronomic and financial — incentivizes long-term adoption of regenerative practices well beyond the crediting period.

The agronomic objective of Carbonsafe is to establish a self-reinforcing cycle of soil regeneration, improved yields, reduced input dependency, and enhanced climate resilience. These outcomes not only secure the long-term productivity of Bulgarian agriculture but also create a replicable model for integrating carbon markets with sustainable agronomic development at scale.[1][2][3]

2.4. Community Objective.

The Carbonsafe project is designed not only as a climate mitigation initiative but also as a project for strengthening rural communities and improving the socio-economic resilience of farmers in Bulgaria. Beyond carbon removals, the project seeks to ensure that farmers and their communities are the primary beneficiaries of the transition to regenerative agriculture, in line with international expectations for environmental justice and equitable benefit-sharing.

Carbonsafe's community objective is a commitment to fairness and transparency. Each participating farmer retains individual ownership of the carbon credits generated on their land, and revenues from credit sales are shared directly with them, with 50–60% allocated to farmers, or as specified in individual agreements between the farmer and the buyer/investor. This ensures that those who manage the land and implement regenerative practices are the ones who receive the primary financial benefits. By acting as an aggregator, Carbonsafe lowers the entry barriers for smallholder and family farms, who would otherwise lack access to global carbon markets due to high transaction costs and complex compliance requirements.

[1] Chenu, C., Angers, D. A., Metay, A., Pellerin, S., & Soussana, J. F. (2023). Soil carbon and yield trade-offs in agriculture: A global review. *Nature Sustainability, 6*, 1124–1134. https://www.irancan.org/wp-content/uploads/2023/07/Soil-carbon-and-yield-s41893-023-01131-7.pdf
[2] Wang, Y., Liu, X., Smith, P., Li, J., Wang, X., Chen, Y., ... & Zhang, W. (2024). Global cropland soil carbon sequestration potential and its sustainability. *Nature Communications, 15*, Article 54536. https://doi.org/10.1038/s41467-024-54536-z
[3] Paustian, K., Lehmann, J., Ogle, S., Reay, D., Robertson, G. P., & Smith, P. (2024). Climate change mitigation through soil carbon management: Prospects, barriers and policy frameworks. *Ecological Economics, 214*, 107030. https://www.sciencedirect.com/science/article/abs/pii/S0378429024000960

In addition to direct revenues, the project delivers annual agronomic benefits to farmers. Through 100% physical soil sampling and comprehensive laboratory analysis, Carbonsafe provides detailed insights not only into changes in soil organic carbon but also into key agronomic indicators such as nitrogen, phosphorus, potassium, pH, and micronutrients. This data is translated into individualized recommendations, enabling farmers to optimize fertilizer use, improve crop yields, and reduce input costs. In this way, carbon farming becomes not only a source of additional income but also a driver of improved farm efficiency and long-term soil health.

The project also strengthens community resilience against climate change and economic volatility. By improving soil moisture retention, enhancing soil organic matter, and diversifying agricultural practices, farmers are better able to withstand droughts, floods, and market shocks. These improvements reduce dependency on external inputs and build stronger, more sustainable rural livelihoods.

Beyond the individual farm level, Carbonsafe creates broader community co-benefits. Health and safety risks are minimized as regenerative practices reduce reliance on synthetic agrochemicals. Food security is strengthened through improved soil fertility and sustainable production, while biodiversity and water systems benefit from reduced tillage, cover cropping, and organic amendments. The project has an ongoing conversation with farmers and stakeholders from the early stages to ensure transparency and procedural fairness.

Carbonsafe adheres to a strict “Do-No-Harm” framework. Only landowners or legal land users with verified rights are eligible to participate, preventing land tenure conflicts or displacement. Environmental justice is central to the project design, ensuring that communities who are most vulnerable to climate risks and economic instability are the ones who experience direct improvements in their livelihoods.

In the long term, Carbonsafe’s community objective is to create systemic benefits that extend beyond the lifetime of the project. By embedding knowledge, technical skills, and regenerative practices at the farm level, the project ensures that improvements in soil health and community well-being persist even after crediting periods conclude.

Through this comprehensive approach, Carbonsafe demonstrates that carbon farming can serve not only as a climate solution but also as a pathway for rural empowerment and sustainable development. The Community Objective therefore reinforces Carbonsafe’s position as a project that integrates environmental, social, and economic benefits, setting a benchmark for transparency and community inclusion in soil carbon projects.

3. PROJECT BOUNDARY AND GEOGRAPHIC SCOPE.

3.1. Geographic Boundary.

The geographic boundary of the Carbonsafe project for South Bulgaria encompasses all enrolled agricultural lands within the southern half of the country across the South-West, South-Central and South-East belts. This grouped area includes lands for example in Sofia Province (rural province, excluding the capital), Plovdiv, Yambol, and Burgas—with each field mapped and geo-referenced at plot level—and extends to adjacent southern provinces under the same agro-ecological continuum. This grouping reflects a coherent set of farming systems spanning inland plains, peri-urban valleys, foothills, and coastal lowlands.

Landscape zones and soils: South Bulgaria integrates several major agro-landscapes:

- The Upper Thracian Plain (Plovdiv), characterized by extensive arable land on fertile Chernozems and Alluvial/Fluvisols, historically managed under intensive tillage and simplified rotations.
- The South Valley and surrounding foothills (South Province), a mosaic of Chernozems, Cambisols, and valley Fluvisols/Alluvials, with peri-urban pressures and mixed farm sizes.

- The Lower Thracian Plain and hilly margins (Yambol), where Chernozems/Leached Chernozems grade into Cambisols/Luvisols on rolling terrain with higher erosion sensitivity.
- The Black Sea coastal and inland plains (Burgas), combining fertile lowlands (Chernozems, Fluvisols) with sandy coastal soils and Luvisols/Cambisols in Strandzha and Eastern Balkan foothills.

Climate envelope: The grouped area spans continental to continental-Mediterranean regimes with maritime influence along the coast. Typical ranges across the enrolled provinces are:

- Mean annual temperature: ~9–13 °C (cooler in South Valley; warmer in Plovdiv/Yambol; warmest on the Burgas littoral).
- Annual precipitation: ~480–700 mm, unevenly distributed, with wetter springs/autumns and hot, drier summers that elevate drought and heat-stress risk in crop systems.

These gradients shape management risks (summer soil-moisture deficits inland; wind/salinity risks near the coast) and underpin the project's emphasis on residue retention, cover, and reduced disturbance to build soil water-holding capacity and SOC.

Hydrology: Key river systems intersect the boundary and influence irrigation potential and moisture dynamics: the Maritsa and tributaries in the Thracian Plain; the Iskar system in South Province; the Tundzha network in Yambol; and multiple Black Sea–draining rivers (Aytoska, Ropotamo, Fakiyska) across Burgas. Legacy but uneven irrigation infrastructure and competing water uses heighten the importance of on-farm infiltration and retention practices.

Topography: South Bulgaria's agricultural lands range from flat to gently undulating plains (≈100–300 m a.s.l.) in Plovdiv, Yambol and inland Burgas, through coastal lowlands (≈100–200 m) in Burgas, to valley floors at ≈500–600 m with surrounding foothills in South Province. Erosion risks rise on sloping uplands and foothill margins, reinforcing the need for conservation tillage, cover, and contour-aware field operations.

Crops and farm structure: Across the grouped area, farms range from smallholder plots (2–15 ha) in peri-urban or hilly municipalities to consolidated holdings (>150–200 ha) in the plains. Dominant crops include winter wheat, maize, sunflower, barley, and rapeseed, with potatoes/vegetables (South peri-urban, Samokov), and vineyards/orchards in selected pockets (Yambol, Burgas). This diversity enables tailored regenerative rotations and year-round soil cover strategies.

Socio-economic rationale: Agriculture remains pivotal to rural livelihoods across South Bulgaria, yet faces low profitability, subsidy dependence, land fragmentation or consolidation pressures, and limited access to innovation—especially pronounced in peri-urban belts and coastal/hilly municipalities. By enrolling fields under a unified MRV and practice framework, Carbonsafe targets climate-vulnerable yet strategically important farming communities, aligning with national/EU climate and agricultural strategies.

Formal boundary statement: The geographic boundary for South Bulgaria is defined as the entirety of enrolled, geo-referenced agricultural fields within the participating southern provinces (initially including Sofia Province, Plovdiv, Yambol, and Burgas), representing a cross-section of the region's most productive yet climate-exposed soils and cropping systems. This grouped boundary supports consistent regenerative practice deployment and annual SOC measurement at scale, while respecting provincial administrative limits and field-level eligibility rules.

Notes on mapping and enrollment: All participating farms are digitally mapped at field level, with parcel IDs, coordinates, fixed sampling plots, and cadastral alignment; expansions to additional southern provinces follow the same geo-referenced protocols and eligibility screens to preserve methodological consistency across the South Bulgaria grouped area.[4][5][6][7][8][9][10][11]

3.1.1. Regional Allocation of Farms with Multiple Plots

In certain cases, an individual farm participating in the project may consist of agricultural plots located in two or more distinct project regions. In such instances, each plot is allocated to the respective regional project according to its geographic location and regional classification. The farm as a whole is therefore included in more than one regional sub-project, with each plot subject to the applicable Monitoring, Reporting, and Verification (MRV) procedures of the region in which it falls.

This approach ensures that:

- Emission reductions and removals are attributed accurately to the corresponding regional baseline and additionality conditions.
- Monitoring and soil sampling are implemented consistently with the stratification of each region.
- The integrity of credit issuance is maintained by preventing double counting while enabling full participation of farms with diverse landholdings.

The project registry and MRV system are designed to manage such cases transparently, so that each plot is tracked, verified, and credited within its relevant region.

3.2. Technical Boundaries.

The technical boundary of the Carbonsafe project for South region, Bulgaria defines the greenhouse gas (GHG) sources, sinks, and reservoirs (SSRs) included in the accounting system, as well as the physical soil parameters, management practices, and measurement approach applied to quantify carbon sequestration. This boundary ensures that all relevant carbon fluxes

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[4] FAO – Land Degradation in Bulgaria
Food and Agriculture Organization of the United Nations (FAO). (2000). *Land degradation in Bulgaria*. In *Land Resources Information Systems in Central and Eastern Europe* (Chapter 4). Rome: FAO. Retrieved from https://www.fao.org/4/y0785e/y0785e04.htm

[5] Regional Development Strategy of Sofia Region (2014–2020)
Oblastna administratsia Sofia. (2013). *Oblastna strategiya za razvitie na oblast Sofia 2014–2020* [Regional Development Strategy of Sofia Region 2014–2020]. Regional Administration – Sofia. Retrieved from https://sofoblast.bg/wp-content/uploads/OSR_2014-2020_SO_final__17_10__2013.pdf

[6] Quaternary Deposits of the Alluvial Rivers in Sofia Basin
Kojumdgieva, E., & Nakov, R. (2017). *Quaternary deposits of the alluvial rivers in Sofia Basin. Annual of the University of Mining and Geology "St. Ivan Rilski,"* 60(1), 79–83. Retrieved from https://www.researchgate.net/publication/315444915_Quaternary_deposits_of_the_alluvial_rivers_in_Sofia_Basin

[7] SUWANU Europe. (n.d.). *Case study: Plovdiv, Bulgaria*. Retrieved September 29, 2025, from https://suwanu-europe.eu/plovdiv-bulgaria/

[8] Regional Forestry Development Plan – Yambol Region (2025)
South-East State Enterprise – Sliven. (2025). *Oblasten plan za razvitie na gorite v oblast Yambol* [Regional Forestry Development Plan for Yambol Region]. Executive Forest Agency, Ministry of Agriculture and Food of the Republic of Bulgaria. Retrieved from https://sliven.iag.bg/data/docs/OPRGT_Yambol__7_2025.pdf

[9] Regional Directorate of Agriculture – Yambol: History and Structure
Ministry of Agriculture and Food of the Republic of Bulgaria. (n.d.). *Istoriya i struktura na Oblastna direktsiya "Zemedelie" – Yambol* [History and Structure of the Regional Directorate of Agriculture – Yambol]. Retrieved October 2025, from https://www.mzh.government.bg/odz-yambol/bg/Structure/History.aspx

[10] National Statistical Institute – Land Use in Bulgaria (2021)
National Statistical Institute of the Republic of Bulgaria (NSI). (2022). *Izpolzvane na zemedelskite zemi i kategorii zemya – Balgariya, 2021* [Land Use and Agricultural Land Categories – Bulgaria, 2021]. Territorial Statistical Bureau – Burgas. Retrieved from https://www.nsi.bg/tsb/wp-content/uploads/2022/08/Landuse-2021-brgs.pdf

[11] Basin Directorate for Water Management in the Black Sea Region – River Basin Management Plan (2022–2027)
Basin Directorate for Water Management in the Black Sea Region (BSBD). (2021). *Plan za upravlenie na rechnite baseyni 2022–2027 – Razdel 1: Obsto opisanie na rechnite baseyni* [River Basin Management Plan 2022–2027 – Section 1: General Description of the River Basins]. Ministry of Environment and Water of the Republic of Bulgaria. Retrieved from https://www.bsbd.bg/PURB/2022-2027/FINAL/Razdel_1/%D0%A0%D0%B0%D0%B7%D0%B4%D0%B5%D0%BB%201_fin.pdf

are captured, while maintaining scientific integrity, transparency, and consistency with internationally recognized methodologies.

3.2.1. GHG Covered.

The project accounts for carbon dioxide (CO_2) removals associated with the sequestration of atmospheric carbon into Soil Organic Carbon (SOC) pools. SOC is the primary reservoir monitored within the boundary, representing stable, long-term carbon storage in agricultural soils.

3.2.2. Spatial Boundary of Measurement.

Within each participating farm in South Region, land is subdivided into plots of up to 25 hectares. Each plot is geo-referenced and remains fixed throughout the project crediting period. Within each plot, 25 soil cores (drills) are collected annually, each at three standardized depth layers: 0–30 cm, 30–60 cm, and 60–90 cm. Then 3 representative samples are formed for the 3 depths. These depth-specific samples ensure that changes in both topsoil and subsoil carbon stocks are fully captured within the project boundary.

3.2.3. Soil Reservoirs and Pools Included:

1. Soil Organic Carbon (SOC) within the 0–90 cm depth profile, measured annually.

3.2.4. Soil Reservoirs and Pools Excluded:

1. Aboveground and belowground biomass (outside of soil pools), since the project focuses exclusively on SOC removals.
2. Dead organic matter (e.g., litter), as these pools are not directly measured under the project design.
3. Non-CO_2 GHGs (N_2O, CH_4)

3.2.5. Baseline and Project Scenarios

Baseline Scenario: Conventional agricultural practices typical of Bulgaria, including deep plowing, monocropping, heavy reliance on synthetic fertilizers, and limited use of cover crops. Under this scenario, SOC levels remain stable or continue to decline.

Project Scenario: Regenerative agriculture practices such as reduced or no tillage, crop diversification, cover cropping, organic amendments, and precision nutrient management. These practices enhance carbon sequestration by increasing biomass inputs, improving soil structure, and reducing oxidation of soil carbon.

3.2.6. Time Boundary (Crediting Period).

The monitoring and accounting boundary is a total of 40 years, which includes a 5-year individual farms renewable crediting periods, with annual measurement cycles. Credits are issued only ex-post, following independent verification of SOC increases. This ensures that only actual, measured removals are included within the technical boundary.

3.2.7. Conservativeness.

The project explicitly includes conservative issuance rules applied (e.g., holding back 75% of verified net removals in a reserve on a sub-project level, released upon positive farm balance results in next monitoring period.). This ensures that uncertainty is actively incorporated into crediting outcomes.

3.2.8. Leakage Considerations.

Activity-shifting and market leakage are unlikely, as the project does not reduce agricultural production but instead improves soil fertility and productivity. If risks are identified, mitigation strategies will be documented and addressed in the monitoring reports.

The technical boundary of the Carbonsafe project for South region, Bulgaria encompasses only measured SOC removals within agricultural soils in South Province, excludes unmonitored or non-relevant carbon pools, and integrates conservative approaches to uncertainty, leakage, and permanence. This rigor ensures that all issued credits represent high-integrity, verifiable removals.

3.3. Temporal Boundary.

The temporal boundary of the Carbonsafe project defines the timeframe over which carbon removals are measured, monitored, verified, and credited. This includes the baseline year, the duration of the renewable sub-projects crediting periods, the project lifetime, and the rules applied to ensure that carbon removals are real, permanent, and conservatively accounted for.

3.3.1. Baseline Year.

The baseline year establishes the reference against which all subsequent changes in soil organic carbon (SOC) are measured. For Carbonsafe in South Province, the baseline is defined as Year 0, corresponding to the first complete cycle of soil sampling, laboratory analysis, and documentation of management practices under conventional agricultural systems.

3.3.2. Project Start and Duration.

The project start date is aligned with the initial soil sampling campaign and the formal enrollment of participating farms into the project. For Carbonsafe, the official start is set in 2023, with the first farm enrolled under a signed contract on 17/01/2023 and subsequent annual monitoring.

The initial project duration is defined as 40 years (2023-2063), consistent with prevailing carbon standards. Each participating farm signs a contract for 5 years with encouragement to renew the contract every 5 years. This approach provides both long-term continuity and flexibility to adapt to evolving best practices and scientific knowledge.

3.3.3. Crediting Period.

The crediting period refers specifically to the timeframe during which verified carbon removals can generate carbon credits. For Carbonsafe, the renewable crediting period is 5 years per individual farm (sub-project) and 40 years (2023-2063) for the duration of the whole project, during which soil carbon increases are measured annually and credits are issued ex-post following third-party verification. This ensures that every issued credit corresponds to carbon removals that have already occurred and been confirmed, rather than projected future sequestration.

3.3.4. Monitoring Frequency.

Annual monitoring cycles are central to Carbonsafe's temporal boundary. Each year, all participating farms undergo:

1. Field soil sampling (geo-referenced, repeated on the same plots),
2. Laboratory analysis of SOC and associated soil parameters,
3. Compilation of management practice data, and

Independent verification is conducted periodically.

This annual cadence allows the project to both capture short-term changes and identify long-term trends in SOC sequestration, while ensuring early detection of potential reversals.

3.3.5. Durability Considerations.

While soil carbon sequestration is subject to potential reversals due to changes in land use or extreme climate events, the temporal boundary incorporates measures to manage permanence risk. These include:

1. A reserve mechanism, whereby 75% of verified carbon removals are initially held back on a sub-project level and released only if positive results are shown in subsequent measurement. A 5% buffer pool on all credits for force majeure incidents.
2. Long-term farmer contracts with renewal encouragement, ensuring sustained implementation of regenerative practices.
3. Annual re-sampling of the same plots, which provides a reliable record of persistence of stored carbon.

3.4. Legal & Ownership Boundary.

The legal and ownership boundaries of the Carbonsafe project for South region define the rights and responsibilities of all entities participating in the generation, ownership, and transfer of carbon credits. Establishing these boundaries is critical to ensure transparency, avoid disputes, and guarantee that carbon removals are attributed only to landowners or operators with legitimate rights to implement the required practices.

3.4.1. Land Ownership and Use Rights.

The project includes only agricultural lands within the South Province where land tenure is clear, undisputed, and legally documented. Participation is restricted to farmers who can demonstrate either:

1. Legal ownership of the land (via deeds or official property records), or
2. Long-term usage rights through formal lease or tenancy agreements.

By requiring verifiable tenure documentation, the project ensures that credits are not generated on contested or insecure land and that no third parties can claim overlapping rights to the same carbon benefits.

3.4.2. Farmer Participation Agreements.

Each farmer enrolled in the project signs a binding participation contract with Carbonsafe. These agreements set out:

1. The farmer's rights and responsibilities in implementing regenerative practices,
2. Their entitlement to revenues from credit sales (50-60% or individual agreements between the farmer and the buyer/investor),
3. Their obligation to maintain practices for the duration of their renewable crediting periods and to allow access for soil sampling and verification, and
4. Provisions for early exit, penalties in the case of non-compliance, and the handling of reversals.

This contractual framework ensures clarity in benefit-sharing and accountability in land management.

3.4.3. Ownership of Carbon Credits.

Carbon credits generated by the project are legally recognized as intangible assets. Within the project structure, ownership is attributed as follows:

1. Farmers are the ultimate owners of the carbon benefits generated on their land.
2. Carbonsafe acts as the project developer and aggregator, responsible for project design, monitoring, reporting, verification (MRV), and registration of credits. Carbonsafe facilitates the issuance of credits but does not claim ownership of them unless explicitly agreed under farmer contracts.
3. Farmers transfer to Carbonsafe the right to register and market credits on their behalf, but retain contractual ownership and revenue entitlement, ensuring equitable benefit-sharing.

3.4.4. Registry and Traceability.

All credits are recorded and tracked on the Balkan Carbon Credits Registry (BCCR). Each issued credit is assigned a unique serial number that links directly to the specific farm, and year of origin. This guarantees full transparency and prevents double counting. Farmers are listed as the official credit owners in the registry, with Carbonsafe identified as the managing project developer.

3.4.5. Compliance with Legal Frameworks.

The project complies with all national and EU laws governing land ownership, agriculture, and environmental management. This includes:

1. Law on Ownership, which governs land ownership rights;
2. Law on Obligations and Contracts, which provides the legal basis for farmer contracts;
3. Relevant EU agricultural regulations under the Common Agricultural Policy (CAP);
4. Law on the Protection of Agricultural Land
5. EU climate policy frameworks, Carbonsafe particularly strives to fullfil the criteria of the Carbon Removal Certification Framework (CRCF).

3.4.6. Safeguards Against Displacement and Conflicts.

The project explicitly prohibits participation of lands where ownership is disputed or where participation could result in physical or economic displacement of local communities. All lands included are subject to documented legal consent, ensuring that the project does not exacerbate land tenure inequalities or create conflicts.

3.4.7. Alignment with High-Integrity Standards.

This legal and ownership boundary framework reflects the international high-integrity standards, which require clear attribution of benefits, legal compliance, and protections against social harms. By ensuring that only lands with clear tenure are eligible, and that farmers remain the primary beneficiaries, Carbonsafe demonstrates its commitment to equity, transparency, and the long-term legitimacy of the credits issued.

4. METHODOLOGY APPLIED

4.1. Methodology

The Carbonsafe project quantifies carbon dioxide removals exclusively through measured increases in Soil Organic Carbon (SOC) using a 100% measure–remeasure approach. The methodology followed is “Methodology for improving and reporting the level of sequestered carbon in the soil in the agricultural sector”. Credits are issued ex-post only, after independent verification confirms net SOC stock increases.

4.1.1. Project design and alignment

The methodology is built around four pillars: (i) robust baseline establishment through direct soil measurement and documented management history; (ii) annual, geo-referenced re-measurement on the same spatial units; (iii) conservative quantification with explicit regenerative practices followed and agronomic strategies generated; and (iv) independent validation/verification and transparent credit tracking in a public registry.

4.1.2. Baseline establishment (Year 0)

Each participating farm (sub-project) in South is mapped and divided into fixed sampling plots of ≤25 ha. During the baseline campaign (Year 0), Carbonsafe conducts:

(a) geo-referenced soil sampling across three depth layers (0–30 cm; 30–60 cm; 60–90 cm) per plot;

(b) a survey of past five-year management where available to document tillage intensity, crop rotations, fertilizer and amendment use, residue management, and any regenerative practices; and

(c) verification of land tenure and eligibility criteria. The baseline SOC stock (t C/ha) is calculated for each depth and plot, forming the reference against which all subsequent changes are assessed.

4.1.3. Project scenario and practice set.

The project facilitates adoption of regenerative agricultural practices tailored to the South context: reduced or no-tillage, diversified rotations, cover/intercrops, residue retention, organic amendments/compost, precision nutrient management, and soil-health informed fertilization. Management changes are recorded annually at the plot level to support attribution and auditability.

4.1.4. Sampling design and field execution

Each ≤25 ha plot is sampled with 25 individual soil cores (drills) taken from each of the 3 depth layers in a diagonal/zigzag pattern that avoids atypical microsites. For every plot and monitoring event, three composite samples are created—one per depth layer—by homogenizing the 25 cores from that layer. Sampling is performed using an automatic, geo-referenced probe mounted on an ATV. The ATV's GPS track and sampling points are recorded in the software, and the same plot geometry is re-sampled each year, ensuring spatial comparability. Chain-of-custody forms, sample IDs, timestamps, and field conditions are captured digitally and archived.

4.1.5. Laboratory analysis and physical soil parameters

Accredited laboratories (ISO/IEC 17025 or equivalent) conduct:

1. SOC determination by dry combustion (ISO 10694 or equivalent);
2. Bulk density (BD) by core method (ISO 11272 or equivalent)
3. Rock fragment/stone content and moisture correction to convert concentrations to stocks.
4. Soil health panel (macro/micro nutrients, pH, texture) to support agronomic co-benefits and contextualize SOC dynamics.

4.1.6. SOC stock calculation and CO_2 conversion

The methodology uses several parameters to calculate the actual amount of carbon credits generated by the project.

The method quantifies how much soil organic carbon (SOC) increases on farmland over time and converts that into greenhouse gas (GHG) removals, while also accounting for emissions from fuel use.

1. Soil quantity is calculated for each plot (cell) based on its area, sampling depth (0–30 cm, 30–60 cm, 60–90 cm), and bulk density.
2. Change in organic carbon (OC) is determined by comparing laboratory results of organic carbon (mg/kg) in the control year with either the baseline year or the previous control year, depending on whether increases or decreases are observed.
3. Carbon content per depth is obtained by multiplying the change in OC with the soil quantity per depth.
4. The total carbon content per plot is the sum of the three depths.

5. The gross CO_2 removals are calculated by converting soil carbon to CO_2 using the IPCC factor (1 ton C = 3.667 tons CO_2).

6. Fuel emissions from agricultural equipment are estimated using national methodology, fuel consumption data (tons/ha), and a conversion factor (3.42 tCO_2e per ton fuel).

7. The net removals are obtained by subtracting fuel-related emissions from the gross soil CO_2 removals.

8. 5 % of Net removals are deducted to address uncertainty

Finally, the farm balance is the net CO_2 removals summed across all plots and depths for the reporting period, giving the verified climate benefit of the farm's practices.

4.1.7. Accounting for Emissions from On-Farm Fuel Use

Carbon dioxide (CO_2) emissions associated with field operations arise primarily from the use of diesel-powered machinery. In line with the applied methodology, the Project Proponent (PP) has adopted a conservative and transparent approach to quantify and deduct these emissions when determining the project's net removals.

Emissions from diesel fuel consumption are converted into CO_2 equivalents using the following relationship:

- 100 liters of diesel/ha = 340 kg CO_2/ha.
- Equivalently, 1 liter of diesel corresponds to 36 MJ of energy. Given that 1 MJ = 95.1 g CO_2, the conversion factor becomes: 36x95.1/1000=3.42. Thus, a coefficient of 3.42 is applied to convert total fuel consumption (tonne/hectare) into tonnes of CO_2 equivalent.

At plot (cell) level, the PP calculates total fuel use based on average consumption values established under the official Methodology of the Ministry of Agriculture for determining annual quotas under the "Aid in the form of a discount on the value of the excise duty on gas oil used in primary agricultural production" scheme. This ensures alignment with nationally recognized benchmarks.

The resulting tonnes of CO_2 equivalent from fuel use are subtracted directly from the gross sequestration of soil organic carbon (SOC) achieved under the sub-project. In doing so, the sub-project reports only the net amount of CO_2 removals.

This conservative deduction of diesel-related emissions prior to credit issuance represents a unique and distinguishing feature within the voluntary carbon market, where many methodologies do not require such explicit subtractions. By applying this safeguard, Carbonsafe ensures that credited removals reflect actual net climate benefits.

4.1.8. Buffer

All CO_2 removals are reduced by 5%, being set aside in a buffer account. The buffer is aimed at guaranteeing the permanence and sustainability of the projects, and also serves as insurance against force majeuree events. It acts as a guarantee fund that covers all risks of possible leaks or unforeseen fluctuations in SOC levels.

In the calculation method described above, the farm balance is offset year by year. At the end of the project (at the end of the renewable crediting period of a sub-projec) an overall farm balance is reported. The overall balance of the farm is equal to the net quantities of greenhouse gas emissions removed carbon dioxide (CO_2) reported at the end of the crediting period

In cases of a negative balance in the first verification period, the farm is not submitted for verification and no credits are issued. The project can be validated.

When the balance of the farm is positive for the specific reporting period, the farm is submitted for verification and credits are issued. When the balance of the farm is negative for the specific reporting period, the farm can be included in the monitoring report, but no credits are issued. In the case of the cell-level calculation method with a return to the base year or the highest result, and reporting the results based on the balance of the farm, compensations from the buffer fund are not necessary in the case of credits issued in a previous reporting period and a negative balance in a subsequent reporting period.

When the overall balance of the farm is negative, the losses should be covered by a Buffer.

4.1.9. Additionality and eligibility

Additionality is demonstrated through (i) farm-level management histories confirming that the credited practices were not common on the enrolled fields in the five years pre-enrollment, and (ii) regional practice assessments showing that advanced regenerative practices are not business-as-usual in South region. Carbonsafe excludes lands with recent conversion from high-carbon ecosystems (e.g., forests) and requires proof of legal land tenure or long-term operating rights. Fields under other carbon schemes are ineligible to prevent double-claiming.

4.1.10. Leakage and yield safeguards

The project does not aim to reduce production; instead, it promotes productivity-neutral or positive practice changes (better nutrient use efficiency, water retention). If credible leakage risks is identified, a conservative deduction will be applied.

4.1.11. QA/QC and data integrity

1. Soil sampling and analyses conducted by accredited laboratories
2. Data recorded in ERP; geo-trace verification; anomaly flags (e.g., improbable year-over-year swings); full audit trails and version control. All records (field logs, chain of custody, lab certificates, calculations) are retained and made available to VVBs.

4.1.12. MRV cadence and verification.

Annual re-measurement and reporting are mandatory for all plots. A third-party VVB validates the PDD and verifies monitoring reports at a set cadence (annual or periodical issuance batches), including on-site audits. Only verified removals are forwarded for serial-number issuance, ensuring traceability to the farm and vintage.

4.1.13. Change management and continuous improvement.

The MRV plan is periodically updated to reflect updated lab methods and methodology updates. Material changes that affect crediting integrity are documented and, where required, re-validated; non-material improvements are versioned and disclosed in monitoring reports.

4.1.14. Scope boundaries and exclusions.

Credit issuance includes only SOC stock increases within 0–90 cm measured under the project protocol. Above-/below-ground biomass, litter, and non-CO_2 gases are excluded from issuance (but may be reported).

The released amount (CO_2) from the equipment used for the production of agricultural crops is calculated for every plot (cell).

The emissions of CO_2 from the on-farm fuel use are deducted from the gross CO_2 removal generated by each sub-project to calculate the net CO_2 removal.

4.1.15. Transparency and registry integrity

All issued credits are publicly listed with unique serials that encode the project, country, sub-project/farm ID, vintage, and serial range. Transfers and retirements are transparently recorded to prevent double issuance/use and to support downstream assurance (buyers, auditors, rating agencies).

4.2. Baseline Scenario.

4.2.1. Narrative baseline (business-as-usual, without the project).

In the absence of the Carbonsafe intervention, agricultural management across Southern Bulgaria (South-West, South-Central, and South-East planning regions) remains characterized by conventional, input-intensive practices focused on yield stability under mixed cool-continental to continental-Mediterranean climates. Rainfall is spatially heterogeneous: valley floors and coastal lowlands receive roughly 480–560 mm, while uplands and foothills reach 600–700 mm, with hot, dry summers and recurring moisture deficits. Legacy irrigation networks from the socialist period are fragmented or degraded, so the overwhelming share of arable land is rainfed, exposing producers to summer droughts and intra-seasonal variability. These conditions, coupled with long-standing tillage habits, provide no systematic driver for measured SOC enhancement under BAU.

4.2.2. Cropping systems and rotations.

Dominant rotations throughout the South region feature winter wheat, sunflower, barley, and maize, with rapeseed in many areas. Pulses (e.g., chickpea) occur locally but remain marginal. Horticulture and vineyards/orchards persist in peri-urban belts and foothills (e.g., South Valley margins, Lower Thracian Plain, Black Sea hinterland), while vegetable production is concentrated in smallholder systems near markets. Overall, simplified cereal–oilseed sequences limit biodiversity and off-season cover, reinforcing a baseline that does not target SOC accrual.

4.2.3. Tillage and residue management.

Under BAU, primary land preparation relies on deep moldboard ploughing (often annually), followed by multiple secondary passes to establish seedbeds. Residues are frequently removed (fodder/bedding/fuel) or incorporated after ploughing; surface retention is uncommon. Although "conservation tillage" is reported in official statistics, true zero-tillage remains negligible and systematic cover cropping is rare across the South region. This repeated inversion tillage plus residue removal is consistently associated with soil structure decline and elevated erosion risk, particularly on sandy coastal soils and sloping foothills.

4.2.4. Fertility management and inputs.

Nutrient supply is dominated by mineral fertilizers (≈130 kg nutrients/ha nationwide in recent years), while manure/compost use is sporadic and mostly near livestock areas. Fertility programs aim to sustain yields, not to build SOC stocks; routine annual SOC testing to depth is exceptional outside projects or research.

4.2.5. Water management.

Despite rivers and reservoirs in all three southern planning regions, irrigation is limited to high-value crops (vineyards, orchards, vegetables). Large-scale cereals/oilseeds are overwhelmingly rainfed, leaving yields exposed to summer droughts, heat stress, and episodic salinity near the coast. Compaction from heavy machinery and inversion tillage further limits infiltration, worsening water deficits in May–August.

4.2.6. Soil condition and SOC trend under BAU.

Across Southern Bulgaria, arable soils face SOC stagnation/decline, compaction, and erosion. Chernozems on plains are vulnerable to SOC depletion under monocropping and residue removal; Cambisols/Luvisols in uplands show sheet erosion on tilled slopes; sandy coastal soils exhibit wind-erosion and organic matter loss risks. European analyses under unchanged management and warming point to stable-to-negative SOC trajectories, consistent with observed regional patterns.

4.2.7. GHG profile in the baseline.

Under BAU, net greenhouse gas outcomes include:

1. SOC stock change: expected to be stable to negative, given disturbance from tillage and limited residue/cover inputs.
2. N_2O emissions: ongoing emissions from mineral fertilizer use, unmanaged with respect to SOC outcomes.
3. CO_2 from operations: significant emissions from diesel use in deep ploughing and multiple secondary tillage passes.
4. CH_4: negligible in dryland arable systems, as rice and paddy cultivation are absent.

4.2.8. MRV in the baseline.

There is no structured, field-level MRV system for SOC under BAU conditions. Farmers in South typically do not conduct systematic SOC sampling or calculate stock changes; soil tests are performed sporadically for agronomic purposes (pH, NPK) rather than for carbon accounting. No geo-referenced SOC monitoring exists that could generate ex-post credits without external intervention.

This baseline establishes that:

1. Default management in South remains conventional, input-intensive, and not optimized for SOC sequestration;
2. True zero tillage and systematic cover cropping are virtually absent; adoption of residue-retentive practices is limited and inconsistent;
3. No pre-existing MRV systems would enable SOC-based credits absent the project.

These conditions provide the factual foundation to demonstrate regulatory, technological, and behavioral additionality when the Carbonsafe project introduces regenerative practices combined with annual, geo-referenced measure-remeasure SOC accounting.[12][13][14][15][16][17][18]

4.3. Project Scenario.

4.3.1. Project Scenario (With-Project Case).

Under the Carbonsafe project for the region of South, participating farms in South Province transition from conventional, disturbance-intensive management to a measured, verifiable, and conservatively credited package of regenerative agricultural practices that increase Soil Organic Carbon (SOC) stocks. The project scenario is defined by (i) a clearly specified set of eligible practices tailored to local agro-ecology; (ii) field-level implementation plans and training; (iii)

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[12] Nojarov, P. (2024). *Evaporation and the difference between precipitation and evaporation in Bulgaria* [Journal Article]. Journal of the Bulgarian Geographical Society, 51, 131–149. https://doi.org/10.3897/jbgs.e135422

[13] European Commission, Joint Research Centre (JRC). (2009). *Case study: Bulgaria – Sustainable agriculture and soil conservation (SoCo Project).* Retrieved from https://esdac.jrc.ec.europa.eu/projects/SOCO/Case%20Studies/casestudyBG_000.pdf

[14] TheGlobalEconomy.com. (n.d.). *Bulgaria: Fertilizer use.* Retrieved September 29, 2025, from https://www.theglobaleconomy.com/Bulgaria/fertilizer_use/

[15] Teoharov, M., & Atanassova, I. (Eds.). (n.d.). *Bulgarian Journal of Soil Science.* Bulgarian Soil Science Society. Retrieved from https://www.researchgate.net/publication/353556074_BULGARIAN_JOURNAL_OF_SOIL_SCIENCE_R_Bulgarian_Soil_Science_Society_Published_by_Bulgarian_Soil_Science_Society_Editor-in-Chief_Executive-Editor_Prof_Metodi_Teoharov_Prof_Irena_Atanassova

[16] Zhang, X., Davidson, E. A., Mauzerall, D. L., Searchinger, T. D., Dumas, P., & Shen, Y. (2016). Managing nitrogen for sustainable development. *Scientific Reports, 6*, 32525. https://doi.org/10.1038/srep32525

[17] Eurostat. (2023, October). *Agri-environmental indicator – Tillage practices*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental_indicator_-_tillage_practices

[18] Ninov, N. (2015). *Processes of soil degradation in Bulgaria. Scientific Works of the Agricultural University – Plovdiv*, Vol. LIX, Book 5, pp. 29–40. Retrieved from http://nauchnitrudove.au-plovdiv.bg/wp-content/uploads/2019/06/39_05_2015.pdf

100% measure–remeasure SOC accounting at fixed geo-referenced sampling units; (iv) conservative issuance; and (v) independent validation, verification, and transparent credit registration.

4.3.2. Practice package and eligibility (field level).

Each enrolled field (organized as a fixed sampling plot ≤ 25 ha) adopts a minimum bundle of practices aimed at reducing soil disturbance, increasing organic inputs, and improving soil structure and nutrient cycling. The package is applied with flexibility to reflect crop or machinery constraints, while maintaining the overall intent to raise SOC:

1. Reduced or no-tillage (primary lever): Eliminate inversion tillage where agronomically feasible; where full no-till cannot be maintained (e.g., wet springs, severe weed pressure), strategic minimal tillage is permitted with a return to reduced/no-till in subsequent windows.

2. Residue retention: Retain and distribute crop residues to maintain protective ground cover and carbon inputs.

3. Cover/intercrops: Introduce winter or shoulder-season covers (or intercrops) to extend photosynthetic capture, protect soil, and augment below-ground carbon inputs. Species mixes are adapted to local conditions (e.g., cereals–legume blends, brassicas for rooting).

4. Diversified rotations: Move away from long wheat–sunflower or wheat–maize cycles towards more diverse rotations that include deep-rooted or leguminous phases (e.g., alfalfa, vetch, pea) to enhance rooting depth and rhizodeposition.

5. Organic amendments/compost: Apply composts or stabilized manures where available and agronomically justified; avoid over-application relative to crop demand and nutrient balance.

6. Precision nutrient & pH management: Use soil test–based prescriptions from annual lab panels (macro/micro nutrients, pH) to meet yield goals with fewer losses; incorporate split applications, placement technology, and liming where needed.

7. Traffic/compaction control and water retention: Minimize traffic on wet soils; use controlled traffic where feasible. Encourage surface cover and root density to improve infiltration and reduce erosive losses.

Eligibility rules: Fields with clear tenure/operating rights, no recent conversion from high-carbon land uses, and not enrolled in other carbon projects. A five-year management history is required at enrollment to demonstrate that credited practices are additional to pre-project management. Projects must introduce or implement one or more new changes to pre-existing practices.

4.3.3. Implementation model and farmer support.

For each farm, Carbonsafe develops an individual strategy for managing the areas on the farm that specifies: target rotations, cover crop windows, residue targets, tillage exceptions, and nutrient plans aligned with lab results, use of biological and organic plant protection products. Carbonsafe provides training and technical assistance to address operational bottlenecks. Practice adherence is recorded annually via digital forms and field audits.

4.3.4. Spatial unit, sampling, and lab analytics (MRV backbone).

The project's MRV is built on fixed geo-referenced sampling plots (≤ 25 ha). Annually, each plot is sampled with 25 drills in a zigzag/diagonal pattern, composited into three depth-specific samples (0–30 cm; 30–60 cm; 60–90 cm). Sampling is executed with an automatic GPS-enabled probe; the ATV track is recorded in a mobile app/ERP, creating a reproducible spatial record.

Accredited laboratories (ISO/IEC 17025 or equivalent) analyze:

1. SOC by dry combustion.

2. Bulk density (BD) by core method.
3. Stone fraction and moisture to convert concentrations to stocks.
4. Soil health panel (macro/micro nutrients, pH, texture) to support agronomic optimization and interpret SOC dynamics.

Chain-of-custody, duplicates/controls, and full QA/QC are applied in field and lab (БДС ISO/IEC 17025:2017). All records are versioned in the ERP and made available to the verifier.

4.3.5. Quantification and conservative issuance.

SOC stocks are computed per depth (0-30 cm, 30-60 cm, 60-90 cm). Annual change (ΔSOC) equals the difference between the monitoring period and the previous reporting period.

Issuance is ex-post only and conservative:

1. 25% of verified, conservative removals are issued each reporting period.
2. 75% are placed in a sub-project level reserve and released upon positive performance. Negative results halt releases.

This structure manages over-crediting risk and supports durability under variable climate.

4.3.6. Data integrity, governance, and verification.

Carbonsafe maintains end-to-end data integrity through:

1. Digital field logs (geo-trace, timestamps), chain-of-custody, and QC rules in ERP.
2. Lab QA/QC (certified protocols, CRMs, proficiency testing).
3. Audit trails for any calculation or data correction.

A third-party VVB validates the PDD and verifies monitoring reports on an annual or periodical cadence, including on-site audits. Only verified removals are submitted for issuance.

4.3.7. Registration, traceability, and no double counting.

Issued credits are registered on the Balkan Carbon Credits Registry (BCCR) with unique serial numbers that encode project/country/farm/vintage. Farmers are listed as owners; Carbonsafe is the project developer and account manager. The registry structure and contractual attestations ensure no double issuance/use and no double claiming.

4.3.8. Leakage, production safeguards, and co-benefits.

The project is designed to be production-neutral or positive. By improving nutrient-use efficiency, moisture retention, and soil structure, the practice bundle sustains yields while increasing SOC, reducing the likelihood of market leakage.

Environmental effects are monitored and disclosed as co-benefits but not credited. This maintains conservativeness while providing transparent evidence of wider sustainability impacts.

4.3.9. Durability and reversal management.

Contracts bind farmers to maintain the practice bundle through the sub-project crediting period, and monitoring is annual. Farmers are encouraged to renew contracts at the end of their individual crediting periods. Where farm balance negative results occur in the final crediting year, these are covered by the farm's credit reserve and in cases where reserve is not enough – from the buffer pool.

4.3.10. Social safeguards and participation equity.

Participation requires clear tenure or operating rights; there is no physical/economic displacement. Carbonsafe maintains community engagement and grievance pathways.

4.3.11. Expected performance and claims discipline.

The project does not make ex-ante sequestration claims. Performance is field-specific and ex-post measured. Over time, as adoption matures, sustained positive ΔSOC is expected in many fields; however, gains are credited conservatively, maintaining the integrity demanded by leading buyers and standard setters.

In essence, the project scenario operationalizes a locally adapted, scientifically rigorous, and verification-ready transition to regenerative agriculture in South, turning annual, geo-referenced SOC measurements into high-integrity ex-post credits with robust safeguards for high-level uncertainty, durability, leakage, and social equity.

5. ELIGIBILITY AND ADDITIONALITY[19][20][21][22][23][24][25]

5.1. Eligibility Criteria.

Participation in the Carbonsafe project is restricted to farms and fields that meet strict eligibility requirements, ensuring that all carbon credits generated are environmentally robust, legally sound, and free of double counting. These criteria are designed to provide clarity on land type, parcel size, land-use history, legal tenure rights, exclusivity in carbon accounting, and the responsibilities of participants in relation to monitoring and verification.

The project admits only lands in agriculture, which fall within a system of land use and taking into account the relevant national specificities in South Province. Plots falling into wetlands, peatlands and riverbeds are not allowed - they are not part of the National Land Use System. Projects located on the Forest Fund territory are inadmissible.

These lands must be under agricultural use prior to enrollment, with a five-year history of cropping, tillage, fertilization, and residue management. This management history serves both to establish the baseline scenario and to demonstrate additionality, as it shows that the regenerative practices promoted under the project were not in common use on these fields before joining. Lands that have recently been converted from forests, wetlands, or other high-carbon ecosystems are strictly excluded.

Within each farm, land is subdivided into fixed sampling plots of 4 to 25 hectares (+ 3% tolerance), which form the basic unit of measurement, monitoring, and issuance. This ensures that SOC stock changes are measured and reported at a fine spatial resolution, with geo-referenced boundaries that remain constant throughout the project. Larger parcels are subdivided, while very small contiguous parcels may be grouped. Once a plot boundary is fixed,

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[19] Climates to Travel. (n.d.). *Climate – Bulgaria*. Retrieved September 29, 2025, from https://www.climatestotravel.com/climate/bulgaria

[20] European Commission, Joint Research Centre (JRC). (2009). *Case study: Bulgaria – Sustainable agriculture and soil conservation (SoCo Project)*. Retrieved from https://esdac.jrc.ec.europa.eu/projects/SOCO/Case%20Studies/casestudyBG_000.pdf

[21] Eurostat. (2023, October). *Agri-environmental indicator – Tillage practices*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental_indicator_-_tillage_practices

[22] World Bank. (n.d.). *Fertilizer consumption (% of fertilizer production, AG.CON.FERT.ZS)*. World Development Indicators. Retrieved September 29, 2025, from https://databank.worldbank.org/source/world-development-indicators/Series/AG.CON.FERT.ZS#

[23] Trading Economics. (n.d.). *Fertilizer consumption (kilograms per hectare of arable land) – World Bank data*. Retrieved September 29, 2025, from https://tradingeconomics.com/country-list/fertilizer-consumption-kilograms-per-hectare-of-arable-land-wb-data.html

[24] Panagos, P., Borrelli, P., Poesen, J., Ballabio, C., Lugato, E., Meusburger, K., Montanarella, L., & Alewell, C. (2015). The new assessment of soil loss by water erosion in Europe. *Environmental Science & Policy, 54*, 438–447. https://doi.org/10.1016/j.envsci.2015.08.012

[25] Lugato, E., Smith, P., Borrelli, P., Panagos, P., Ballabio, C., Orgiazzi, A., ... & Montanarella, L. (2021). Soil erosion is unlikely to drive a future carbon sink in Europe. *European Journal of Soil Science, 72*(5), 2045–2060. https://doi.org/10.1111/ejss.13483

it is re-sampled annually on exactly the same geometry, providing the comparability necessary for the measure–remeasure approach.

Only farmers with clear, verifiable tenure or operating rights are eligible. Ownership must be documented through property deeds or cadastral records, while tenants must demonstrate long-term lease agreements that extend for at least the sub-project crediting period.

Another central principle of eligibility is the prevention of double counting. Fields already enrolled in other carbon schemes or claiming carbon benefits under a separate project are not allowed to participate. Farmers are required to sign a statement of exclusivity. In the event of a breach, the affected fields are immediately excluded, and corrective action is taken to ensure the integrity of issued credits. Likewise, credits are labeled and tracked in the Balkan Carbon Credits Registry (BCCR) to prevent double issuance and to clarify that they are not simultaneously claimed.

Eligibility also depends on a farmer's willingness to participate fully in Monitoring, Reporting, and Verification (MRV). Each year, farmers must allow field teams and accredited verifiers to access their land for soil sampling and audits. They must also provide complete records of crop types, yields, tillage, residue management, fertilizer applications, irrigation and any other activities that affect SOC stocks. These records are collected by Carbonsafe, ensuring that an auditable trail exists for every participating field.

Finally, participants must commit to the adoption and maintenance of regenerative practices—including reduced or no-tillage, residue retention, crop diversification, and soil-test-based fertilization. While temporary flexibility is allowed in exceptional circumstances (such as strategic tillage in wet years), repeated departures from the agreed practices may result in suspension of eligibility or reduced credit issuance. All participants must also comply with national agricultural laws, EU Common Agricultural Policy requirements, and labor and safety standards.

5.1.1. Eligibility criteria.

A participant in the project can be any natural or legal person registered as an agricultural producer (AP), according to Ordinance No. 3 of January 29, 1999 on the creation and maintenance of a register of farmers whose holding is located on the territory of the Republic of Bulgaria.

The farm can be crop-growing or mixed - crop-growing and animal-breeding. Minimum requirements for participation:

Areas:

The holding must have a minimum total area of 2000 decares for cereals/ technical/ fodder crops/ fallow areas/ perennial medicinal and aromatic crops and/or 500 decares for perennial crops. In the case of holdings with annual and perennial crops, one of the two minimum area requirements is accepted. Plots with a minimum area of 40 decares/culture are considered eligible;

Legal grounds:

The AP must have/maintain legal grounds for a minimum of 5 years for the plots participating in the carbon farming project. The minimum term for participation in the project is 5 years, and it should be implemented on the same areas for the entire period;

Implementation of new practices:

The farm must have opportunities to learn and apply new good agricultural practices. They must be consistent with mitigating climate and environmental impacts, but also not hinder the production of the necessary amount of food for food security. This criterion is related to the assessment of complementarity for upgrading the activities applied to the agricultural areas participating in the project and is a mandatory element for participation.

5.2. Baseline Justification & Conservativeness

The baseline for the Carbonsafe SOC project in South Province represents the most plausible set of agronomic conditions and management behaviors that would persist on enrolled fields in the absence of the project. It is anchored in three pillars: (i) the observed regional agronomic context (climate, soils, and prevailing practices), (ii) the five-year pre-enrollment management history at field level, and (iii) a field-specific, geo-referenced baseline SOC stock established through accredited laboratory analysis at Year 0 (the first sampling campaign)

5.2.1. Regional agronomic context

The South region spans valleys and plains (Upper/Lower Thracian, Black Sea coastal plain, South Valley) and foothills/uplands (Sakar, Strandzha, Western Balkan margins), with annual precipitation ~480–700 mm and strong interannual variability. Recurring summer droughts, spring wet spells, and frost events constrain biomass and consistent residue retention. Independent climatic descriptions for western, central, and southeastern Bulgaria converge on these constraints and on recurring risks of SOC decline and compaction under conventional tillage. Anchoring the baseline in Year 0 SOC and documented management histories remains the most credible and conservative approach for BAU in Southern Bulgaria.

5.2.2. Prevailing practices and their implications.

At national scale, official indicators report “conservation tillage,” yet zero-tillage adoption is very low and winter cover crops are rare, typically < a few percent of arable land. In practice, “conservation tillage” often means shallow non-inversion passes—not the full regenerative bundle (reduced disturbance plus residue retention plus annual cover crops plus soil-test-based nutrient management). Mineral fertilizer rates (~131 kg nutrients/ha) reflect mainstream practice rather than SOC-oriented strategies. Consequently, much of Southern Bulgaria remains under conventional or mixed tillage with winter bare soils, conditions under which SOC stocks stagnate or decline.

5.2.3. Regulatory and policy backdrop.

Neither Bulgarian agricultural legislation nor CAP conditionality requires adoption of the regenerative bundle promoted by the project (annual cover crops or intercrops where feasible, residue retention, reduced disturbance, diversified rotations, soil test-guided fertilization, and annual SOC monitoring). Agro-environmental schemes exist but are voluntary and fragmented, and do not systematically drive SOC increases. Thus, absent project incentives, farms have no regulatory obligation to adopt comprehensive regenerative practices or to monitor SOC at field level.

5.2.4. Field-level definition of the baseline.

Five-year pre-enrollment management history is reviewed for completeness and plausibility. This historical profile establishes the business-as-usual (BAU) baseline management against which additionality is assessed. In parallel, Carbonsafe determines the baseline SOC stock for each plot (cell) through geo-referenced coring and accredited laboratory analysis. For every plot (cell), the baseline is defined as the SOC stock from the first sampling campaign. If there is an increase in the subsequent sampling campaign the baseline is moved to the highest measured SOC stock value ever recorded for that plot (cell). All subsequent measurements are compared exclusively against the maximum reference point. Because each plot (cell) baseline is dynamically anchored to its peak SOC result, the system prevents over-crediting and ensures that reductions are transparently recognized. At the farm level, the balance is reset annually and reflects the actual total net removals of all plots (cells) in that reporting year, rather than a cumulative projection. This approach avoids reliance on modeled counterfactual trajectories, applies strict conservativeness, and ensures that issuance is based solely on observed, verifiable improvements in soil carbon. Removals are credited ex post, and only when a positive farm balance is observed credits are issued.

Given South’s climatic variability, the historical evidence of SOC vulnerability under conventional tillage, and the lack of regulatory drivers mandating regenerative practices, the most credible and conservative baseline is the continuation of pre-project management, with no systematic SOC enhancement. Anchoring the baseline in Year 0 SOC measurements and farm management histories ensures that only real, additional SOC gains are credited.

The Carbonsafe baseline is designed to err on the side of under-crediting, such that no carbon removal is issued unless it is demonstrably real, material, and statistically supported. Conservativeness is embedded in how the baseline is defined, measured, and compared to with-project results, in the statistics used to quantify change, and in the issuance policy that further buffers any residual over-statement risk.

The baseline is a field-specific, geo-referenced SOC stock established at Year 0 from accredited laboratory analysis of composite samples collected within fixed sampling plots. In the counterfactual (without project), the baseline assumes no systematic SOC increase; any gains attributable to improved management are a project effect.

5.2.5. Laboratory and sampling safeguards.

Field and lab QA/QC—certified reference materials and chain-of-custody—are mandatory. Inorganic carbon is excluded via pretreatment or correction to ensure only organic carbon is counted. Coarse fragments and bulk density are measured using agreed protocols to avoid stock inflation.

5.2.6. Conservative spatial and depth boundaries.

Stocks are quantified to 0–30 cm, 30–60 cm, 60–90 cm. Although deeper horizons may contain additional carbon, the project does not claim beyond 90 cm, avoiding optimistic attributions in deep layers that are harder to influence and verify. Plot boundaries are fixed.

5.2.7. Temporal safeguards and materiality.

The baseline year is established prior to any credited practice changes; any pre-enrollment improvements are not credited. If severe anomalies (e.g., extreme flood/drought) compromise data integrity, issuance for affected plots is deferred until re-measurement confirms direction and magnitude.

5.2.8. Governance, transparency, and independent checks.

Independent validation and verification (VVB) review the baseline construction, sampling frames and calculation sheets. All issued credits are traceable in the registry with serials that encode project, farm and vintage. Any material correction discovered post-issuance results in adjustments to reserve releases or credit cancellation as required by the project's reversal and error-correction procedures.

5.3. Additionality Demonstration

5.3.1. Legal Compliance & Non-Mandatory Activities

The Carbonsafe project for South region satisfies regulatory (legal) additionality because none of the practices credited, nor the project's MRV and issuance framework, are required by law for participating farms in South Province. In the absence of the project, farmers are obligated to meet general agricultural laws and CAP conditionality (e.g., good agricultural and environmental conditions, basic soil-erosion safeguards, crop diversification rules where applicable), but they are not required to:

(i) adopt the comprehensive regenerative bundle specified by the project (reduced/no-till with residue retention, annual cover/intercrops where feasible, diversified rotations, organic amendments, soil-test-based nutrient management),

(ii) implement annual, geo-referenced, multi-depth SOC measure–remeasure sampling to 90 cm using accredited labs, or

(iii) generate, verify, and register ex-post carbon removal credits traceable to farm-level serials.

5.3.2. Legal compliance baseline

Participating farms must comply with Bulgarian law, CAP cross-compliance/conditionality, pesticide and fertilizer regulations, and any site-specific restrictions (e.g., protection rules if applicable). These rules set minimum environmental performance (e.g., erosion control, basic crop diversification) but do not prescribe the project's specific management system, do not mandate annual SOC measurements, and do not compel participation in a carbon crediting project. Consequently, all SOC increases credited by Carbonsafe arise from actions and monitoring that exceed legal minimums and therefore pass the "regulatory surplus" test.

5.3.3. Voluntary nature of eco-schemes and public incentives

Where farmers voluntarily enroll in eco-schemes or agri-environmental measures, these are incentive-based, not compulsory. Participation (or non-participation) does not alter the project's regulatory additionality: even when public support helps defray costs of practice adoption, there remains no legal requirement to produce measured SOC gains or to undertake certified MRV and issuance. Carbonsafe ensures no double counting of the same outcome across instruments; the creditable unit under this project is the measured increase in SOC stock ex-post, which is not awarded by law or regulation.

5.3.4. Evidence package and compliance attestation.

Each farm provides:

1. Five-Year Pre-Enrollment Practice History – a record of land management activities over the previous five years, demonstrating that project practices will be newly adopted and not part of existing routine operations or maintained practices will be improved.

2. Exclusivity Statement – a signed application including a section confirming that the enrolled land is not, and will not be, claimed under any other carbon project, thereby avoiding overlap or double-counting.

These records are reviewed by Carbonsafe and subject to third-party verification (VVB).

5.3.5. Dynamic regulatory screen (future-proofing).

The project applies a dynamic regulatory screen: should Bulgarian or EU rules later mandate elements that materially overlap with credited activities (e.g., compulsory cover crops or legally required SOC monitoring), Carbonsafe will reassess additionality for affected practices or plots. Depending on the scope and timing, the project will (i) adjust baselines or accounting boundaries, (ii) cease crediting for now-mandated elements, and/or (iii) require an update of the methodology and issuance policy to preserve environmental integrity.

5.3.6. Separation from compliance obligations and inventories.

Credits issued under Carbonsafe are not used to satisfy legal pollution limits or agricultural compliance obligations, nor are they double-claimed against the national GHG inventory. Registry procedures (BCCR) and project contracts enforce no double issuance/use and clear ownership and claim boundaries. This separation ensures that credited removals remain voluntary and additional to statutory requirements and government accounting.

5.3.7. Non-Common Practice Evidence.

Carbonsafe demonstrates practice-based additionality by showing that the specific regenerative bundle credited by the project—and the associated annual, parcel-level SOC measure–remeasure MRV—is not common practice in South Bulgaria and would not plausibly occur at scale without the project's incentives, technical support, and verification pathway.

What "non-common practice" means in this project.

For the purpose of eligibility and crediting, “common practice” refers to prevailing management in the same agro-ecological context across comparable farm sizes and crop systems. Carbonsafe defines the following practices that can be included in the credited bundle:

- Zero till;
- Cover crops/intercrops and residue management;
- Organic fertilization (manure, compost and others) and pesticides;
- annual, geo-referenced SOC measure–remeasure (0–30 cm, 30–60 cm, 60–90 cm) in accredited labs and ex-post issuance.

We evaluate the required bundle as a system of at least one practice implemented or improved plus annual, geo-referenced SOC measure–remeasure (0–30 cm, 30–60 cm, 60–90 cm) in accredited labs and ex-post issuance.

Legend of Practices	
I. Zero-till	1. Conservation without processing
II. Cover crops/intercrops and residue management	1. Treatment of beds 2. Minimal processing 3. Biological agriculture 4. Diversification of crops 5. Cultivation of nitrogen-fixing crops 6. Mulching treatment 7. Processing of stripes 8. Pasture and/or crop rotation and crop rotation management 9. Weeding of the rows in perennial crops and vineyards 10. Joint cultivation of more than one agricultural crop 11. Implementation of strip farming 12. Improvement measures in permanently grassed areas
III. Organic fertilization (manure, compost and others) and pesticides	1. Integrated production 2. Precision agriculture 3. Fertilization with microbial fertilizers 4. Green fertilization (Sideration) 5. Use of organic/natural pesticides

1. Method applied

Per methodology: to show the activity (or suite) is not common, the area-weighted mean adoption rate of the two (or more) predominant proposed activities in each region must be < 20%. When no statistics exist for their combined adoption, multiply pre-project adoption rates of the individual activities.

Carbonsafe applies the internationally recognized <20% common-practice threshold from the UNFCCC/CDM tool, which sits below the diffusion ‘critical mass’ and minimizes free-rider risk; where joint-adoption data are absent, we multiply individual adoption rates as a conservative proxy for suite adoption.

We use national adoption signals as conservative upper-bounds (regional data are sparser; using national maxima is conservative for regions with even lower uptake):

- Cover crops (BANCIK/MAFF 2000–2022):

EA_{cover} = 2% = 0.02

- Zero tillage in EU (According to Eurostat, Bulgaria's zero-till % is close to zero, but we will take the EU zero-till adoption rate for the purposes of the calculation) (Eurostat/MAFF 2016 & 2020):

$EA_{zero\text{-}till}$ = 3.7% = 0.037

1.1 Base calculation (two-activity product):

$EA_{bundle,base} = EA_{cover} \times EA_{zero\text{-}till}$ = 0.02 x 0.037 = 0.00074

Expressed as percent:

AR_{base} = 0.074% (<20%)

1.2. Conservative 3-activity extension (when manure/organic inputs are considered):

Using manure application share as an upper-bound proxy for organic inputs:

- Manure application: EA_{manure} = 5.30% = 0.053

$EA_{budle,\ 3\text{-}act}$ = 0.02 x 0.037 x 0.053 = 0.00003922 → $AR_{3\text{-}act}$ = ~0.003922% (<20%)

1.3. Adding MRV rarity (upper-bound stress test):

Routine annual SOC testing to 90 cm in accredited labs with geo-referencing is effectively near-zero in commercial practice. Applying a lenient upper bound of 1%:

$EA_{bundle+MRV}$ = 0.02 x 0.037 x 0.053 x 0.01 = 0.0000003922 → 0.00003922% (<20%)

1.4. Sensitivity (conservative "inflation" of adoption to test robustness):

- Scenario A (double both inputs):
  Cover = 4.00% (0.04); Zero-till = 7.4% (0.074)

0.04 x 0.074 = 0.00296 → 0.296% (<20%)

- Scenario B (10× zero-till; 2× cover):
  Cover = 4.00% (0.04); Zero-till = 37% (0.37)

0.04 x 0.37 = 0.0148 → 1.48% (<20%)

Even with aggressively inflated assumptions, the area-weighted mean adoption remains orders of magnitude below the 20% threshold.

2. Regional application (grouped project)

For grouped projects, additionality is demonstrated on the initial instances and applies to subsequent instances within comparable agro-ecological contexts. For example, Carbonsafe's regions (Plovdiv, Dobrich, Lovech, Pleven, Sofia, Targovishte, Burgas, Shumen, Varna, Vratsa, Yambol) share arable systems where:

- Zero-till is marginal nationally;
- Cover-crop prevalence is low and heterogeneous;
- Annual, geo-referenced 0–90 cm SOC MRV in accredited labs is exceptional.

Accordingly, the area-weighted mean adoption of the two predominant practices (zero-till + cover crops) in each region remains < 20%. The full Carbonsafe bundle + MRV is rarer still.

3. Not-Common Practice Test — Passed

- Quantitative test (per methodology): Using conservative national adoption maxima for cover crops (2%) and zero-till at EU level (3.7%), the combined adoption is 0.074%—far below the 20% threshold.
  Incorporating a third activity (organic inputs 5.30%) and the rarity of annual 0–90 cm accredited MRV drives the implied combined prevalence to ~0.003922% and ~0.00003922%, respectively.

- Regional relevance: The same conclusion applies across all project regions; none approach the 20% bar.

- Governance: Ex-post issuance, annual measure–remeasure, and VVB oversight ensure ongoing confirmation.

Therefore, Carbonsafe's credited bundle + MRV is demonstrably *not common practice*.[26][27][28][29][30][31][32][33][34]

5.3.8. Evidence sources and triangulation.

To establish that the bundle is not common practice, the project employs a triangulated evidence framework:

1. Farm-level pre-enrollment history (5 years) of operations: tillage depth and frequency, residue handling, crop sequence, fertilizer/amendments, irrigation, and any winter coverage.)

2. Regional agronomic intelligence. Interviews with local agronomists, cooperatives, and input retailers, and review of extension materials, provide qualitative indicators of adoption barriers (equipment cost, weed control in dry springs, seed availability for cover crops, moisture competition risks) and the relative rarity of the concurrent practice bundle.

3. Regulatory and subsidy mapping. We distinguish incentivized but voluntary practices (eco-schemes) from mandated measures (cross-compliance). The existence of a subsidy does not imply common practice; enrollment rates, agronomic feasibility, and persistence matter.

4. We review EU and national signals on reduced/zero till adoption, winter cover prevalence, and SOC trends in arable systems.

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[26] UNFCCC. (2015). *Tool for the demonstration and assessment of additionality (Version 07.0): Market penetration approach* (EB 88, Annex 1). CDM Executive Board. Retrieved from https://cdm.unfccc.int/sunsetcms/storage/contents/stored-file-20220713215726950/MP88_EA01_CN_Market%20Penetration.pdf

[27] Agrostatistics Department, Ministry of Agriculture and Food of Bulgaria (MAFF). (2000–2022). *BANCIK Survey of Land Cover and Land Use*. Sofia: MAFF. [Available in Bulgarian].

[28] Eurostat. (2016, 2020). *Agri-environmental indicator – Tillage practices*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Agri-environmental_indicator_-_tillage_practices

[29] Eurostat. (2016, 2020). *Crop production methods – soil management (ef_mp_prac)* [Data set]. Eurostat Data Browser. Retrieved from https://ec.europa.eu/eurostat/databrowser/view/ef_mp_prac/default/table?lang=en

[30] Eurostat. (2016, 2020). *Land use by NUTS 2 regions (ef_lus_main)* [Data set]. Eurostat Data Browser. Retrieved from https://ec.europa.eu/eurostat/databrowser/view/ef_lus_main/default/table?lang=en

[31] Ministry of Agriculture and Food of Bulgaria (MAFF), Agrostatistics Department. (2016, 2020). *National agristatistics on soil management*. Sofia: MAFF. Retrieved from https://www.mzh.government.bg/bg/statistika-i-analizi/

[32] Ministry of Agriculture and Food of Bulgaria (MAFF). (2016). *Farm Structure Survey (FSS) – Bulgaria*. In *Научни трудове на АУ – Пловдив, том LXIV, кн. 2*. Retrieved from http://nauchnitrudove.au-plovdiv.bg/wp-content/uploads/2021/10/02_02_2020.pdf

[33] Eurostat. (n.d.). *Glossary: Farm structure survey (FSS)*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Farm_structure_survey_(FSS)

[34] Eurostat. (n.d.). *Farm structure survey – Survey coverage*. Retrieved from https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Farm_structure_survey_%E2%80%93_survey_coverage

5.3.9. Handling partial or transitional practices.

Many farms exhibit partial adoption (e.g., occasional reduced tillage or sporadic cover crop trials). Carbonsafe treats these as transitional and does not presume SOC gains from them unless the recommended by the project practices are installed prospectively and maintained. Transitional farms can be admitted only if:

1. the baseline clearly captures past practice (no credit for prior gains);
2. the farmer commits to follow the individual farm strategy and regenerative practices rules prospectively; and
3. the measure–remeasure method confirms a positive SOC results.

5.3.10. Practices bundle is not common in South's context.

Climatic realities—semi-arid seasons, hot dry summers, and uneven rainfall—create practical barriers to adopting the full regenerative bundle simultaneously (reduced disturbance, consistent winter cover, residue retention, and annual SOC-oriented testing/MRV). Where reduced tillage is attempted, it is often interrupted by periodic ploughing for weed control/seedbed preparation or moisture management; winter cover crops are viewed as water competitors and costly; residue retention competes with fodder/bedding/fuel uses; and accredited, deep SOC testing is exceptional outside projects. Taken together, the Carbonsafe bundle + MRV remains non-common relative to prevailing management patterns across the South region.

5.3.11. Governance safeguards against over-statement.

To prevent over-crediting where practice novelty is ambiguous, Carbonsafe embeds two safeguards:

(1) Ex-post issuance only when measured SOC increases in sub-projects (no credit for intent alone); and

(2) a sub-project 25% issuance / 75% performance reserve that delays most value until verified gains are demonstrated.

5.4. Barrier Assessment: Financial & behavioral barriers to adoption without incentives.

In the agro-ecological and market context of South Province, the transition from conventional or mixed tillage to a comprehensive regenerative bundle faces a set of material financial and behavioral barriers. Absent a credible incentive mechanism and structured technical support, these barriers keep most farms locked in path-dependent routines that are operationally familiar, cash-flow compatible, and perceived as lower risk.

Institutional/Practical Barriers:

- Investment barriers: specialized drills/planters, roller-crimpers, precision technology; lumpy capex; scarce working capital.
- Technological barriers: know-how gaps on cover crop species/termination; local seed availability; moisture management in semi-arid springs; agronomy for reduced disturbance.
- Policy/payment uncertainty: CAP eco-schemes are voluntary, modest (€16–€38/ha, lower for large farms), administratively complex, and were under-subscribed; reforms ongoing.
- Behavioral/cultural: risk aversion; reliance on established tillage/weed-control routines; transition-year yield risks.
- Tenure/organizational: short leases; fragmented land; contractor/labor coordination.

- MRV burdens: annual geo-referenced multi-depth coring (0–30/30–60/60–90 cm), accredited labs, chain-of-custody, and third-party VVB—not done under BAU.

5.4.1. Capital and operating cost barriers.

Many farms in South Province lack the specialized equipment (no/low-till drills, high-residue planters, roller-crimpers, precision applicators) needed to consistently implement reduced disturbance and managed cover. While some peri-urban vegetable producers own small-scale mechanization, larger grain farms in the South Valley rely heavily on deep ploughs and conventional seeders. Converting fleets or purchasing suitable regenerative machinery requires non-trivial capital investments that are difficult to amortize under fragmented land tenure and short lease terms. On the operating side, cover crop seed and termination add costs and management complexity—particularly in a climate where spring wet spells complicate planting and summer droughts intensify water-competition risks. Retaining crop residues also poses opportunity costs, as straw and stover are valuable for feed, bedding, or household use in the mixed farming systems prevalent around South.

5.4.2. MRV and transaction burdens.

High-integrity carbon accounting requires annual, geo-referenced SOC sampling across fixed plots (≤ 25 ha), multi-depth coring and accredited laboratory analysis, plus third-party validation/verification and registry issuance. For an individual farm, the coordination, documentation, and audit overhead is significant: scheduling field access, handling samples, maintaining chain-of-custody, and entering complete activity data (rotations, tillage, residues, applications, yields). Without aggregation, per-hectare MRV costs and transaction friction often exceed any near-term revenue from credits, eliminating the economic case for individual farm participation.

5.4.3. Market and policy uncertainty.

Farmers in South perceive participating on their own in the voluntary carbon market as costly, complex and volatile: buyer standards evolve, ratings and due diligence create additional scrutiny, and price expectations are uncertain.

5.4.4. Behavioral and organizational frictions.

Farming is inherently risk-managed; decision heuristics emphasize operational reliability over experimental gains. Local norms, agronomic advice traditions, and peer influence often discourage deviation from established seedbed preparation and weed-control routines. Knowledge gaps exist around species selection for cover mixes, termination methods, and fine-tuning nutrients under reduced disturbance. Where farms depend on seasonal or migrant labor, introducing new operations (cover establishment, alternative termination) raises training needs and coordination risk—costs that are rarely priced into conventional budgets.

5.4.5. How Carbonsafe's design addresses these barriers.

Aggregation to reduce cost and friction - Carbonsafe aggregates multiple farms across South and standardizes MRV through fixed-plot geometry, automatic geo-referenced probing, consolidated logistics, and accredited lab contracts. Economies of scale reduce per-ha costs for sampling, analysis, verification, and registry issuance. The ERP is developing processes to capture operations data once at the source and format it for audit, while Carbonsafe manages chain-of-custody, validator coordination, and registry workflows—removing the transaction burden that would be prohibitive for individual farms.

Performance-based, ex-post revenue with risk-sharing - Credits are ex-post and strictly tied to measured SOC increases. To align incentives and protect buyers and producers against reversal risk, Carbonsafe issues 25% of verified net removals each year and retains 75% in reserve, releasing the reserve in subsequent period only if positive performance is shown. This structure shares risk across the portfolio and smooths cash flow while safeguarding integrity. Importantly, Carbonsafe's revenue-sharing model directs a material share of proceeds to farmers, strengthening the micro-economics of practice conversion.

Targeted agronomic support that lowers transition risk - Each farm receives an annual, plot-level soil profile (SOC plus macro/micro nutrients, pH) and custom agronomic recommendations that optimize fertilization and rotations under reduced disturbance. This data-driven advisory helps preserve yields, reduce unnecessary inputs, and manage water—key for South's drought-prone environment. Where agronomic necessity dictates (e.g., weed outbreaks, wet years), the design allows temporary, strategic tillage without automatic exclusion; instead, issuance follows measured outcomes, avoiding punitive responses to legitimate risk management.

Tenure-aware contracting to solve split incentives - Carbonsafe requires clear land tenure or long-term leases, with contracts that tie credit ownership and revenue allocation to the implementing operator.

Trust, transparency, and market access - All issued units are traceable in the Balkan Carbon Credits Registry (BCCR) with public serials linked to farm and vintage, and the project undergoes independent validation/verification. The methodology is measurement-only and the credits are ex-post, two features that directly address buyer concerns about over-crediting and forecast risk—improving price discovery and off-take reliability for farmers.

Learning loop and de-risking over time - Annual measure–remeasure creates a feedback loop: if a plot (cell) underperforms, advisory shifts minimizing persistent losses. The sub-project reserve and release mechanism provide a prudential security that covers unexpected negatives—giving producers confidence that participation will not expose them to net financial penalties beyond foregone issuance in weak years.

In the absence of Carbonsafe's financial incentives, aggregation, MRV infrastructure, and agronomic advisory, most farms in South region, Bulgaria would rationally delay or avoid adopting the full regenerative bundle at scale. Capital intensity, drought-related transition risk, MRV and transaction costs, and uncertainty about carbon revenues are binding constraints. Carbonsafe's design directly relaxes these constraints—lowering unit costs, sharing risk, clarifying tenure and claims, and converting measured soil carbon gains into bankable, traceable credits—thereby unlocking adoption that is unlikely to occur without the project.

5.5. Financial Additionality Assessment

Carbonsafe looks into financial additionality by comparing (i) the counterfactual—continuation of business-as-usual (BAU) management in South Province—with (ii) the with-project case, in which farms adopt the full regenerative practice bundle and submit to annual SOC measure–remeasure MRV, third-party validation/verification, and ex-post issuance. We investigate whether, absent carbon revenue, the with-project case is (a) not financially attractive and/or (b) unlikely to clear adoption benchmarks commonly used by producers (e.g., short payback expectations, working-capital neutrality, volatility tolerance). We also explore whether carbon revenue is the decisive factor that converts an otherwise unattractive or delayed investment into a feasible one.[35][36][37][38][39][40]

5.5.1. Financial incentives (with-project vs BAU).

1. CAP Eco-schemes vs. Carbon Credit Revenues in Bulgaria

In 2023 Bulgaria launched new voluntary eco-schemes under the EU Common Agricultural Policy (CAP) to encourage sustainable farming (e.g. reduced pesticide use, crop diversification, green manuring, etc.). These schemes had a combined budget of roughly €134 million and were

[35] European Court of Auditors. (2021). *Special Report 16/2021: Common Agricultural Policy and climate – Half of EU climate spending but farm emissions are not decreasing*. Luxembourg: Publications Office of the European Union. Retrieved from https://op.europa.eu
[36] European Commission. (2022). *Commission approves Bulgaria's CAP Strategic Plan 2023–2027* [Press release]. Directorate-General for Agriculture and Rural Development. Retrieved from https://agriculture.ec.europa.eu
[37] Tridge News. (2023). *Bulgaria: Farmer participation in 2023 eco-schemes drops significantly compared to greening*. Retrieved from https://www.tridge.com
[38] Bulgarian Paying Agency (BPA). (2023). *Eco-scheme payment rates for 2023* [via Bulgarian News Agency (BTA)]. Retrieved from https://www.bta.bg
[39] Carbonsafe. (2024). *Project Registry: Issued credits from projects in Bulgaria*. Retrieved from https://carbonsafe.bg
[40] Carbonsafe. (2024). *Project description: Lovech (Drenov) carbon farming project*. Retrieved from https://carbonsafe.bg

intended to reward environmentally friendly practices. However, farmer uptake was limited – only about 20,000 farmers (under 36% of those eligible) applied for the new eco-schemes in 2023, compared to ~54,000 who used to receive "green" payments under the prior CAP period. The most popular were the easy measures (crop diversification, pesticide reduction, soil preservation), while more demanding schemes (like maintaining on-farm biodiversity areas) saw low participation. This low uptake, due to complexity and uncertainty, already signals that many farmers do not rely on or fully benefit from these policy incentives – an important context for additionality (whether carbon projects provide benefits beyond business-as-usual).

Crucially, CAP payments per hectare under these eco-schemes are relatively low – and even lower for large farms. Bulgaria's plan explicitly favors small farms with higher payments (and sets a cap on payouts to big farms). For example, a small farm might earn around €38/ha from a given eco-scheme, whereas a large landholding might get only about €16/ha for the same practice (a reflection of redistributive support limits). By contrast, the potential income from carbon credits in Carbonsafe soil projects far exceeds these figures. Carbon credit revenues – even at conservative prices – dwarf the CAP eco-scheme payments. For instance, one Bulgarian soil carbon project (~700–760 hectares) issued ~8,600 credits; if sold at €30 each, that would yield roughly €258,000 total, or about €340 per hectare. With 50% farmer share, this equates to €170 per hectare. Even at a lower price of €15/credit, the farmer share would be about €85/ha, which is still more than double to five times greater than the €16–38/ha from typical eco-scheme subsidies. At €45/credit, farmer income would reach roughly €255/ha, making the gap even wider.

Furthermore, the reliability of CAP incentives going forward is uncertain. Implementation of the new schemes was delayed and plagued by administrative complexity in 2023, and it's unclear if specific Carbonsafe projects even received any funding. Policymakers are now considering adjustments to these schemes due to the poor initial results. The shifting political and policy landscape (e.g. ongoing CAP reform tweaks) casts doubt on the long-term consistency of these payments. Notably, past "greening" measures in the CAP (2014–2020) delivered limited environmental outcomes – €100 billion in EU spending had little impact on reducing farm emissions – suggesting that these subsidies have not fundamentally changed business-as-usual. This all bolsters the additionality argument for Carbonsafe projects: the carbon credit revenue is a decisive, extra incentive driving climate-friendly farming, above and beyond what existing policies provide. Below, we examine this financial additionality in each targeted region of Bulgaria, under three carbon price scenarios (€15, €30, and €45 per credit, with a 50% farmer share).

Across Southern Bulgaria, CAP eco-scheme payments remain modest (often ~€15–40/ha, size-dependent). By contrast, measured ex-post soil credits yield materially higher farmer benefits (illustratively ~€85/ha at €15, ~€170/ha at €30, ~€255/ha at €45 per credit), demonstrating that carbon revenues, not subsidies, are the decisive enabler of the regenerative bundle under local climatic and market conditions.

Cross-Regional Analysis: For example, across Plovdiv, Dobrich, Lovech, Pleven, Sofia, Targovishte, Burgas, Shumen, Varna, Vratsa, and Yambol, the pattern is consistent. The financial returns from carbon credits (with farmers receiving 50% share) dramatically exceed those from overlapping policy incentives.

- CAP eco-schemes: ~€16–38/ha (lower for large farms).
- Carbonsafe farmer share: ~€85–255/ha at €15–45/credit.
- Additionality proof: Carbon farming delivers 2–15× higher revenues than subsidies.

This demonstrates that the adoption of regenerative practices and SOC gains in Carbonsafe projects are clearly financially additional: they would not occur at scale under business-as-usual subsidies, but they do under the robust, market-driven incentive of carbon credits.

Across all example regions – Plovdiv, Dobrich, Lovech, Pleven, Sofia, Targovishte, Burgas, Shumen, Varna, Vratsa, and Yambol – the pattern is consistent. The financial returns from carbon credits under the Carbonsafe program dramatically exceed those from overlapping policy incentives (CAP eco-schemes). While Bulgaria's CAP eco-schemes provide a helpful but small payment (roughly €16–38 per hectare), the carbon credit revenues at even modest market prices are an order of magnitude higher (roughly €85–255 per hectare under €15–45/credit scenarios). This means that the carbon projects' climate mitigation activities are not financially attractive under business-as-usual conditions (i.e. they wouldn't be adopted at scale for a €15–€30 subsidy alone), but they become attractive when carbon income is introduced. Multiple factors reinforce this conclusion:

- Policy overlap is limited and uncertain: Some practices rewarded by Carbonsafe (e.g. soil carbon sequestration via no-till, cover crops) might receive token support from CAP, but the new eco-schemes in Bulgaria had low uptake and are subject to change. Delays and reforms in CAP implementation mean farmers cannot count on them reliably, whereas a forward sale of carbon credits or a long-term carbon contract provides clearer income expectations.

- Large farmers get very little from subsidies: Many regions (South, Pleven, Vratsa, etc.) have large farming companies that hit CAP payment caps, making the eco-scheme payout per hectare almost negligible. Carbonsafe projects give these farms a substantial revenue source that simply did not exist before – a strong additionality argument.

- Carbon revenue eclipses any single subsidy: Even where a farmer could stack multiple eco-schemes or agri-environment payments, the total would still be far below the carbon credit earnings in our scenarios: credits at €30 fetch ~€170/ha, *with no upper limit on area*. Thus, carbon finance clearly provides an additional financial flow that goes beyond the scale of conventional incentives.

- Evidence of limited prior impact: The track record since 2013 shows that EU farm environmental payments alone did not significantly reduce emissions or change practices. In our case, however, the introduction of carbon payments has triggered new actions (measured soil carbon increases and verified credit issuance). This indicates the projects are delivering climate benefits that would not have happened otherwise, satisfying the core of financial additionality.

2. Financial incentive forecast of Carbonsafe Projects (Forecast: 500k credits, 100k ha by 2027)

Key Assumptions:

- Forecast (by 2027): 500,000 credits across 100,000 ha = ~5 credits/ha/year.

- Market prices tested: €15, €30, €45 per credit.

- Farmer share: 50% of revenues.

- Resulting farmer income per hectare:

    - At €15 → €37.5/ha

    - At €30 → €75/ha

    - At €45 → €112.5/ha

- CAP eco-scheme reference: ~€16–38/ha (higher for small farms, lower for large farms).

Financial incentive forecast (with 50% farmer share):

- CAP support: €16–38/ha (many small/medium farms, closer to upper range).

- Carbon income: €37.5–112.5/ha

- Additionality: At €15/credit, carbon income is higher than average CAP rates, but at €30–45, it clearly surpasses eco-schemes. This demonstrates additionality, especially for mid- and large-sized farms.

5.5.2. Capital expenditures (CapEx).

Most participating farms require investment and/or re-tooling to reliably implement reduced disturbance with high residue loads and cover/intercrops: no/low-till drills, high-residue planters, roller-crimpers, precision applicators, and—case by case—upgrades to storage/handling for organic amendments. These are lumpy expenditures that are difficult to amortize under short leases or variable cashflows.

5.5.3. Operating expenditures (OpEx).

Direct costs increase in transition years: certified cover seed, establishment and termination passes (mechanical or chemical), adjusted weed-control projects under reduced tillage, and enhanced scouting. Where residues have market value (e.g., straw), in-field retention implies an opportunity cost. Agronomic advisory tailored to plot-level soil profiles also adds cost in the first years (training, field days, decision support).

5.5.4. MRV and transaction costs.

High-integrity accounting requires annual geo-referenced sampling, accredited laboratory analysis, independent validation/verification (VVB), and registry fees. Without aggregation, the per-hectare cost is material and often exceeds any near-term input savings.

5.5.5. Cost of capital.

Farm businesses carry higher effective hurdle rates than corporate benchmarks due to seasonality, collateral limitations (soil health gains are not bankable collateral), and revenue volatility.

5.5.6. Financial scenarios.

- Counterfactual (BAU):
  Under BAU, farms avoid CapEx for specialized seeding/termination equipment, do not incur annual SOC MRV costs, and face known gross-margin variability. There is no new revenue stream.
- Impelenting carbon farming (without-project, no carbon revenue):
  Introducing the regenerative bundle without carbon revenue produces (in typical pro formas):
  1. Lower or volatile margins in Years 1–2 (transition),
  2. Higher OpEx (cover seed/termination, advisory, scouting),
  3. CapEx service (debt or depreciation) for equipment.
  4. At farm-level hurdle rates, payback is extended beyond practical decision thresholds.
- With-project (with carbon revenue):
  When carbon revenue is included, the cashflows shift materially: ex-post issuance creates a new revenue line that aligns with measured performance; over time, reserve releases compound the effect.

5.5.7. Treatment of public support and stacking.

Where farms access eco-schemes or agri-environment support, these payments are disclosed and treated as cost-offsets, not as creditable outcomes. They do not eliminate the need for carbon revenue because:

1. they do not remunerate measured SOC increases,
2. they typically do not cover MRV/transaction costs, and
3. they do not address the cashflow timing of ex-post issuance.

5.5.8. Financial additionality test- passed

Given (a) the up-front and recurring costs of practice conversion and high-integrity MRV, (b) transition risk to yields in a moisture-limited environment, and (c) the higher hurdle rates faced by farms, the regenerative bundle is not financially viable at scale without carbon revenue. Carbon credit proceeds—issued only when measured SOC increases are verified—are the decisive enabler that converts an otherwise unattractive or delayed transition into a feasible, investable pathway. Therefore, the Carbonsafe project meets the financial additionality test.

5.6. Carbon finance.

Carbon finance is the enabling mechanism that converts measured increases in soil organic carbon (SOC) into a reliable, auditable revenue stream for participating farms in South Province, Bulgaria. It underwrites adoption of the full regenerative bundle (reduced disturbance with residue retention, cover/intercrops where feasible, diversified rotations, nutrient optimization), funds high-integrity MRV, and provides buyers with ex-post, traceable, science-backed removals. The financial architecture is deliberately conservative: issuance is strictly ex-post, risk is shared via sub-project reserves and a permanence buffer, and all credits are serialized and publicly traceable on the Balkan Carbon Credits Registry (BCCR).

5.6.1. Credit asset, unit economics, and price formation.

Asset definition: Each Carbonsafe unit represents 1 tCO_2e of net atmospheric CO_2 removed via measured SOC stock increase in the project boundary (0–90 cm). No forward projections, models, or ex-ante issuances are used.

Price drivers: Prices reflect a removals premium for (i) ex-post issuance, (ii) 100% physical soil sampling (measure–remeasure), (iii) annual agronomic plot (cell) level benefit, (iv) independent VVB validation/verification, and (v) full traceability at farm/plot/vintage on BCCR. Additional premia may arise from co-benefits disclosure (soil health, water retention, biodiversity indicators).

Buyer segments: Primary demand is expected from EU/UK corporates with Net Zero and high-integrity VCMI claims frameworks, sustainability-led SMEs seeking credible removals, and intermediaries (brokers/exchanges) curating quality supply. Transactions occur bilaterally (OTC) or via platforms/aggregators.

Issuance policy (ex-post): Credits are minted after verification confirms a positive SOC results for each farmer/year: 25% current + 75% performance reserve. This protects buyers against transitory gains and aligns cash flows with persistence of outcomes.

Permanence risk management: buffer pool (force majeure reversal coverage). Separate from the sub-project reserve, a buffer pool of 5 % holds a fixed share of verified removals to compensate for force majeure reversals (e.g., SOC losses due to extreme drought, erosion, fire etc.).

Serialization and registry controls: All credits are issued with unique serial numbers reflecting project, geography, sub-project/farm ID, vintage, and range. Serial blocks map to specific farms and plots (cells), and are publicly searchable on BCCR. Transfers and retirements are on-chain/book-entry in the registry to prevent double issuance or double use.

Anti-double-counting and exclusivity: Each farm signs exclusivity declarations (no participation in parallel carbon projects) and provides evidence for no double claiming against national inventories where applicable. BCCR listing includes declarations of non-overlap.

KYC/AML and sanctions screening: For OTC sales executed by Carbonsafe as developer-seller, KYB/KYC, beneficial-ownership attestations, and sanctions screening are performed on buyers (and upstream counterparties where relevant). BCCR enforces onboarding checks for account holders. Transaction monitoring aligns with prevailing EU AML expectations for environmental commodity markets.

Retirement: Final use of credits occurs through registry retirement to a named (except explicitly stated by the beneficiary not be publicly disclosed) beneficiary - end buyer or their designee.

Retirement statements include project/farm references, vintage, and (where consented) narrative of co-benefits.

5.6.2. Contract forms and offtake architecture.

Spot and pay-on-issuance: Default contracting is spot or pay-on-issuance against a defined serial block. Title transfers upon registry issuance/transfer, not before.

Forward offtake (conditional): Where buyers seek multi-year volumes, Carbonsafe may enter forward offtake with pay-on-issuance settlement, incorporating price floors/collars and downward volume flex keyed to verified outcomes. No pre-sale of unissued units occurs without such contingencies; delivery risk rests explicitly on measured SOC performance.

Escrow and settlement assurance: For larger trades, proceeds can be routed via escrow with release conditioned on registry transfer/retirement confirmations. This protects farmers and buyers and reduces receivables risk.

5.6.3. Portfolio finance, liquidity, and risk controls.

Inventory and liquidity: Issued inventory equals the 25% current issuance plus any released reserves. Liquidity is managed through sub-project staging.

Counterparty risk: Buyer credit risk is mitigated via pay-on-issuance, escrow, or staged deliveries. Brokered transactions use counterparties with market reputation and adequate AML/KYC.

FX and pricing currency: Contracts are denominated in EUR (BGN-pegged), minimizing FX volatility. Where buyers pay in other currencies, conversions occur at settlement with disclosed reference rates.

Auditability: Financial flows from issuance to farmer disbursement are recorded and auditable. The registry's public ledger plus internal ERP reconciliations provide end-to-end traceability.

5.6.4. Alignment with integrity initiatives and policy frameworks.

Carbonsafe structures MRV, governance, and registry transparency to be auditable, including documentation of additionality, conservative accounting, and robust reversal management. The BCCR registry publishes methodology acceptance, serials, and project documents to meet buyer due diligence expectations.

5.6.5. Governance, conflicts, and ring-fencing.

Separation of roles: The Registry (BCCR), VVB, and Project Developer have distinct roles: BCCR administers registration/serialization; the VVB validates and verifies; Carbonsafe develops projects and executes sales for farmer accounts. Where Carbonsafe sells credits on behalf of farmers, it operates under agency terms with transparent commissions and no discretion to re-pledge or encumber farmer assets.

Decision controls: Changes to issuance pacing or reserve release rules follow documented governance. Any material change triggers stakeholder notice and, where required, VVB review and confirmation.

6. MONITORING PLAN (MRV).

6.1. Sampling Design.

The Carbonsafe monitoring plan is founded on the principle of direct measurement only, applying an annual measure–remeasure approach to soil organic carbon (SOC). Its objective is to ensure that every issued credit corresponds to a physically observed increase in soil carbon, verified with statistical rigor, and documented with full traceability from the field to the registry. To achieve this, the sampling design is deliberately conservative, scientifically robust, and fully auditable.

Each participating farm in the South region is divided into fixed sampling plots, ranging in size from four to twenty-five hectares. Once established, the plot boundaries remain constant throughout the sub-project's renewable crediting period, ensuring that re-measurement is conducted on the same areas year after year. This permanence of sampling units is a cornerstone of the project, as it allows genuine SOC changes to be tracked over time with high confidence.

Sampling within these plots (cells) follows a systematic yet flexible field design. In each plot (cell), twenty-five soil cores are collected along a zig-zag or diagonal transect, designed to evenly cover the entire polygon while avoiding areas that would distort results, such as field margins, tractor ruts, or manure piles. The overall pattern ensures both representativeness and repeatability. The sampling track of the ATV vehicle is georeferenced and logged in the project's ERP system, creating a permanent digital record of sampling activities.

The depth profile of sampling is critical to capturing true changes in SOC. Carbonsafe measures soil carbon to a depth of 90 centimeters, subdivided into three layers: 0–30 cm, 30–60 cm, and 60–90 cm. This horizon reflects the bulk of carbon storage in arable soils and aligns with international best practice and reporting frameworks. For each depth, the 25 cores from a plot (cell) are composited into a single representative sample, resulting in three samples per plot (cell) each year. A retained sample of each composite is archived for period of two years to allow for future re-analysis, ensuring dispute resolution and cross-laboratory checks remain possible.

Accurate SOC stock accounting requires not only concentration data but also bulk density and coarse fragment corrections. These measurements, together with stone content assessments, allow the conversion of laboratory concentrations into reliable carbon stock values. Quality assurance thresholds are applied such as accredited lab standard operating procedures.

Samples are transported under chain-of-custody procedures, labeled with barcodes that encode all relevant metadata, and delivered to accredited laboratories. Laboratory processing follows strict protocols: samples are dried, sieved, ground, and analyzed using dry combustion methods. Total inorganic carbon is measured so that only organic carbon is credited. Laboratories are required to run certified reference materials, blanks, duplicates, and control charts to verify accuracy.

The entire process is supported by a digital audit trail. Field teams record data and photographs directly into a mobile app synchronized with the ERP. GPS tracks, timestamps, and barcodes link every sample back to its origin plot (cell) and depth. This ensures that any future verifier or buyer can trace each credit to its physical evidence. Exceptions, such as delayed sampling due to weather or management interventions (e.g., deep tillage, conversion to orchard), are logged.

Carbonsafe sampling design ensures that the project's monitoring is systematic, conservative, and transparent. By combining fixed plot boundaries, rigorous core counts, multi-depth analysis and accredited laboratory testing, the project delivers a data foundation of the highest scientific quality. This framework provides buyers with confidence that every issued credit is backed by direct, measurable, and verifiable increases in soil carbon stocks, making Carbonsafe fundamentally distinct from methodologies that rely primarily on modeling or infrequent sampling.

6.2. Sampling Frequency.

Carbonsafe applies a strict, annual measure–remeasure cadence to every active sampling plot, so that soil organic carbon (SOC) stock changes are observed over a consistent intervals. Each farm in the South project area is scheduled into a fixed monitoring year that mirrors the regional agronomic cycle: sampling is performed within 10 to 14 months intervals in the same seasonal window for that plot (cell) each year. This temporal discipline of revisiting the same plot in the same interval minimizes bias and ensures that the observed ΔSOC reflects true year-on-year change rather than timing effects.

In South's continental–Mediterranean setting, the preferred window is post-harvest and pre-primary tillage, when fields are accessible, residues have settled, and soil moisture is relatively stable. Where a plot's rotation or logistics demand a different window (for example, early spring prior to planting), that alternative is locked in as the reference window and used consistently thereafter.

Bulk density must be taken by core method (ISO 11272 or equivalent) and registry of the land areas with bulk density samples taken must be maintained.

Each populated land area has an identification code - The Unified Classifier of Administrative-Territorial and Territorial Units (EKATTE). Bulk density is taken from a specific plot (cell), selected randomly from the first farm enrolled within a specific land area (EKATTE) and this bulk density is valid for the whole sub-project renewable crediting period. If subsequent farm is enrolled in the same land area (EKATTE), the already registered bulk density is taken into account. Bulk density samples are taken from the three soil layers: 0-30 cm, 30-60 cm, and 60-90 cm, and are sent for testing in an accredited laboratory

Laboratories analyze every composite sample every year for SOC by dry combustion, and they also determine total inorganic carbon so that only organic carbon contributes to credited removals. The lab's internal QA/QC reflects every batch, not intermittently.

Quarantine period must be observed after fertilization - 180 days for rotted manure. For all mineral fertilizers, we observe a quarantine of 40-60 days until sampling.

For a given monitoring year, a plot's samples must be collected, received by the lab by the close of the issuance cycle. Where a plot (cell) misses its window and cannot be re-sampled in time, its data are carried forward for inclusion in the next annual issuance once compliant re-measurement is completed. No forward crediting is allowed: ex-post only issuance relies strictly on data from that plot's most recent, on-schedule re-measurement.

6.3. Data Collected.

Carbonsafe's monitoring system captures a complete and auditable record of the physical, chemical, and managerial conditions that determine soil organic carbon (SOC) stocks and their year-on-year change. The data model is structured around the plot–depth–year triad: every observation is anchored to a fixed sampling plot (4–25 ha), a defined depth horizon (0–30, 30–60, 60–90 cm), and a monitoring year, with immutable links to the farm, field, and later to credit serial numbers on the registry. All entries carry timestamps, user IDs, and GPS metadata, creating a verifiable chain from the field to accredited laboratories and ultimately to issuance.

At the core are the primary biophysical measurements required to compute SOC stocks. For each plot (cell) and depth, composite samples produced from twenty-five individual cores are analyzed for soil organic carbon concentration by dry combustion. Where stones or coarse fragments larger than 2 mm occur, their proportion is quantified so that stocks are expressed on a fine-earth basis. The three parameters—SOC concentration, bulk density, and coarse fragments—form the minimum viable set for stock (Mg C/ha) and stock change (ΔSOC) calculations. The laboratory logs preparatory steps (drying, sieving, grinding), instrument identifiers, calibration runs, and quality controls, ensuring that every reported value is traceable to method performance (ISO 10694, ISO 11465).

Because Carbonsafe is designed to deliver agronomic value alongside climate outcomes, each composite is also profiled for soil fertility and health indicators. The project routinely captures pH and a panel of macro- and micro-nutrients (for example N, P, K, S, Ca, Mg, and micronutrients such as Fe, Mn, Zn, Cu, B). These data do not directly enter the carbon accounting but are critical to generating the plot-level agronomic recommendations that support practice persistence, nutrient optimization, and long-term soil resilience.

The field context is ovserved at the time of sampling. The ATV GPS track is stored. Photographic evidence (geotagged) is appended where useful. These contextual fields ensure that any subsequent reviewer can reconstruct how and where the sample was obtained.

Equally important is the management dataset, collected for each plot (cell) and year to document the practices whose adoption constitutes the project scenario. Carbonsafe reviews the crop grown (including cultivar where available), sowing and harvest dates, rotation history, cover/intercrop species and their termination method, tillage regime (type, depth, dates). Nutrient management is captured at high resolution: fertilizer types (synthetic/organic), formulations and rates, application dates and methods, and any lime or organic amendments (compost, manure, digestate). Where applicable, irrigation and plant protection applications will be recorded. This management data is used for three purposes: (i) to verify eligibility and additionality (non-common practice at enrollment), (ii) to attribute SOC changes to practice bundles at audit, and (iii) to enable co-reporting of non-CO_2 effects (e.g., N inputs relevant to fertilizer usage monitoring), which are disclosed as non-credited information unless and until an accepted methodology explicitly integrates them.

To maintain full transparency and accountability, every physical sample is bound to a chain-of-custody record that travels from field to laboratory and then to the data warehouse. The chain-of-custody includes the farm/field/plot codes; depth; barcodes; GPS track reference; sampler identity; date, time, and conditions; and any anomalies. Laboratory intake records link these identifiers to the batch, while ERP integrations lock the records after QA sign-off and retain an immutable audit log of edits, approvals, and data exports used for verification.

Together, these data streams—primary SOC stock inputs, fertility and health profiles, field context, management practices, and custody metadata—form a cohesive and conservative evidence base. They allow independent verifiers to confirm that each tonne of CO_2 credited by Carbonsafe corresponds to a measured, well-documented, and statistically robust increase in soil carbon, achieved through practices that are explicitly recorded and persistently managed at the plot (cell) scale.

6.4. Geo-referencing.

Geo-referencing underpins Carbonsafe's claim that every issued unit is traceable to a specific piece of land where the increase in soil organic carbon (SOC) was physically measured. The system is designed to (i) locate, with audit-grade precision, each sampling plot (cell) and field operation; (ii) ensure spatial comparability across years; and (iii) maintain an immutable spatial record that links field data to laboratory results and, ultimately, to registry serial numbers.

At project initiation, each participating farm is digitized into fixed sampling plots (4–25 ha) using a controlled GIS workflow. Source layers include cadastral boundaries (for legal clarity). Plot polygons are stored in a versioned geodatabase; the geometry of a plot, once confirmed with the farmer, becomes the reference spatial unit for the full monitoring term. Any later change (e.g., consolidation or subdivision) is treated as a material spatial change: the previous geometry is archived, a new version is created with a timestamp and rationale.

All field operations are captured with GPS -enabled equipment. The automated probe mounted on an ATV records a continuous GPS track during sampling.

The within-plot sampling pattern is spatially balanced and reproducible at the polygon scale rather than at permanent point coordinates. Twenty-five cores per depth are collected along a systematic zig-zag/diagonal transect that spans the plot and intentionally avoids biasing features. In the course of sampling, it is mandatory to avoid the boundaries of the plot (cell), where it is possible to have a deviation from the normal values of the results due to various reasons, such as: over-fertilization, over-drying, waterlogging of the soil; overcrowding as a result of agricultural machinery; various impacts and specifics of the relief; independent and uncontrolled by the project actions on adjacent areas performed by unspecified persons. This design choice—anchoring the pattern to the plot polygon, not to fixed points—reduces the risk of disturbance artifacts (e.g., repeatedly coring the same microsite). The complete ATV track is saved and bound to the plot (cell) ID, monitoring year, operator ID, and sample barcodes.

Every composite sample (per plot and depth) carries a unique geo-linked identifier that encodes Farm, Field, Plot (cell), Depth, and Year. Barcodes are scanned in the field (at bagging), at lab intake, and at analysis. The chain-of-custody record references the plot polygon ID and the GPS track, so that any later review can reconstruct exactly where the operator drove and how the composite was formed. Photographs (geotagged) are attached for contextual evidence and the mobile app enforces completion of mandatory spatial metadata before a sampling job can be closed.

The ERP validates that all cores were collected inside the target polygon and that the traverse adequately covers the plot. If a segment falls outside the boundary or coverage is inadequate, the necessary measures are taken. Year-to-year overlays of GPS tracks are recorded.

Spatial data provide the backbone for traceability to the registry. When credits are issued, the serial-number block for each issuance explicitly references the farm. This creates a verifiable link from a buyer-visible credit back to the exact farm sampled. The registry can, at any time, map a serial back to its geographic origin. All spatial records are retained under immutable audit logs, with controlled access and GDPR-compliant safeguards for landowner privacy.

Through this architecture—fixed, versioned polygons; GPS tracking; polygon-anchored sampling geometry; and end-to-end geo-linked custody—Carbonsafe ensures that each tonne credited is spatially unambiguous, re-locatable, and auditable, meeting the demands of high-integrity buyers, independent verifiers, and registry oversight.

6.5. QA and QC Protocol: Laboratory standards.

Carbonsafe's laboratory quality system is designed to ensure that every reported soil organic carbon (SOC) value is accurate, traceable, and defensible under independent audit. All analytical work is performed by ISO/IEC 17025. The QA/QC framework spans the entire analytical chain—from sample receipt and preparation through instrument analysis, data reduction, uncertainty estimation, and secure archiving—so that analytical variance is explicitly quantified and kept distinct from project's field variance.

Sample receipt & chain of custody. Upon delivery, the laboratory reconciles each shipment against Carbonsafe's chain-of-custody: farm/field/plot IDs, depth, barcode, and time stamps. The lab records the condition of each sample. Discrepancies trigger a hold and a corrective action request prior to processing. The Laboratory ERP ingests the barcode set and binds them to a unique batch ID and analytical work order; all subsequent data inherit this ID so that results, QC events, and instrument runs are immutably linked to the specific samples.

Sample preparation controls. Preparation follows: air- or low-temperature oven-drying (≤40 °C for SOC pre-treatment), gentle disaggregation, 2 mm sieving, and fine grinding to achieve homogeneity. Between samples, mills are purged and cleaned to prevent carryover; process blanks (empty vessels subjected to the entire prep) accompany each batch to check for cross-contamination. Subsamples are split with a riffle or rotary splitter to maintain representativity. For each composite, the lab retains a sealed archival aliquot (with a unique ID) for potential re-analysis, dispute resolution, or inter-lab comparison.

Primary carbon measurements. SOC is determined by dry combustion (high-temperature elemental analysis). In soils likely to contain carbonates, the laboratory either: (i) measures Total Carbon (TC) by dry combustion and Total Inorganic Carbon (TIC) by an accredited carbonate method (e.g., manometric/coulometric Scheibler-type), reporting SOC = TC − TIC; or (ii) applies controlled acid pretreatment/fumigation to remove inorganic carbon prior to combustion, followed by verification that carbonate removal is complete. The chosen pathway is documented per sample set, including criteria (pH, effervescence tests, known lithology) that trigger TIC determination or acid pretreatment. For calcareous horizons, TIC-based correction is the default to minimize bias. (ISO 10694)

Bulk density and coarse fragments. Bulk density (BD) is derived from undisturbed core volume and 105 °C oven-dry mass on separate field BD cores, with coarse fragments (>2 mm) quantified gravimetrically or volumetrically. The lab records ring dimensions, tare, moisture state, drying time, and balance calibration checks. (ISO 11272:2014)

Calibration, reference materials, and control charts. Instruments are calibrated using certified reference materials (CRMs) that bracket the expected SOC range of project samples. Each analytical batch includes:

1. CRMs (at least two levels), run at the beginning and at regular intervals;
2. Method blanks to detect contamination;

3. Laboratory duplicates (blind splits) to quantify precision; and
4. Drift checks (mid- and end-run standards) for correction if necessary.

Results are tracked on control charts (e.g., Shewhart) with statistically defined warning and action limits. If a CRM falls outside action limits, the affected sequence is investigated (leaks, drift, detector saturation). The lab performs maintenance/recalibration, documents corrective actions, and re-runs the impacted samples. Only runs with all QC elements within acceptance limits are released from QA hold.

Acceptance criteria and re-run rules. Carbonsafe requires, at minimum:

- CRMs within their certified value ±2 SD (or stated uncertainty) after any drift correction;
- Blanks below the method detection limit (MDL);
- SOC duplicate pairs with ≤5–10% RPD depending on concentration range;
- TIC duplicates within ≤10% RPD; and

Failures prompt a structured escalation: (1) confirm calculations and metadata; (2) re-analyze from the retained ground subsample; (3) if still out-of-spec, re-prepare from the primary composite; and (4) if unresolved, request field re-sampling. All deviations, investigations, and outcomes are appended to the batch record.

Through this end-to-end laboratory QA/QC regime—accredited methods, rigorous internal controls, proficiency testing, and secured traceability—Carbonsafe ensures that every analytical datum used for SOC stock and ΔSOC estimation is fit for purpose, auditable, and conservatively framed for high-integrity carbon credit issuance.

6.6. MRV lifetime Design Plan.

The Carbonsafe MRV system is engineered as a lifetime framework that governs how evidence is created, audited, and preserved from project start through the end of liability. It is built on direct, annual measure–remeasure of soil organic carbon (SOC) at fixed geo-referenced plots (cells), backed by accredited laboratories and an auditable data backbone. The plan defines what is measured, when, by whom, how it is quality-assured, how uncertainty is treated, and how decisions to issue, defer, or reverse credits are made throughout the project's life.

6.6.1. Scope and time horizon.

The MRV plan spans a total of 40-year crediting period consisting of 5-year renewable individual farm crediting periods (annual monitoring and accounting each year). During crediting, every active plot (cell) is measured annually; after crediting, targeted surveillance continues to detect and manage reversals. The plan is renewable subject to re-validation of scope and performance.

6.6.2. Annual evidence cycle (measure–remeasure).

Each farm is partitioned into fixed sampling plots (4–25 ha) that remain constant over the MRV lifetime unless a documented material change occurs. For every plot (cell) and each depth horizon (0–30, 30–60, 60–90 cm), the project executes one annual, geo-referenced campaign.

6.6.3. Roles, competence, and calibration.

1. Field Operations: Trained samplers operate GPS automatic probes on ATVs, following SOPs for composite formation, chain-of-custody, and safety. Equipment (probes, balances, GPS) is calibrated to schedule with logs retained; out-of-tolerance instruments trigger halt/remediate rules.
2. Laboratory: ISO/IEC 17025 or equivalent–accredited labs perform SOC by dry combustion with carbonate correction where required; bulk density and coarse fragments are

measured on dedicated cores. Full QC is mandatory per batch; non-conformities trigger re-runs or re-preparation.

3. Data & QA: The MRV platform (ERP) enforces data integrity, immutable audit logs, and role-based approvals.
4. VVB: An accredited validator/verifier reviews design, field execution, lab QC, calculations, uncertainty, and issuance proposals; conducts site checks as needed.

6.6.4. Data model and traceability.

All observations are anchored to a plot–depth–year key and bind to farm, field, GPS track, sampler ID, and laboratory batch. Barcoded samples, digital chain-of-custody, and GPS tracks create an end-to-end evidence thread from farm to registry serial numbers. Spatial QA verifies that cores lie within polygons and that the traverse sufficiently covers the plot (cell); exceptions require corrective passes or documented waivers.

6.6.5. Conservativeness and issuance rule.

Issuance follows a precautionary policy:

1 25% of verified net removals are issued ex-post in the monitoring year.

2 75% of verified net removals are withheld in a performance reserve at the sub-project level. Withheld units are released in subsequent measurement period if the same farm shows positive performance, and 75% from the new issuance are allocated to the reserve to substitute the released ones. This rolling substitution ensures that the reserve remains fresh (non-aging) while protecting integrity if final farm balance measurements show losses.

3 Carbonsafe applies a fixed 5% deduction to total net verified removals due to uncertainty in carbon accounting.

6.6.6. Non-conformity management.

If a plot's sampling falls outside time tolerances, QC fails, or material anomalies are detected, the plot (cell) results are withheld, re-sampling is ordered (if feasible), and the event is logged. Credit issuance from that plot (cell) is paused until the VVB accepts the corrective action outcome.

6.6.7. Reversals and buffer interface.

Reversals in the final year of farm's crediting period first consume the farm performance reserve; if insufficient, the project draws from the shared buffer pool.

6.6.8. Change management and version control.

The MRV plan is adaptive. Any change to instruments, labs, or calculation parameters follows a controlled change process: documented rationale, possible validation and VVB notification. Material changes (that could affect credited quantities) are reflected and verified by VVB upon new issuance cycles. All documents carry version identifiers, effective dates, and supersession history.

6.6.9. Verification cadence and materiality.

Verification is annual (or in some cases periodical) for renewable farmer contracts during Years 1–5 to establish a high-confidence performance baseline and subsequent SOC changes. Materiality thresholds (e.g., for minor arithmetic corrections) are pre-defined; any adjustment beyond thresholds triggers re-statement of the affected issuance and, if needed, credit revocation and buffer compensation.

6.6.10. Data security, privacy, and retention.

All field and lab data, QC artifacts, calculation workbooks, and issuance records are retained under secure storage at rest and in transit. Soil samples are kept for 2 years, project documentation at Carbonsafe is kept for 5 years, lab records are kept for 10 years. Access is role-based, with GDPR-compliant handling of personal data. VVBs receive complete evidence packages for each monitoring year.

6.6.11. Integration with registry and serialization.

When the VVB approves issuance, the registry is instructed to create traceable serial numbers that encode the project, farm identity, monitoring year (vintage), and issuance tranche. Retirement events are publicly visible; transfers maintain chain-of-title. Any confidential annexes (e.g., commercial terms) are kept separate from public MRV artifacts.

6.6.12. Governance and accountability.

The Head of Integrated Management Systems (IMS) within Carbonsafe owns the schedule, QA gates, and VVB liaison. The Agronomic team reviews farm level diagnostics annually and recommends adjustments. The executive director signs off on SOP updates after recommendation from the Head of IMS and the Agronomic Committee. All decisions and rationales are minuted and archived.

In essence, the MRV Lifetime Design Plan ensures that every credited tonne is supported by fresh, annual, geo-referenced measurements, conservative treatment, disciplined QA/QC, and verifiable traceability—year after year, through issuance, reserve management, and the post-crediting liability window.

6.7. MRV Plan Review Protocol.

Carbonsafe's MRV Plan Review Protocol is the governance mechanism that keeps the monitoring system scientifically robust, operationally disciplined, and aligned with evolving best practice over the entire life of the project. It defines who reviews the MRV system, what is reviewed, when reviews occur, which evidence is required, and how decisions lead to controlled updates of SOPs, calculations, issuance rules, and training. The protocol integrates quality management (QA/QC), risk management, and change control into a single, auditable process.

6.7.1. Governance and Accountability.

The MRV Review team is led by the Head of IMS and includes the Head of Administration, Agronimic team, Laboratory Liaison, the Registry Liaison and the VVB Liaison. Where needed, external scientific advisors and independent statisticians join as invited experts. The Team's mandate is to assure that the MRV design remains fit for purpose; that execution evidence supports annual issuance; and that all material changes follow controlled, documented pathways. The Team maintains authority to recommend partial issuance, deferral, or suspension at the plot (cell), farm, or project level.

6.7.2. Cadence and Review Windows. Reviews occur at four levels.

1. Annual Comprehensive Review aligns with the issuance cycle: after laboratory results and preliminary calculations, but before VVB submission.
2. Field readiness and Lab capacity Review prior to the next sampling.
3. Event-Triggered Reviews are convened when non-conformities or risk signals arise (e.g., unusually high variance, instrument failure, extreme weather, VVB observations, or stakeholder complaints).
4. Periodical Reviews of new science or regulation.

Each review covers design adequacy, execution quality, calculation integrity, concervativeness treatment, and decision consistency:

1. Design Adequacy: Are the sampling windows and fixed plot (cell) geometry still appropriate? Are depth intervals and BD protocols followed?
2. Execution Quality: Does evidence show that all active plots (cell) were sampled within time tolerances; that GPS tracks are complete and within polygons?
3. Calculation Integrity: Are SOC stock and ΔSOC calculations correct, reproducible, and transparently documented? Are unit conversions and bulk density consistently applied?
4. Conservativeness: Is the issuance rule applied without exception?
5. Decisions to Issue/Defer/Reverse: Do issuance proposals respect materiality thresholds, non-conformity rules, and reserve/ buffer logic? Is negative performance transparently recognized and recorded?

The Team reviews a standard evidence pack: ERP exports binding field IDs to lab batches; GPS track files with spatial QA; complete chain-of-custody; Laboratory valid accreditation certificate; bulk density; calculation workbooks with version hashes. Any missing or inconsistent artifact triggers an immediate corrective action before decisions proceed.

In case non-conformity is observed, the Team is obliged to resolve it internally before proceeding with VVB review.

Farmers are briefed annually on MRV performance, and any protocol updates that affect their fields. Where changes alter obligations or benefits, updated agreements are executed.

The MRV Review Team prepares a Monitoring Report (MR) with Evidence Package available for VVB review. VVB comments are logged and formally closed, with outcomes folded into the next review.

The protocol integrates results monitoring: if ΔSOC is negative no credits are issued.

The Review Team verifies that all evidence remains complete, consistent, and enduring. Retention meets “crediting period + five years” with immutable audit trails. Any data incident (corruption, loss, or unauthorized access) is treated as a critical non-conformity with immediate remediation and reporting.

Insights from reviews drive targeted training, SOP refinements, and technology upgrades. The Team tracks the impact of these improvements in subsequent cycles, aiming for declining uncertainty, fewer non-conformities, and tighter alignment with emerging standards and buyer criteria—without compromising conservativeness.

7. QUANTIFICATION AND CALCULATION.

7.1. Carbon Sequestration Calculation.

1. Parameters measured:
   - Organic carbon (mg/kg)
   - Bulk density

Data according to obtained results from accredited laboratory.

2. Calculations following the control soil sample:

3.1 Soil quantity

Amount of soil (ton) = area * 10000 * 0.3 * bulk density

Where:

- Area = plot (cell) size (ha)
- 10000 = ha to m^2 area conversion factor
- 0.3 m = Depth (m), soil samples were taken from three soil layers 0-30 cm, 30-60 cm and 60-90 cm.
- Bulk density (g/cm^3) is measured once during first control year and is valid for the entire sub-project crediting period.

3.2 Difference in organic carbon (OC) at the plot (cell) level.

3. Calculation method for the reporting period of the first control:

Measured organic carbon (OC) mg/kg in the first control year (-) Measured organic carbon (OC) mg/kg in the baseline year.

The method is applied to all plots (cells) on the farm.

4. Calculation method for subsequent reporting periods after the first control:

A) Measured organic carbon (OC) mg/kg in the current control year (-) Measured organic carbon (OC) mg/kg in the previous control year

The method is applied to all plots (cells) on the farm with a reported positive result for measured organic carbon (OC) mg/kg in the previous control year.

B) Measured organic carbon (OC) mg/kg in the current control year (-) Measured organic carbon (OC) mg/kg in the base year.

The method is applied to all plot (cells) on the farm with a net-zero or negative result for measured organic carbon (OC) mg/kg in the previous control year and for which no increase above measured organic carbon (OC) mg/kg in the base year was detected.

C) Measured organic carbon (OC) mg/kg in the current control year (-) Measured organic carbon (OC) mg/kg above the base year

The method is applied to all plots (cells) on the farm with a reported result for measured organic carbon (OC) mg/kg above the base year, where a subsequent decrease in the levels of measured organic carbon (OC) mg/kg is observed.

5. (OC) content in soil per depth.

Difference in organic carbon (OC) * Soil quantity (mg/kg) per depth

6. Total (OC) content in the soil per plot (cell).

Sum of (OC) content in soil of the tree soil depths (0-30 cm, 30-60 cm and 60-90 cm)

7. Gross amount of removed greenhouse gas emissions Carbon dioxide CO_2.

Total (OC) content in the soil * 3.667

Where: 3.667 is a conversion factor for tC to tCO_2 (IPCC)

8. Data on fuel emission footprint from production equipment.
   - Average fuel consumption (tons/ha)

The average fuel consumption determined by the Methodology of the Ministry of Agriculture for determining the individual annual quotas in connection with the implementation of the state aid scheme "Aid in the form of a discount on the value of the excise duty on gas oil used in primary agricultural production

- Total fuel consumption per plot (cell) (tons/ha)

Average fuel consumption (tons/ha) * plot (cell) area (ha)

- Total fuel consumption (t CO_2 eq)

Total fuel consumption per plot (cell) (tons/ha) * 3.42

Where: 3.42 is conversion factor for tons/ha to tCO_2 eq

1l of diesel is equal to 36 MJ (Ordinance No. H-18 of August 8, 2016).

1MJ is equivalent to 95.1 g CO_2 (Methodology for determining the intensity of greenhouse gas emissions from the entire life cycle of fuels and energy of non-biological origin in transport). Therefore 36 * 95.1 / 1000 = 3.42

9. Net amount of removed emissions of greenhouse gas carbon dioxide CO_2 (ton).

Gross amount of removed greenhouse gas emissions Carbon dioxide CO_2 (ton) - Total fuel consumption (tCO_2e)

10. Uncertainty deduction.

Net amount of removed emissions of greenhouse gas carbon dioxide CO_2 (ton) - Uncertainty deduction (5 % of Net amount of removed GHG emissions carbon dioxide (CO_2)) = Net amount of GHG removed carbon dioxide (CO_2) after 5% uncertainty deduction

7.2. Farm balance

The farm balance is equal to the net amount of greenhouse gas emissions removed carbon dioxide CO_2.

Net amount of greenhouse gas emissions removed carbon dioxide CO_2 (=) Gross amount of greenhouse gas emissions removed carbon dioxide CO_2 (-) Total fuel consumption CO_2 equivalent

Gross amount of greenhouse gas emissions removed carbon dioxide CO_2 (=) the sum of all cells, positive and negative for the specific calculation period.

Total fuel consumption CO_2 equivalent (=) the sum of all cells, positive and negative for the specific calculation period.

7.3. Uncertainty Management

Carbonsafe's issuance policy is deliberately more conservative than standard practice to ensure that no tonne is overstated at issuance and that future variability in soil carbon stocks is prudently absorbed without passing risk to buyers. The mechanism rests on the nested safeguards that operate together across the full project life: (i) a sub-project level performance reserve, (ii) a shared project buffer for force majeure reversals, and (iii) uncertainty in carbon accounting.

7.3.1. Performance reserve.

Carbonsafe imposes a sub-project level performance reserve that explicitly manages future-year variability and operational non-conformities that cannot be captured at a single measurement point:

1. Issuance ratio. In the monitoring year, only 25% of verified net removals are issued ex-post. The remaining 75% are held as a farm-specific performance reserve.

2. Release. In subsequent re-measurement period, if the same farm shows positive ΔSOC, the reserved balance is released for issuance.

3. Stop-loss rules. If a farm records a negative ΔSOC, no credits are issued and release is paused until positive performance is re-established.

7.3.2. Justification of reserve.

Even with annual measure–remeasure, soils respond non-linearly to climate and management. The reserve transforms year-to-year noise into buyer-grade certainty, letting the project "self-insure" operational variability without reaching prematurely into the project buffer.

7.3.3. Project reversal.

If the overall balance of the farm is negative in the final year of the farm's crediting period, this is treated as reversal and compensation from the reserve is triggered.

In the rare event that farm performance reserves prove insufficient the project accesses a shared project buffer coordinated with the registry. Draws from this buffer are transparently recorded.

7.3.4. Uncertainty deduction in carbon accounting

Carbonsafe applies a fixed 5% deduction to total net verified removals. It reduces the credited amount of carbon to make sure reported results are not overstated due to measurement error, lab variability, or sampling limitations. This deduction is used in addition to (not instead of) our full QA/QC program and conservative calculation choices elsewhere in the MRV. The 5% factor reflects (i) robust sampling design and execution, (ii) accredited laboratory methods with documented precision, (iii) multi-layer QA/QC (field, lab, data), and (iv) alignment with market norms for projects with strong evidence of data quality.

7.4. Buffer pool, Credits reserve & Risk mitigation.

7.4.1. Release of Credits reserve.

Carbonsafe's conservative issuance model is designed not only to safeguard the environmental integrity of credits but also to reward farms that demonstrate sustained, measurable progress in removing CO_2 from the atmosphere. A central part of this model is the release for issuance of credits from the reserve, which occurs only when positive trend in the farm balance is evident once the measure–remeasure results are out. The results must be then verified by the VVB. If discrepancies are found in the released removals before the VVB verification, the data from the verification report shall be considered valid, and corrective actions will be taken. Each sub-project has its own reserve.

This release structure serves several vital purposes. It protects buyers and the market by preventing premature issuance of large credit volumes when performance improvements are still modest or uncertain. At the same time, it aligns farmer incentives with climate impact, ensuring that greater soil carbon sequestration and higher farm balances directly translate into greater credit income.

By embedding this performance-based release mechanism, Carbonsafe provides a system that is both risk-averse and motivating. Farmers are encouraged to adopt and maintain regenerative practices that deliver stronger and more consistent carbon benefits, while buyers gain confidence that each credit released represents not just a removal in the past but part of a verified trajectory of improvement. In this way, the reserve functions as a performance escrow, releasing value only when farms continue to deliver measurable climate impact.

The sub-project credits reserve consists of verified net sub-project removals before serial number issuance. The reserve is allocated in the Carbonsafe's sub-project internal registry. If the sub-project's SOC balance in the final year of the sub-project's crediting period is negative, the reserve is used to cover this reversal. Carbonsafe submits to the Registry the necessary verified net sub-project removals needed to cover the reversal. The Registry issues serial numbers for those removals and allocates them to the Buffer pool for direct retirement.

7.4.2. Buffer pool.

In addition to Carbonsafe's conservative issuance and reserve release policies, the project for South region maintains a centralized buffer pool equivalent to 5% of all verified net removals across participating farms. This buffer is specifically designed to address force majeuree events—rare, large-scale, and unpredictable occurrences that are beyond the control of individual farmers or the project developer, yet capable of undermining the permanence of stored soil organic carbon.

Force majeuree risks include, but are not limited to, severe droughts, floods, wildfires, pest infestations, geopolitical disruptions, or major systemic shocks to agricultural practices. The 5% buffer pool exists as a collective insurance mechanism to cover these low-probability but high-impact scenarios.

Every project participant contributes equally on a proportional basis—5% of their verified removals—into the buffer pool. This ensures that the burden of risk management is shared across the entire Carbonsafe project for South region rather than borne by individual farms disproportionately affected by natural disasters or extreme events.

The buffer is drawn upon when a documented force majeuree event leads to a clear and irreversible reversal of soil organic carbon at the farm or regional level, as determined through monitoring evidence and third-party verification. Examples include widespread crop failure due to prolonged drought that diminishes belowground carbon inputs, or catastrophic flooding that strips topsoil layers.

All claims on the buffer are subject to VVB review and must be validated as genuine force majeuree occurrences. Approved claims are recorded in the registry, and credits are permanently retired from the buffer pool to compensate for the loss. This process guarantees that environmental integrity is preserved and that no buyer holds credits linked to unmitigated reversals.

The buffer pool is continuously replenished with each issuance cycle, ensuring that the collective insurance mechanism remains active and adequately capitalized.

The buffer pool is a last-resort safeguard. Only when reserves are insufficient to cover negative farm balance results in the final year of the farm's crediting period or due to force majeuree circumstances, the shared 5% buffer is used. This layered structure ensures that the buffer remains dedicated to extraordinary risks.

Buyers of credits generated from Carbonsafe South region project are protected not only by the conservativeness of issuance and by farm-level reserves, but also by a project-wide safety net that guarantees compensation for unexpected, large-scale events beyond the control of any individual farmer. The buffer thereby ensures long-term permanence and market confidence.

8. DURABILITY, PERMANENCE & RISK MITIGATION.

8.1. Overview

One of the central challenges in soil carbon projects is ensuring durability, or the capacity of stored carbon to remain sequestered in the soil for long periods without being re-emitted into the atmosphere. In the context of the Carbonsafe South region project, durability is treated not as a fixed assumption but as a continuum of managed risk, governed by agronomic practice design, conservative accounting, and institutional safeguards such as reserves and buffer pools.

Soil organic carbon (SOC) is inherently dynamic. Unlike geologic storage, where permanence may span millennia, SOC stocks fluctuate in response to land management, climatic variation, and external shocks. In poorly managed systems, carbon can be quickly lost through intensive tillage, monoculture cropping, or soil erosion. Conversely, under regenerative agriculture practices—reduced tillage, cover cropping, crop rotation, organic amendments—SOC can be progressively stabilized into humified pools that persist for decades or longer. Carbonsafe acknowledges this duality: soils have enormous potential for durable carbon storage, but also carry inherent risks of reversal.

To address this, Carbonsafe defines permanence not simply as the "lifetime" of a credited tonne, but as a governed durability term, supported by annual monitoring and layered safeguards. The project's MRV system ensures that all removals are measured annually using geo-referenced sampling and accredited laboratory analysis. This creates a transparent time series of evidence, allowing declines in SOC to be detected immediately. Rather than relying on assumptions or modeled permanence horizons, Carbonsafe grounds its durability claims in empirical annual data.

Complementing this measurement-first philosophy is a crediting architecture designed to manage uncertainty and variability – credits reserves and buffer pool.

Durability in Carbonsafe also extends beyond physical safeguards to behavioral and contractual mechanisms. Farmers enter legally binding individual 5-year agreements requiring adherence to regenerative practices and are strongly encouraged to renew their participation every 5 years for the whole duration of the project. These contractual frameworks reduce the risk of premature abandonment of practices, which is one of the principal threats to SOC permanence.

Durability is understood within a broader policy and buyer context. The EU's Carbon Removal Certification Framework (CRCF) emphasizes that soil-based removals must be coupled with robust monitoring, conservative accounting, and liability mechanisms. Similarly, buyers demand clear evidence that durability is actively managed, not simply asserted. Carbonsafe's system of annual verification, conservative issuance, performance reserves, and buffer pools is designed to meet these requirements, offering a level of prudence and transparency that distinguishes it from projects relying heavily on models or sporadic sampling.

8.2. Reversals and leakage.

Within Carbonsafe, durability is safeguarded by treating reversals and leakage as distinct but interlinked risks, each addressed through measurement-led detection, conservative accounting, and layered liability.

8.2.1. Reversal

A reversal is defined as a verified net loss of the overall farm balance in the final year of the farm's crediting period. The farm balance for each reporting period is equal to the net amounts of removed greenhouse gas carbon dioxide (CO_2) emissions and includes the sum of all plots (cell) with reported positive and/or negative results regarding the soil organic carbon content for the specific calculation period. The overall farm balance is equal to the net amounts of removed greenhouse gas carbon dioxide (CO_2) emissions reported in the final year of the sub-project crediting period. The sub-project shall be deemed successfully implemented when the overall farm balance is positive. The sub-project shall be deemed unsuccessful when the overall farm balance is negative. In the event of a reported negative farm balance in the final year of the sub-project crediting period, the corresponding reserve shall be used to cover the reversal.

8.2.2. Leakage

In agriculture, the principal risk is activity-shifting: if practices reduce yields materially and consistently, a producer—or the local market—might compensate by expanding cultivation elsewhere or intensifying inputs, resulting in net emissions increases beyond the project's perimeter. Carbonsafe addresses this risk at three levels.

First, project design: the agronomic strategy is explicitly yield-protective (or yield-enhancing) through nutrient optimization based on full soil panels, moisture management via residue cover, and diversified rotations that stabilize production. Annual soil reports, fertilizer recommendations, and practice tracking are intended to maintain or improve productivity, reducing the incentive for displacement.

Second, monitoring: the project requires annual collection of farm management data (crop maps, yields, fertilizer use, tillage passes, fuel consumption). These data, combined with regional statistics, allow the team to identify material yield declines or land-use changes adjacent to project farms that could indicate leakage pressure.

Third, covenants and safeguards: participation agreements require compliance with applicable land-use regulations.

8.3. Durability: Operational risk.

Carbonsafe recognizes that permanence is fundamental to the credibility of soil carbon projects. While soil carbon sequestration can deliver long-lasting climate benefits, its integrity depends on the continuity of regenerative practices over the contracted crediting period. In agriculture, however, circumstances such as changes in land tenure, farmer decisions, or unforeseen external pressures may lead to land or participant withdrawal ("dropout"). To maintain environmental integrity and buyer confidence, Carbonsafe applies contractual safeguards, land-rights due diligence, and a conservative land buffer mechanism that collectively minimize risks without imposing disproportionate burdens on farmers.

8.3.1. Contractual obligations.

All farmer agreements contain explicit clauses requiring that:

- Enrolled practices and processes recommended by Carbonsafe are followed throughout the sub-project crediting period.
- The project is implemented on the same legally defined land parcels for the duration of enrollment.

This ensures continuity and traceability of credited activities and prevents "land shifting" that could undermine additionality or permanence.

8.3.2. Land-rights due diligence.

Prior to enrollment, Carbonsafe verifies the legal rights of participating farmers over the land they seek to include in the project. This due diligence reduces risks of dropout linked to contested tenure, lease expirations, or ownership disputes, thereby protecting both project integrity and participating farmers.

8.3.3. Land buffer recommendation.

Recognizing that some level of change in land tenure or farmer participation is unavoidable and in relation to managing the risk of non-permanence in land use, Carbonsafe recommends that farmers set aside a minimum of 10% of their agricultural area outside the project boundary. This reserve land is not credited but serves as a risk management measure in case of:

1. Land consolidation

2. Land swaps
3. Reallocation of land to non-project uses and business ventures other than agriculture

By applying this land buffer, the project strives to ensure that issued credits remain fully backed and insulated from credibility risks.

8.3.4. Monitoring and governance.

Farmer adherence to contractual obligations is reviewed annually through Carbonsafe's MRV process, which integrates farm-level data, site inspections, and verification by independent VVBs. Any dropout cases are recorded and disclosed in annual reporting.

8.3.5. Contractual penalties for dropout

Individual contracts with farmers contain explicit clauses addressing premature withdrawal. These penalties are designed not as punitive measures, but as necessary safeguards to preserve program integrity and fairness among participants. Key provisions include:

- Repayment of unearned benefits: Farmers who withdraw before the end of a reporting cycle may be required to return any advance payments or unverified revenue shares linked to projected credits.
- Withholding of future payments: Pending disbursements from verified credits are forfeited if dropout occurs prior to verification.
- Administrative penalties: To cover the costs of monitoring, and verification already incurred, a fixed administrative fee is applied in cases of dropout without justified cause.
- Grace provisions: Penalties are waived in cases of force majeuree (e.g., severe drought, flooding, natural disaster) or where withdrawal is linked to documented hardship beyond the farmer's control.

In the event of early termination of a farm's participation in the project, all carbon credits issued, realized, or sold that were generated by this farm shall be considered invalid. The cancellation shall be certified by an additional document, and its entry and notation in the Registry is mandatory. The farmer shall be subject to the penalties for early withdrawal provided for in the contract and the general terms and conditions, and shall bear full responsibility for the consequences incurred. In the event that the issued credits have already been transferred to third parties, the project organizer shall be obliged to compensate the buyers by replacing them with credits of equivalent quality and value, issued under other projects, until their rights are fully restored. All actions taken shall be duly certified and recorded in full and transparent manner in the official Registry.

By embedding these provisions in contracts, Carbonsafe creates accountability while maintaining fairness and avoiding disproportionate burdens on vulnerable farmers.

9. LEAKAGE.

9.1. Leakage Risk Analysis.

In Carbonsafe, "leakage" is treated as an economic displacement risk: greenhouse gas (GHG) emissions that may increase outside the credited project boundary as an unintended consequence of in-boundary practice changes. Unlike reversals (loss of previously credited SOC within the boundary), leakage concerns market- and behavior-driven effects that might offset part of the climate benefit. This section identifies the plausible leakage pathways for a soil-carbon (SOC) project, evaluates their likelihood and magnitude.

9.1.1. Plausible leakage pathways.

1. Activity-shifting (production displacement).

If regenerative practices were to reduce yields persistently, the farm (or market) might compensate by bringing *new land* into production elsewhere or intensifying production off-site, increasing emissions beyond the project boundary. Examples include converting marginal grassland or scrub outside the farm to cropland, or a nearby producer increasing tillage/fertilizer intensity to fill supply gaps.

2. Tenure and rent effects.

Improvements in soil quality can raise land desirability. If not handled carefully, landlords might increase rents, displacing lessee farmers who then seek production elsewhere, potentially on higher-emission lands. This is a recognized social-economic vector for leakage.

9.1.2. Likelihood assessment.

Low inherent risk for SOC projects structured like Carbonsafe, for three reasons:

1. Yield-protective agronomy. The project emphasizes nutrient optimization from full soil panels (macro/micro elements, pH), residue cover, diverse rotations, and traffic/tillage management to maintain or improve yields, reducing economic incentives to displace production.
2. No land expansion covenant. Participation agreements require legal compliance with land-use regulations, reducing the most material leakage vector (new land conversion).
3. Annual management data and regional checks. Collection of crop maps, inputs, and yields, paired with regional statistics, provides an early-warning system for yield shortfalls or nearby land conversion pressure.

10. ENVIRONMENTAL, SOCIAL AND ECONOMIC CO-BENEFITS AND SAFEGUARDS.

10.1. Environmental Co-benefits .[41][42][43][44][45][46]

10.1.1. Increased biodiversity from crop rotation.

Carbonsafe treats crop rotation as a core ecological lever that expands habitat diversity in time, stabilizes trophic interactions, and rebuilds below- and above-ground biological communities. In contrast to single-crop or short, repetitive sequences, multi-species, multi-year rotations provide heterogeneous resources (root exudates, residues, canopy structure, phenology) that create more niches for organisms from soil microbes to beneficial insects, birds, and small mammals. This temporal heterogeneity—when coupled with reduced soil disturbance and residue retention—drives measurable gains in species richness, functional diversity, and ecosystem stability.

Ecological mechanisms. Rotating botanical families alternates root architectures and exudate profiles, which select for different microbial guilds (e.g., actinomycetes with fibrous cereals; arbuscular mycorrhizae with many legumes and oilseeds). Legume phases add reactive nitrogen, increasing residue quality and stimulating microbial biomass and enzyme activity; brassica or deep-rooted phases improve soil structure, porosity, and water infiltration, enabling broader habitat for soil fauna such as earthworms and predatory arthropods. At the field surface, varied canopy heights, flowering windows, and residue structures support pollinators and

[41] State Fund Agriculture (Bulgaria). (2023). *Разнообразяване на отглежданите култури – еко-мерка (Crop diversification eco-scheme)*. Retrieved from https://dfz.bg/diversification-of-cultivated-crops/
[42] Bowles, T. M., Atallah, S. S., Campbell, E. E., Gaudin, A. C. M., Wieder, W. R., & Grandy, A. S. (2018). Addressing agricultural nitrogen losses in a changing climate. *Ecosphere, 9*(10), e02335. https://doi.org/10.1002/ecs2.2235
[43] Beillouin, D., Cimon-Morin, J., Makowski, D., … & Loreau, M. (2023). Benefits of crop diversification for biodiversity and ecosystem services. *Nature Communications, 14*, 7869. https://doi.org/10.1038/s41467-023-44464-9
[44] Li, Y., Zhang, J., Wang, Y., & Zhang, S. (2024). Effects of crop rotation on soil microbial communities and nutrient cycling: A global meta-analysis. *Plant and Soil*. Advance online publication. https://doi.org/10.1007/s11104-024-06994-z
[45] Michigan State University Extension. (2018). *Study shows crop rotation has positive impact on soil microbes and long-term sustainability*. Retrieved from https://www.canr.msu.edu/news/study_shows_crop_rotation_has_positive_impact_on_soil_microbes_and_long_ter
[46] Ministry of Agriculture of Bulgaria. (2022). *Прессъобщение: Дерогация за определени изисквания в земеделието* [Press release]. Retrieved from https://www.mzh.government.bg/media/filer_public/2022/10/31/press_derogaciya_1.pdf

natural enemies (e.g., hoverflies, lady beetles, parasitoids) and disrupt pest and pathogen life cycles that thrive in monoculture. Over time, this reduces the need for broad-spectrum pesticides and encourages integrated pest management (IPM) based on ecological regulation.

Anticipated biodiversity outcomes. By diversifying botanical families and phenologies, rotations broaden resource spectra across seasons, elevating soil microbial richness and functional redundancy (greater resilience to stress), increasing earthworm abundance and epigeal predator activity, and improving plant species richness in inter-row and margin zones. At landscape scale, staggered flowering pulses from different crops and covers extend forage availability for pollinators, while rotational disruption of host-specific pests reduces chemical input pressure and non-target impacts. These gains are expected to co-stabilize yields over time by dampening pest outbreaks and enhancing soil water and nutrient cycling.

Biodiversity is treated as a reported co-benefit:

1. Rotation diversity per plot and farm (e.g., number of crop families over a rolling period),
2. Botanical surveys and/or statistics based on regenerative practices
3. Practice-linked proxies, including pesticide treatment frequency trends, as a signal of ecological regulation replacing chemical control.

Crop rotation multiplies ecological niches across time, rebuilds soil food webs, and supports beneficial fauna, while interacting synergistically with reduced disturbance and cover cropping to deliver durable, system-level biodiversity gains.

10.1.2. Reduced pesticide use.

Within the Carbonsafe framework, reduction in pesticide use is recognized as a critical ecological and agronomic co-benefit of regenerative practices, particularly when integrated with diversified crop rotations, cover cropping, residue retention, and reduced soil disturbance. By shifting away from monoculture-based systems and creating ecological conditions that foster natural pest regulation, farms can gradually lower their reliance on synthetic chemical controls. This not only reduces greenhouse gas emissions associated with pesticide manufacturing and application but also enhances soil biodiversity, water quality, and farm ecosystem resilience.

Ecological mechanisms.

Pesticide dependence arises primarily from simplified agroecosystems, where repetitive monocropping, bare fallows, and heavy soil disturbance create environments conducive to pest and weed dominance. Carbonsafe directly addresses these drivers by requiring farmers to adopt multi-species crop rotations that disrupt pest and disease cycles, while cover crops and permanent ground cover reduce opportunities for weed germination and competition. Furthermore, reduced tillage maintains habitat for predatory arthropods and soil-dwelling organisms (e.g., carabid beetles, spiders, nematode antagonists), which suppress pest populations naturally. By layering these ecological processes, farms progressively shift pest control dynamics from chemical reliance to ecological regulation, thereby reducing the need for broad-spectrum synthetic inputs.

Implementation within Carbonsafe for South region, Bulgaria.

Farmers participating in the project are guided through a transition plan that emphasizes the gradual reduction of pesticide use rather than abrupt elimination. Each farm's pesticide use is monitored including total quantities applied and treatment frequency. Consequently, farms adopt practices such as:

1. Diverse crop rotations that reduce host-specific pest populations.

2. Catch and cover crops that suppress weeds by limiting bare soil exposure.

3. Mulching and residue retention that physically inhibit weed emergence.

4. Integrated Pest Management (IPM) strategies, such as pest scouting, threshold-based application, and the introduction or conservation of natural enemies.
5. Selective or reduced-rate chemical applications where necessary, ensuring that synthetic use is minimized and targeted rather than systemic.

The project does not mandate complete elimination of synthetic inputs, recognizing that responsible, selective use may be necessary in some circumstances. Instead, Carbonsafe sets a target trajectory of progressive reduction, anchored in annual monitoring and adaptive farm-specific recommendations.

Anticipated outcomes.

The anticipated impact of this transition includes a reduction in the total volume of active ingredients applied, fewer treatment applications per season, and a decline in pesticide dependence as cover crops and mechanical suppression take over weed control functions. Over time, participating farms are expected to show:

1. Lower treatment frequency compared to previous years.
2. Reduced pesticide expenditure, directly lowering farm input costs.
3. Increased abundance of beneficial organisms (predatory insects, pollinators, soil microbes) due to reduced chemical disturbance.
4. Improved soil microbial diversity and activity, which further contributes to nutrient cycling and disease suppression.
5. Decreased risk of pesticide resistance in weed and pest populations, as reliance on single-chemistry solutions is broken.

Monitoring and indicators.

Monitoring of pesticide reduction is integrated into the Carbonsafe MRV framework. Each year, participating farms submit input-use records that detail:

1. Types and quantities of pesticides used.
2. Frequency and timing of applications.
3. Treated areas by crop and field.

These records are verified against purchase receipts. These metrics are compared to previous years, providing a transparent measure of reduction progress.

Risk management.

Carbonsafe recognizes that during the early transition years, pest and weed pressures may fluctuate, and chemical applications may temporarily rise in isolated cases to prevent crop loss. To manage this risk, the project employs a “no backsliding” rule: farms that increase pesticide use above baseline without documented agronomic justification (e.g., extreme pest outbreak, force majeuree event) are flagged, and issuance of credits for the affected monitoring year may be suspended or reduced until compliance is restored. Training and extension support are provided to minimize reliance on emergency treatments and to strengthen resilience against such shocks.

Attribution and conservativeness. As with biodiversity co-benefits, reductions in pesticide use are treated as qualitative and quantitative co-benefits, not netted into carbon credit issuance. This ensures transparency and avoids overstating climate outcomes. Nonetheless, these reductions provide tangible environmental value—lower chemical runoff into waterways, healthier soils, and improved biodiversity—that strengthen the overall sustainability profile of the Carbonsafe credits.

By embedding crop diversification, cover cropping, IPM, and reduced soil disturbance, Carbonsafe creates conditions where chemical reliance declines naturally and progressively. This delivers measurable benefits to farmers (reduced input costs and risks), to ecosystems (healthier soils, greater biodiversity), and to society (lower chemical residues and improved water quality). Importantly, by monitoring input-use trends annually and tying reductions to transparent reporting, Carbonsafe ensures that claims of pesticide reduction are credible, traceable, and consistent with the project's high-integrity standards.[47][48]

10.1.3. Improved water retention and water quality.

Carbonsafe treats water as a co-equal outcome of soil-carbon restoration. By rebuilding soil structure, increasing organic matter, and maintaining year-round cover, participating farms in the South region progressively shift from fast runoff and episodic water stress to higher infiltration, greater plant-available water, and cleaner edge-of-field discharges. These water benefits are reported as co-benefits (they are not netted into carbon accounting), but they are tightly integrated with the agronomic guidance and annual MRV cycle.

Hydrological mechanisms. The project's regenerative practice set—reduced soil disturbance, diversified rotations, cover/catch crops, residue retention, and targeted organic amendments—promotes aggregate formation and stability. As macro-aggregates develop and pore networks reconnect, saturated hydraulic conductivity and infiltration rates increase, while bulk density declines. Rising soil organic carbon (SOC) elevates field capacity (FC) and, when paired with moderated compaction, can also lower permanent wilting point (PWP), expanding plant-available water (PAW = FC – PWP). Continuous cover reduces kinetic energy of raindrops and shear stress at the surface, suppressing crusting and sediment detachment. Root channels from cover and rotation species act as biopores, accelerating preferential flow into the profile rather than across the surface. The net effect is less runoff and erosion, greater soil moisture buffering during dry spells, and lower risk of waterlogging following intense rainfall.

Water-quality pathways.

With reduced runoff and gentler overland flow, sediment-bound phosphorus (P) losses decline, and filtration through residue and cover slows transport of dissolved nutrients and pesticides to ditches and canals. Diversified rotations and nutrient recommendations grounded in full soil panels (macro/microelements, pH) temper over-fertilization, which lowers nitrate (NO_3-N) leaching risk, particularly when cover crops capture residual N post-harvest. Minimizing broad-spectrum pesticide applications (via IPM and ecological regulation) further reduces the chemical load in edge-of-field water.[49]

Implementation in the South context.

On lighter textured soils and in foothill transitions, intense events can create short, destructive runoff pulses; on heavier textures, summer deficits constrain yields without irrigation. Carbonsafe's practices are therefore tuned to: (i) maintain surface cover ahead of storm seasons, (ii) build deep and fibrous rooting in rotations to open pore channels, (iii) protect soil structure by limiting passes and axle load during wet conditions, and (iv) optimize N timing and forms to reduce nitrate flushes. Where irrigation is used, improved soil water holding and reduced evaporative losses from mulched surfaces can lower irrigation demand and stabilize crop water productivity.

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[47] Ministry of Agriculture, Food and Forestry of Bulgaria. (2021). *Наредба № 9 от 26 февруари 2021 г. за интегрирано производство на растения, растителни продукти и храни от растителен произход* [Ordinance No. 9 of February 26, 2021, on integrated production of plants, plant products, and foods of plant origin]. Retrieved from https://www.mzh.government.bg/media/filer_public/2021/03/12/naredba__9_ot_26_fevruari_2021_g_za_integrirano_pr_0.pdf

[48] Guo, X., Li, Y., Xu, Z., Zhang, C., Shen, J., & Liang, W. (2023). Diversified cropping systems enhance soil biodiversity and ecosystem multifunctionality. *Nature Communications, 14*, 7320. https://doi.org/10.1038/s41467-023-43234-x

[49] University of Wisconsin–Madison Division of Extension. (n.d.). *Cover crops for improved surface water quality: Benefits and limitations*. UW–Madison Extension Agricultural Water Innovations. Retrieved September 29, 2025, from https://agwater.extension.wisc.edu/articles/cover-crops-for-improved-surface-water-quality-benefits-and-limitations/

10.1.4. Soil structure improvement & soil health.

Carbonsafe treats soil structure and soil health as foundational outcomes that enable—and stabilize—carbon sequestration, yield performance, and ecosystem services. Through reduced disturbance, continuous cover, diversified rotations, and targeted organic and mineral amendments, participating farms progressively rebuild aggregate architecture, porosity, and biological function. The result is a soil system that resists erosion, infiltrates and holds more water, cycles nutrients efficiently, and buffers climatic and operational stress.

Mechanisms of structural change.

At the core of structural improvement is the formation and stabilization of macro- and micro-aggregates. Living roots (including cover crops) exude polysaccharides and organic acids that feed microbial communities; fungi (notably arbuscular mycorrhizae) produce glomalin and hyphal networks that act as biological binding agents; bacteria secrete extracellular polymeric substances (EPS) that cement particles. Retained residues and organic inputs increase particulate organic matter (POM)—a key substrate for macro-aggregate formation—while progressive accrual of mineral-associated organic matter (MAOM) contributes to long-term stabilization. Reduced tillage preserves these bonds and pore networks, minimizing the collapse of aggregates and biopores that typically follows intensive mechanical disturbance. Structurally, this translates to lower bulk density, greater total and effective porosity, improved hydraulic conductivity, and higher mean weight diameter (MWD) of aggregates—properties that underpin infiltration, aeration, and root exploration.

Nutrient cycling and chemical health.

Rising soil organic carbon (SOC) increases cation exchange capacity (CEC) and improves base saturation where appropriate amendments and residue regimes are used, supporting more stable pH and reduced nutrient losses. Diverse rotations and organic inputs foster microbial biomass and enzyme activities (e.g., β-glucosidase, phosphatase, dehydrogenase), accelerating mineralization–immobilization dynamics and enhancing availability of N, P, S, and micronutrients while reducing reliance on synthetic inputs. Where sodium risks exist (elevated ESP/SAR), structure-friendly calcium amendments and drainage management are advised to prevent dispersion and surface sealing.

Biological health and soil food web.

As disturbance declines and organic inputs increase, fungal:bacterial ratios typically rise, earthworm populations recover, and trophic complexity expands (from bacterivorous/fungivorous to predatory nematodes). These biological communities help suppress pathogens, fragment residues, and create biopores that extend rooting depth and drainage. In turn, improved root architecture enhances carbon inputs to the subsoil, supporting deeper SOC gains and resilience to drought.

Implementation within Carbonsafe.

Each farm's transition plan specifies compatible combinations of:

1. Reduced or strip tillage, with controlled traffic where feasible to confine compaction;
2. Residue retention and multi-species cover crops to maintain year-round soil cover and living roots;
3. Rotation diversification (including legumes and deep-rooted phases) to vary root exudates and break pest/disease cycles;
4. Targeted amendments (lime/gypsum/compost/manures) based on plot-level chemistry to correct pH and Ca:Mg ratios, support aggregation, and supply balanced nutrition.

The plan is adapted annually using the project's 100% measured evidence base: geo-referenced composites from 25 cores per 4–25 ha plot at 0–30, 30–60, and 60–90 cm, analyzed in accredited laboratories. This unusually dense, multi-depth sampling supports plot-specific recommendations that protect structure (e.g., tillage exemptions in wet years, residue management to avoid spring crusting on fine textures, cover crop termination windows to prevent moisture competition).

Soil structure and health are tracked as co-benefits (separate from carbon crediting) yet integrated with MRV for agronomy:

1. SOC (primary), pH, CEC, base saturation, macro-/micronutrients,
2. C:N ratio and P fractions where relevant to erosion/leaching risk.

Sampling windows are harmonized seasonally; chain-of-custody and geo-tags maintain traceability and all results flow into the ERP, where trends are visualized per plot and each plot receives tailored agronomic recommendations.

Attribution, conservativeness, and reporting.

Because structure and health reflect multiple drivers (weather, management history, texture), Carbonsafe interprets trends conservatively, emphasizing directionality and full macro and micro nutrient analysis. These outcomes are reported as co-benefits in MRV annexes (agronomic recommendations) and not netted into carbon issuance, aligning with high-integrity buyer expectations and CRCF principles.

Outcome.

Over successive seasons, participating fields move from compacted, weakly aggregated soils to well-structured profiles characterized by stable aggregates, continuous pores, vigorous roots, and active soil biota. This elevated soil health underpins durable SOC gains, yield stability, water efficiency, and ecosystem resilience—co-benefits that strengthen the credibility and long-term value of Carbonsafe's carbon removals.[50][51][52][53][54]

10.1.5. Reduced Fertilizer Use.

Within the Carbonsafe framework, the reduction of synthetic fertilizer use is not only an agronomic outcome but also a climate-critical co-benefit. Fertilizer inputs—particularly nitrogen-based products—are major contributors to agricultural greenhouse gas emissions through the release of nitrous oxide (N_2O), a gas with nearly 300 times the global warming potential of CO_2 over a 100-year period. By designing a system that improves soil organic carbon (SOC), enhances nutrient cycling, and leverages targeted agronomic recommendations based on detailed soil testing, Carbonsafe enables farms to achieve stable or improved yields with progressively lower reliance on synthetic fertilizers.

Mechanisms of Fertilizer Reduction.

The project reduces fertilizer dependency through multiple synergistic mechanisms:

1. Improved nutrient retention via SOC gains.

   Higher organic matter increases cation exchange capacity (CEC) and enhances nutrient-holding ability, reducing leaching losses of cations like potassium (K^+), calcium (Ca^{2+}), and

[50] Fialkowski, F., Taffarello, D., Côrtes, J. C., & McGrath, J. M. (2024). Exploring soil health indicators and sustainability metrics for agricultural systems: A review. *Journal of Environmental Management, 363*, 122590. https://doi.org/10.1016/j.jenvman.2024.122590
[51] Ramesh, T., Lal, R., & Smith, P. (2024). Advances in soil organic carbon research: Implications for sustainable agriculture and climate change mitigation. *Soil & Tillage Research, 236*, 105140. https://www.sciencedirect.com/science/article/abs/pii/S0167198724001983
[52] Williams, A., Schipanski, M. E., Robertson, G. P., & Drinkwater, L. E. (2024). Soil carbon dynamics in diversified cropping systems: Integrating cover crops and reduced tillage. *Agronomy Journal, 116*(2), 405–421. https://doi.org/10.1002/agj2.21156
[53] Panagos, P., Borrelli, P., Ballabio, C., Meusburger, K., & Montanarella, L. (2024). Continental assessment of soil carbon erosion in Europe. *SOIL, 10*(1), 139–153. https://doi.org/10.5194/soil-10-139-2024
[54] Silva, R. F., Oliveira, D. M. S., Pereira, F. F., Souza, L. C., & Andrade, R. (2024). Agricultural biodiversity and ecosystem resilience: A global perspective. *Diversity, 16*(12), 734. https://www.mdpi.com/1424-2818/16/12/734

magnesium (Mg^{2+}). SOC also buffers pH, creating more favorable conditions for nutrient uptake.

2. Biological nutrient cycling.

   Enhanced microbial biomass and activity, supported by residue retention and reduced tillage, promotes mineralization–immobilization cycles. Soil organisms release nutrients gradually and more synchronously with crop demand, lowering the need for blanket fertilizer applications.

3. Nitrogen fixation by legumes.

   Rotations that include leguminous crops or legume cover crops (e.g., clovers, vetch, peas) biologically fix atmospheric nitrogen, reducing synthetic N requirements for subsequent crops.

4. Nutrient capture by cover crops.

   Catch crops intercept residual nitrogen after harvest, preventing leaching into groundwater and re-releasing nutrients when incorporated or terminated. This closes nutrient cycles and improves efficiency.

5. Precision fertilization based on soil data.

   Carbonsafe's 100% soil sampling model provides not only SOC data but also full macro- and micronutrient profiles for each plot. Annual individualized recommendations are issued to optimize rates, timing, and types of fertilizers. This avoids over-application and targets inputs to actual soil and crop needs.

Implementation in Carbonsafe.

At enrollment, every farm undergoes baseline soil testing across all sampled plots. This includes SOC but also N, P, K, S, pH, and trace elements (Zn, Fe, Mg, Mn, Cu). Each year, updated sampling allows recalibration of fertilizer recommendations. These recommendations are farm-specific and plot-specific, ensuring that inputs are not applied uniformly but in proportion to actual requirements.

Farmers are trained to adopt 4R nutrient stewardship (Right source, Right rate, Right time, Right place). Carbonsafe advisors encourage practices such as:

1. Using split nitrogen applications instead of single heavy doses, aligning release with crop demand.
2. Prioritizing organic amendments (compost, manures) where locally available.
3. Incorporating legume rotations and cover crops to naturally supply nitrogen.
4. Reducing tillage to prevent nutrient volatilization and erosion.

Anticipated Outcomes.

Over time, Carbonsafe expects participating farms to demonstrate:

1. Reduced synthetic N application rates (typically 10–30% reductions in the first 3–5 years, depending on baseline practices and adoption of legumes/cover crops).
2. Stabilized or improved yields despite lower inputs, due to more efficient nutrient cycling and improved soil structure.
3. Reduced nitrous oxide emissions, lowering the risk of over-crediting when only SOC is measured.
4. Lower input costs, improving farm profitability and resilience.

Monitoring and Indicators.

The reduction in fertilizer use is tracked through:

1. Annual input-use reporting: farmers submit records of fertilizer types, rates, timing, and treated areas.
2. Soil nutrient panels: repeated annually, confirming nutrient availability trends and documenting reduced need for external inputs.
3. Nutrient balance sheets: calculated per farm, comparing inputs to outputs and tracking nutrient surpluses/deficits.
4. Proxy indicators of efficiency: crop yields relative to N input, nitrogen use efficiency (NUE), and nitrogen surplus per hectare.

Risk Management.

Carbonsafe recognizes that overly aggressive reductions could jeopardize yields, prompting re-intensification and potential leakage. To avoid this, the project applies a stepwise reduction trajectory, focusing on efficiency rather than elimination. Soil data ensures that any cutbacks are evidence-based, not arbitrary. In drought or stress years, exemptions allow for strategic nutrient adjustments to preserve yields and prevent farmer dropout.

Attribution and Conservativeness.

Reductions in fertilizer use is treated as distinct co-benefits, not netted into SOC-based credit issuance. This ensures that carbon credits remain conservative and do not overstate climate benefits. Fertilizer reductions are reported separately in MRV annexes, providing transparency to buyers and aligning with CRCF and high-quality credits.

By coupling annual full-soil nutrient diagnostics with regenerative practices, Carbonsafe systematically reduces fertilizer dependence while maintaining yields. This not only cuts on-farm costs and N_2O emissions but also reduces nutrient runoff to waterways, improving environmental integrity. The result is a more circular, resilient nutrient economy at the farm level, one that delivers climate, agronomic, and community co-benefits without compromising credit integrity.

10.2. SDGs.

10.2.1. SDGs Overview.

The Carbonsafe project is not only a carbon removal initiative but also a multi-dimensional sustainability intervention that contributes directly and indirectly to the achievement of the United Nations Sustainable Development Goals (SDGs). By linking measured carbon removals with regenerative agriculture practices, Carbonsafe generates tangible environmental, social, and economic co-benefits across farm communities in Bulgaria, with ripple effects that extend into regional markets and ecosystems. This section situates Carbonsafe within the SDG framework, articulating how the project addresses multiple global goals in an integrated and traceable manner.

SDG 2 – Zero Hunger (End hunger, achieve food security, improve nutrition, and promote sustainable agriculture).

Carbonsafe directly enhances soil fertility and food production capacity by improving soil organic matter, nutrient availability, and water retention. By issuing agronomic recommendations based on annual soil tests (including SOC, macro- and micronutrients, and pH), the project helps farmers maintain or increase yields while reducing input costs. Improved soil health underpins more stable and nutritious crop production, contributing to long-term food security.

SDG 6 – Clean Water and Sanitation.

By implementing cover crops, reduced tillage, and optimized nutrient management, Carbonsafe reduces nutrient runoff, nitrate leaching, and pesticide use, leading to improved water quality in surrounding landscapes. Enhanced infiltration and water retention mitigate flood risks and bolster drought resilience, thereby promoting sustainable water resource management.

SDG 12 – Responsible Consumption and Production.

Through annual monitoring and tailored soil strategies, Carbonsafe helps farmers optimize fertilizer use, avoiding waste and lowering the environmental footprint of production. Reduced pesticide use further promotes responsible input management. The project's ERP software and MRV framework establish transparent production records that encourage accountability and efficiency across agricultural value chains.

SDG 13 – Climate Action.

The core of Carbonsafe is climate mitigation through carbon removal. Each credit represents 1 tonne of CO_2 removed from the atmosphere and stored as SOC, validated through annual measure–remeasure sampling and verified by accredited third parties. Ex-post issuance ensures that all credits are tied to removals already achieved, eliminating the risks of forward crediting. By contributing to the European Union's climate neutrality goals and aiming to align with CRCF standards, Carbonsafe strengthens the region's contribution to global climate action.

SDG 15 – Life on Land.

Carbonsafe practices—diverse rotations, cover cropping, reduced tillage—directly enhance biodiversity in soils, field margins, and agroecosystems. Increased earthworm populations, pollinators, and beneficial insects are supported by reduced pesticide use and more heterogeneous crop landscapes. Soil erosion is reduced, organic matter is stabilized, and natural habitats are protected by strict no-conversion covenants. This supports not only productive landscapes but also adjacent ecosystems, contributing to conservation of biodiversity and improved ecosystem services.

10.2.2. Ecosystem services enhancement.

The Carbonsafe project is designed not only as a carbon farming initiative but also as a comprehensive ecosystem services enhancement framework. By embedding regenerative practices into farming systems across South region in Bulgaria, Carbonsafe actively strengthens the capacity of agricultural landscapes to provide multiple ecosystem services that extend well beyond carbon sequestration. These services include soil fertility and nutrient cycling, water regulation, biodiversity conservation, climate resilience, and landscape-level ecological connectivity.

1. Soil Fertility and Nutrient Cycling.

Healthy soils are the cornerstone of functioning ecosystems. Carbonsafe directly improves nutrient cycling through increased organic matter, enhanced microbial activity, and optimized fertilizer use. The measure–remeasure approach provides farmers with annual data on macro- and micronutrients (N, P, K, Mg, Fe, Zn, Cu, etc.), enabling targeted fertilization strategies that reduce nutrient surpluses and prevent runoff. Over time, soils accrue organic matter that increases cation exchange capacity (CEC), buffers pH, and reduces the dependency on synthetic inputs. Enhanced fertility translates into more sustainable production and long-term soil capital, providing a continuous ecosystem service of nutrient supply.

2. Water Regulation and Quality.

Carbonsafe practices improve the hydrological function of soils by increasing infiltration, water retention, and reducing erosion. Residue cover and cover crops act as a natural armor against rainfall impact, reducing sediment runoff and associated nutrient losses. This stabilizes catchments by lowering peak flows during storms and maintaining higher base flows during dry periods. At the same time, optimized fertilizer recommendations and reduced pesticide use decrease the risk of nutrient and chemical contamination of rivers and groundwater, contributing to the ecosystem service of clean water provision.

3. Biodiversity and Habitat Provision.

Diverse rotations, reduced disturbance, and continuous cover foster conditions for increased soil biodiversity (microbes, earthworms, nematodes), as well as beneficial above-ground fauna such as pollinators and predatory insects. Carbonsafe requires rotational designs that introduce legumes, brassicas, and multi-species cover crops, creating temporal and spatial heterogeneity in food and habitat availability. This reduces pest outbreaks, supports natural regulation, and contributes to functional biodiversity. The project also prohibits conversion of natural habitats, thus preventing biodiversity loss and maintaining landscape mosaics. In combination, these actions enhance the ecosystem service of habitat provision and increase landscape-level resilience.

4. Climate Resilience and Regulation.

Through SOC accumulation, increased water-holding capacity, and improved soil structure, Carbonsafe farms are more resilient to both drought and flooding. Reduced pesticide dependence and improved soil biological communities foster systems less vulnerable to external shocks. At the global scale, carbon removals contribute to climate regulation, while at the local scale, improved resilience ensures continuity of production and protection of livelihoods. These outcomes strengthen the ecosystem service of climate stabilization and align with EU climate neutrality pathways.

5. Landscape Connectivity and Cultural Services.

By coordinating efforts across 80+ farms nationally, Carbonsafe creates clusters of regenerative practices that support landscape-level ecological connectivity. Contiguous areas of cover crops, hedgerows, and low-till management reduce habitat fragmentation, providing corridors for pollinators and wildlife. This enhances ecological networks across the agricultural matrix, particularly important in intensively cultivated areas of South region, Bulgaria. In addition, healthier soils, more diverse cropping landscapes, and visibly improved ecosystem services strengthen cultural and community services: farmers take pride in environmental stewardship, local communities benefit from cleaner water and reduced agrochemical exposure, and consumers gain confidence in the sustainability of their food systems.

6. Monitoring and Verification of Ecosystem Services

Carbonsafe integrates ecosystem service monitoring into its MRV system, ensuring that these co-benefits are monitored rather than treated as qualitative claims. Specific indicators include:

- Soil nutrient status, SOC.
- Biodiversity indicators such as crop rotation diversity indicators
- Resilience indicators such as yield stability and nitrogen use efficiency via tailored agronomic recommendations

- Landscape connectivity via GIS-based mapping of regenerative practice adoption and cover crop extent.

Carbonsafe's ecosystem services enhancement positions the project as a multi-benefit sustainability initiative, not merely a carbon removal scheme. By embedding regenerative practices into everyday farm management, the project actively delivers measurable improvements in soil fertility, water regulation, biodiversity, climate resilience, and landscape connectivity, ensuring that Carbonsafe credits reflect not just tonnes of CO_2 removed, but also broader ecosystem value. In doing so, Carbonsafe contributes meaningfully to resilient rural landscapes, thriving farm communities, and long-term environmental integrity in Bulgaria and beyond.

10.2.3. Ecosystem services enhancement monitoring.

1. Monitoring objectives and scope.

We monitor several service domains that are mechanistically linked to regenerative practice adoption and SOC accumulation: soil fertility and nutrient cycling; soil physical condition and structure; and farm performance and resilience.

Design and sampling frame: Census-style measurements embedded in the carbon MRV (every enrolled cell of 4–25 ha): annual, geo-referenced composite sampling (25 cores per cell) at 0–30, 30–60, and 60–90 cm, analyzed by accredited labs for SOC, pH, macro/micro-nutrients, practice bundle, and ancillary chemistry. These data power plot-level agronomic decisions and provide population-scale trends for fertility and chemical health.

2. Indicators and methods.

Soil fertility & nutrient cycling.

- OC, pH, N/P/K/S, micronutrients Zn, Mn, Cu, Fe, B, Ca, Mg, Mo.
- How we measure: annual lab panels on MRV composites (census); nutrient balance sheets (inputs/outputs) and nitrogen use efficiency (NUE) derived from farmer records and yield data.
- Decision triggers: rising nutrient surpluses or declining NUE prompt fertilizer rate/timing adjustments, cover-crop species changes, or pH amendments.

3. Farm performance & resilience.
   - What we track: yields and input intensity (kg nutrient per tonne product)
   - How we measure: farmer records, and cross-checks against soil data
   - Decision triggers: deteriorating stability or margins triggers plot-specific agronomic interventions to avoid re-intensification and leakage.

4. Data capture and traceability.

All field activities use geo-referenced mobile data collection (sampling paths, waypoints, timestamps) synced to the ERP. Chain-of-custody is maintained from field to lab. Farmer logs (inputs, pesticide applications, field operations) are collected. Every record is tied to the persistent plot ID used for carbon MRV.

5. QA/QC and lab management.

All data and analysis are processed in accredited laboratory facilities.

6. Data governance and interoperability.

All data are handled under GDPR-compliant access controls, with role-based permissions in the ERP. Confidential farm-level details are aggregated or anonymized in public outputs unless explicit consent is granted.

7. Outcome.

The project not only quantifies carbon removals but also demonstrates how regenerative practices strengthen soil function and farm resilience across the project area.

10.3. Social Co-benefits.

10.3.1. Improved farmer income through credits.

One of the most significant socio-economic outcomes of the Carbonsafe project is the improvement of farmer income through the generation and sale of verified carbon credits. Beyond its role as a climate mitigation initiative, Carbonsafe functions as a new economic model for Bulgarian agriculture—turning the environmental service of carbon sequestration into a direct and measurable source of revenue for farmers. This ensures that the transition to regenerative agriculture is not only ecologically sustainable but also financially viable for farm households and rural communities.

10.3.2. Revenue model and benefit-sharing.

Farmers enrolled in Carbonsafe receive annual income derived from the verified issuance and sale of ex-post carbon credits. Each credit represents one tonne of CO_2 removed from the atmosphere and stored in the soil as organic carbon, measured through Carbonsafe's rigorous 100% soil sampling and annual remeasurement protocol. The revenues from credit sales are distributed according to a transparent benefit-sharing mechanism.

By ensuring that revenues flow to farmers, Carbonsafe aligns financial incentives with regenerative practice adoption. This structure corrects one of the central barriers to sustainable agriculture—the lack of immediate economic return on ecological practices—making climate-positive actions profitable in the short term as well as beneficial in the long term.

10.3.3. Income diversification and financial resilience.

Carbon credit revenues provide a new, non-commodity income stream that complements traditional agricultural earnings from crops or livestock. This diversification reduces farmers' exposure to risks associated with volatile crop prices, fluctuating input costs, and climate-induced yield variability. In regions where extreme weather events (e.g., droughts and floods) can destabilize farm budgets, the stability of carbon income acts as a financial buffer, improving household resilience and enabling reinvestment into sustainable farm improvements.

Moreover, because credits are ex-post and independently verified, revenues represent already-achieved removals rather than speculative forward promises. This ensures that farmer income is tied directly to real, measurable performance, further reinforcing long-term sustainability of the revenue stream.

10.3.4. Quantification of income potential.

While income levels vary depending on farm size, soil potential, and practice adoption, modeling scenarios suggest that a medium-sized farm (300–600 ha) could generate several thousand euros annually from credits alone. With premium pricing for high-integrity, fully measured SOC credits—Carbonsafe's credits are positioned at the upper end of the voluntary carbon market, reaching levels such as €30/credit—farmer participation translates into meaningful supplementary income.

10.3.5. Incentive alignment and behavioral impact.

Carbonsafe's model ensures that farmers are financially rewarded not only for enrolling but for maintaining and improving soil carbon stocks over time. The conservative issuance system links farmer income to continuous performance. This approach mitigates risk for buyers while motivating farmers to persist with regenerative practices, ensuring both durability of climate impact and continuity of income.

10.3.6. Community-level effects.

Beyond individual farms, carbon credit revenues have the potential to revitalize rural economies. Additional income can support local services, improve farm infrastructure, and reduce rural poverty. As clusters of farms participate, entire communities benefit from more stable incomes, healthier soils, and cleaner water, creating positive multiplier effects across the agricultural landscape. Importantly, the financial benefits are equitably distributed: small and medium-sized farms, which are often most vulnerable economically, have equal access to credit revenues since payments are tied to SOC gains per hectare rather than to absolute farm size.

10.3.7. Transparency and verification of income distribution.

To maintain integrity, Carbonsafe develops ERP-based accounting systems that track credit issuance, revenue flows, and farmer payments in a transparent and auditable manner. Records of benefit-sharing is verifiable by third parties and prevents disputes or inequitable allocation. Farmers receive formal documentation of credits generated from their plots, along with payment records, strengthening trust and accountability.

10.4. Benefit-Sharing Statement.

The Benefit-Sharing Statement of Carbonsafe is a central pillar of the project's integrity framework, ensuring that the economic value generated from carbon credits is fairly, transparently, and equitably distributed among all participating stakeholders, with farmers as the primary beneficiaries. This policy reflects international best practices for carbon projects and aligns with principles of equity, inclusiveness, and accountability. It addresses one of the most critical barriers to the adoption of regenerative agriculture: the lack of financial incentives for farmers to invest in long-term ecosystem health.

10.4.1. Principle of Farmer-Centric Distribution.

Carbonsafe recognizes farmers as the frontline providers of ecosystem services. Without their active participation and sustained adoption of regenerative practices, carbon sequestration outcomes would not be possible. Therefore, the project guarantees that payments of net revenues from carbon credit sales will flow directly to farmers as financial compensation.

10.4.2. Structure of Benefit Allocation.

The distribution of benefits under Carbonsafe follows a structured model:

Farmers (50-60% of credit revenues or individual agreements between the farmer and the buyer/investor such as: priority purchase of the produce at a higher price and advance provision of investment for production).

1. Direct monetary payments derived from carbon credit sales, allocated proportionally to the measured carbon removals (tCO_2e) from each farmer's land.

2. Access to agronomic recommendations derived from annual soil analyses (macro- and micronutrients, SOC, pH), delivering added economic value through yield improvements and input optimization.

3. Training and technical assistance to support adoption of regenerative practices, further reducing farm costs and risks.

Project Operations (20-30%).

1. Costs associated with administration, agronomists, R&D, ERP management, on-ground advisory services, business development

2. This ensures that the MRV framework remains robust, transparent, and scientifically credible, benefiting both farmers and buyers.
3. Independent validation and verification (by VVBs) and registration fees (e.g., BCCR).
4. These costs guarantee that credits meet high-integrity buyer standards and are traceable on a registry.

Carbon credit sales (15%).

1. Engagement with international rating agencies, brokers, and buyers to ensure premium pricing and market access.
2. This enables Carbonsafe to secure better-than-average market prices for farmers' credits, maximizing their income.

Buffer pool (5%).

1. Force majeuree events
2. Serves as an insurance policy

10.4.3. Transparency and Accountability Mechanisms.

To safeguard equity, all financial flows are recorded and are to be managed through Carbonsafe's developing ERP and accounting system, which records issuance, sales, and revenue distribution. Each farmer receives:

1. An annual statement detailing the number of credits issued from their land, and in the event of sale of their credits: the sales price achieved, the revenues generated, and their corresponding share.

2. A digital record within the Balkan Carbon Credits Registry (BCCR) showing credits issued to their farm ID, ensuring traceability from sequestration to credit monetization.

3. Access to grievance and dispute resolution mechanisms in case of disagreements regarding benefit allocation.

This transparency not only builds farmer trust but also assures buyers that Carbonsafe's credits are tied to equitable benefit-sharing agreements, a key component of voluntary carbon market integrity assessments.

10.4.4. Equity Considerations.

Carbonsafe ensures inclusivity by:

1. Providing equal access to participation for smallholder and medium-sized farms, not just large enterprises.

2. Women-led farms and marginalized groups are equally eligible and represented in benefit distribution.

10.5. Agronomic support from Carbonsafe.

A cornerstone of the Carbonsafe project is the comprehensive agronomic support system provided to all participating farmers. This support ensures that regenerative practices are not only adopted but are sustained and optimized to deliver measurable gains in soil organic carbon (SOC), soil fertility, yield stability, and long-term farm resilience. Carbonsafe recognizes that successful carbon farming is inseparable from robust agronomic guidance; therefore, support is embedded as both a technical service and a value-adding co-benefit for farmers, delivered alongside carbon credit revenues.

10.5.1. Annual Soil Diagnostics as the Foundation.

The agronomic support begins with Carbonsafe's 100% soil sampling protocol. Carbonsafe's approach includes a full nutrient panel: macronutrients (N, P, K, S), secondary nutrients (Ca, Mg), micronutrients (Fe, Zn, Cu, Mn, B), as well as soil pH, bulk density, and cation exchange capacity.

This dataset provides a scientifically rigorous foundation for agronomic planning. Farmers receive detailed reports that compare current nutrient levels against crop-specific requirements, highlighting deficiencies, surpluses, or imbalances. These results are contextualized against the previous year's baseline, providing a clear trajectory of soil health improvements or risks.

10.5.2. Tailored Agronomic Recommendations.

From the annual soil diagnostics, Carbonsafe develops plot-specific agronomic strategies for each farmer. These recommendations are not generic but customized, taking into account:

1. Soil nutrient status: optimizing fertilizer application rates and timing, avoiding excess application while preventing nutrient mining.
2. Crop rotation design: introducing or adjusting crop sequences to increase rotation diversity, reduce pest pressure, and incorporate legumes for natural nitrogen fixation.
3. Cover crop species selection: identifying multi-species cover crop mixes tailored to crop needs.
4. Residue management: balancing residue retention for SOC gains with the practical needs of field operations.
5. Tillage decisions: implementing reduced or strip tillage, with defined exemptions for compaction or wet years, ensuring both soil protection and operational feasibility.
6. pH and structure correction: recommending liming, gypsum, or other amendments where acidity, sodicity, or compaction risks threaten soil function.

These recommendations are communicated through the Carbonsafe ERP platform, ensuring farmers have real-time access to their field data, recommendations, and trend analyses.

10.5.3. Training and Knowledge Transfer.

Carbonsafe goes beyond data delivery by providing 1 on 1 conversations between farmers and Carbonsafe agronomists, training and capacity-building farmer discussions. These sessions cover:

1. Best practices in regenerative agriculture (reduced tillage, crop diversification, catch crops).
2. Precision nutrient management and the use of soil diagnostics for decision-making.
3. Integrated pest management (IPM) approaches to reduce pesticide dependence.
4. Soil and water conservation techniques to minimize erosion and runoff.
5. Use of Carbonsafe's ERP and mobile tools for digital record-keeping and compliance.

Farmer discussion are complemented by one-on-one consultations with Carbonsafe agronomists, ensuring farmers can adapt the guidance to their unique operational realities.

10.5.4. Continuous Monitoring and Adaptive Management.

Agronomic support is not static but dynamic and adaptive. Each year's soil results and farm performance data are reviewed, and recommendations are updated accordingly. If a farmer experiences declining SOC, yield penalties, or unforeseen agronomic challenges (e.g., drought stress, pest outbreak), Carbonsafe advisors intervene with targeted strategies to restore trajectory.

For example, If nutrient surplus is detected, fertilizer recommendations are scaled back, reducing both costs and environmental risk. This feedback loop ensures that farmers remain aligned with project goals while safeguarding productivity.

10.5.5. Added Value Beyond Carbon Credits.

Carbonsafe's agronomic support provides farmers with benefits that extend beyond participation in the carbon market:

1. Cost savings through reduced fertilizer and pesticide use.
2. Yield improvements driven by better nutrient availability and soil health.
3. Resilience to droughts and floods thanks to enhanced soil structure and water retention.
4. Long-term sustainability by improving soil capital, reducing erosion, and maintaining productive capacity.

These agronomic benefits often outweigh direct credit revenues in the medium term, creating a compelling value proposition for farmers to remain engaged with the project.

10.6. Land Use and Access Protection Statement.

The Land Use and Access Protection Statement of Carbonsafe is designed to safeguard the rights of farmers, landowners, and rural communities while ensuring that carbon farming activities do not result in any form of displacement, restricted access, or unintended negative impacts on land tenure systems. This policy is a cornerstone of the project's social and environmental safeguards framework, ensuring compliance with international best practices.

At its core, the statement recognizes that land is both a productive resource and a social asset—providing livelihoods, cultural heritage, and community identity. For this reason, Carbonsafe commits to the principle of "no harm, no displacement". Participation in the project is strictly voluntary, and land use rights remain entirely with the farmer or landowner. No physical or economic displacement of communities will occur, and the project structure is designed to reinforce, rather than compromise, secure access to land.

10.6.1. Voluntary Participation and Informed Consent.

All farmers and landowners who join the Carbonsafe project do so on a voluntary basis, underpinned by clear and transparent contractual agreements. Before enrollment, participants are provided with detailed information about:

1. The scope and objectives of the project, including the practices required and benefits expected.
2. The carbon crediting process, including measurement, verification, issuance, and revenue distribution.
3. The legal implications of participation, including their ownership of credits.

Consent is obtained in accordance with the principle of Free, Prior, and Informed Consent (FPIC). No farmer is pressured or coerced into joining, and contracts are reviewed in accessible language to ensure clarity and full understanding.

10.6.2. Land Tenure and Legal Safeguards.

Carbonsafe requires legal proof of land ownership or long-term access rights (e.g., lease agreements, usufruct rights) before any farm can be enrolled. This ensures that only legally secure lands are included in the project, thereby preventing disputes and protecting the rights of legitimate landholders and tenants.

All contracts explicitly state that carbon revenues belong to the farmer or tenant implementing the regenerative practices, ensuring that improvements in soil health translate directly into benefits for the practitioner rather than being captured by landlords.

10.6.3. Access Protection and Community Rights.

The project is designed so that carbon farming activities do not restrict access to land or resources for local communities. Farmers retain full access to their land for food and commodity production, while regenerative practices enhance rather than reduce productivity. Community use rights, such as shared access to water, grazing lands, or field margins, are respected and protected.

Furthermore, the project does not include lands of cultural or ecological significance to local communities. Areas with heritage value or sensitive ecosystems can not be agricultural land.

10.6.4. Monitoring and Enforcement.

The protection of land rights and access is actively monitored throughout the project lifecycle. Key mechanisms include:

1. Baseline land tenure mapping for each participating farm, including documentation of ownership, lease status, and use rights.
2. Annual audits by the Carbonsafe team, cross-referenced with national cadastral records to ensure land rights remain valid and uncontested.
3. Grievance mechanisms available to farmers and communities, allowing concerns about land use or access to be raised and resolved promptly.
4. Third-party verification (by VVBs), which includes review of land access policies and compliance with international safeguards.

10.6.5. Risk Management and Contingencies.

If a land dispute emerges after enrollment, credits associated with the disputed land are automatically withheld from issuance until the matter is resolved. This ensures that no credits are generated from contested land and protects both farmers and buyers from reputational or legal risks.

In the event of policy changes at the national or EU level that affect land rights or carbon ownership, Carbonsafe will adapt its contractual and registry structures to remain compliant while ensuring that farmers' ownership of credits is maintained.

10.7. Flexibility in producer practices

The Flexibility in Producer Practices statement within the Carbonsafe project is designed to balance the integrity of carbon sequestration outcomes with the practical realities of farming operations in South region and Bulgaria. Recognizing that agricultural systems are highly dynamic and subject to external influences such as climate variability, input availability, and market fluctuations, Carbonsafe ensures that farmers are not locked into rigid prescriptions but are instead supported through flexible, adaptive management pathways that maintain the project's credibility while respecting the complexities of agricultural livelihoods.

10.7.1. Rationale for Flexibility.

Agriculture is inherently uncertain. Weather extremes—such as prolonged droughts, unseasonal heavy rains, or late frosts—can alter the feasibility of applying certain regenerative practices in a given season. In addition, Carbonsafe suggest regenerative practices based on the machinery and inventory that farmers can afford to use. Similarly, constraints in seed supply, market access, or unexpected pest outbreaks may require temporary adjustments in practice implementation. International best-practice standards emphasize that flexibility. Carbonsafe embeds this principle into its operational model.

10.7.2. Practical Examples of Flexibility.

No-Till and Reduced-Till Practices.

- Farmers are encouraged to implement reduced or no-till practices to enhance SOC accumulation.
- However, the framework acknowledges exceptions in extreme circumstances, such as wet years that risk soil compaction, or weed infestations that cannot be controlled without mechanical intervention.

Catch Crops and Cover Crops.

- Catch and cover crops are a cornerstone of the project. Yet, under severe drought conditions, establishment may fail. In such cases, farmers are permitted to adapt rotations by including drought-resilient crops or delaying planting.
- Where seed supply chains are disrupted, Carbonsafe provides guidance on approved alternative species mixes that maintain soil cover and biodiversity benefits.

Rotation Adjustments.

- Rotational diversity is required, but flexibility is permitted when market or pest pressures necessitate temporary monoculture extensions. For example, a farmer may extend cereal production for an additional season if disease pressure in legumes is unusually high.
- Such changes are accompanied by mitigation strategies (e.g., introduction of a restorative crop the following year) to ensure that the long-term rotation trajectory is preserved.

Soil Amendments and Fertility Inputs.

- While the project emphasizes reductions in synthetic fertilizer use and optimized nutrient management, farmers may temporarily increase inputs if required to address acute nutrient deficiencies or crop failure risks.
- These interventions are monitored carefully to prevent negative GHG impacts, with associated emissions (fertilizer use increases).

Flexibility does not mean compromise in transparency. Each deviation from the prescribed regenerative practices is reviewed annually by Carbonsafe agronomists.

10.7.3. Farmer-Centric Approach.

By integrating flexibility, Carbonsafe recognizes the expertise of farmers as land stewards. Rather than imposing rigid, top-down prescriptions, the project provides a framework of regenerative principles with room for adaptive management. Farmers are empowered to make context-specific decisions in consultation with Carbonsafe agronomists, ensuring practices remain practical, locally relevant, and sustainable. This flexibility builds trust and long-term commitment, reducing the risk of farmer dropout.

The Flexibility in Producer Practices ensures that Carbonsafe remains both scientifically credible and operationally viable. It acknowledges that regenerative agriculture is not a one-size-fits-all formula but a set of adaptive strategies that must evolve in response to climatic, ecological, and economic conditions. By embedding transparent monitoring and agronomic support, Carbonsafe ensures that flexibility strengthens rather than undermines the project—protecting farmers from undue risk while maintaining the integrity of carbon credits issued.

10.8. Impact on producers resulting from changes in crop yields or management costs.

A fundamental principle of the Carbonsafe project is that participation must strengthen, not weaken, the economic viability of farms. While the core objective is to increase soil organic carbon (SOC) stocks and generate verified carbon credits, the adoption of regenerative practices inevitably affects farm-level agronomy, productivity, and input structures.

10.8.1. Baseline Situation.

In conventional farming systems across the South region and Bulgaria more broadly, yields are often maximized through intensive use of synthetic fertilizers, pesticides, and frequent tillage. While this system produces stable short-term output, it leads to soil degradation, nutrient imbalances, erosion, and increased vulnerability to drought and climate variability. Production costs are high and rising, due to increasing fertilizer and pesticide prices, while net farm margins remain under pressure.

Farmers entering Carbonsafe therefore begin from a baseline where profitability is heavily dependent on input intensity, and soil fertility is increasingly fragile. This context underscores the importance of ensuring that regenerative shifts under the project improve rather than compromise farm economics.

10.8.2. Yield Dynamics under Regenerative Practices.

Carbonsafe acknowledges that transitions to regenerative practices can have short-term yield variability, especially during the initial adjustment period when soil biological activity is rebuilding. Reduced tillage and cover cropping may temporarily suppress yields of certain crops (particularly cereals) due to cooler soils in spring or early nutrient immobilization. However, empirical evidence and international case studies consistently show that after the first two to three years, regenerative practices lead to yield stabilization or gradual improvement as soil organic matter, nutrient cycling, and water retention improve.

To minimize transitional risks, Carbonsafe provides annual agronomic recommendations based on soil analyses, including nutrient correction strategies, crop rotations adapted to local conditions, and optimized fertilizer inputs. This ensures that yield penalties, if any, remain limited and temporary. In the medium to long term, regenerative practices contribute to greater yield resilience, particularly under extreme climate events such as droughts or floods.[55][56][57][58][59][60][61][62]

10.8.3. Changes in Management Costs.

One of the most immediate and measurable impacts for producers is the reduction in input costs:

- Fertilizers: Soil analyses enable precise nutrient management, leading to reductions of 10–50% in fertilizer use while maintaining yields. Over time, improved nutrient retention

[55] European Alliance for Regenerative Agriculture (EARA). (2025). *Farmer-led research on Europe's full productivity – Pilot findings*. EARA. Retrieved from https://www.nature.com/articles/d41586-025-02812-3
[56] Pittelkow, C. M., Liang, X., Linquist, B. A., van Groenigen, K. J., Lee, J., Lundy, M. E., ... & van Kessel, C. (2015). Productivity limits and potentials of the principles of conservation agriculture. *Field Crops Research, 183*, 156–168. https://ecoss.nau.edu/publication/when-does-no-till-yield-more-a-global-meta-analysis
[57] Nature. (2025). Europe's regenerative farming transition [Feature article]. *Nature*, *624*, 18–20. https://www.nature.com/articles/d41586-025-02812-3
[58] Metrobi / Research for Agriculture. (n.d.). *No-till and reduced tillage farming: Adoption outcomes*. Retrieved September 29, 2025, from https://researchforagriculture.com.au/no-till-and-reduced-tillage-farming
[59] The Furrow (John Deere). (2022). *Good soil is our future: Bulgarian farm case study*. Retrieved from https://thefurrow.co.uk/good-soil-is-our-future
[60] Rainforest Alliance. (2021). *Regenerative agriculture: Key insights*. Retrieved from https://www.rainforest-alliance.org
[61] EIT Food. (2020). *Report on regenerative farming practices in Europe*. Retrieved from https://www.eitfood.eu
[62] European Academies Science Advisory Council (EASAC). (2022). *Regenerative agriculture in the European Union*. EASAC. Retrieved from https://www.easac.eu

and the use of legumes as nitrogen-fixing crops further reduce dependence on synthetic fertilizers.

- Pesticides: Diversified crop rotations, cover crops, and improved soil health reduce pest and weed pressure, lowering chemical use by 15–25% in most systems.
- Fuel and Machinery: Reduced tillage or no-till systems decrease fuel consumption and machinery hours, cutting operational costs.
- Water Use: Improved water retention and infiltration reduce the need for irrigation, translating into savings on energy and water fees.

These reductions collectively offset any transitional yield declines, ensuring that producers benefit financially even in the early years.

10.8.4. Carbon Credit Revenues as a Financial Buffer.

In addition to cost reductions, farmers receive direct monetary revenues from carbon credits, providing an important income buffer during the transition phase. Even if yields experience slight reductions, carbon credit revenues ensure that overall farm profitability is not negatively impacted. This mechanism significantly reduces the risk of financial loss and provides farmers with the security to continue regenerative practices.

10.8.5. Monitoring and Evaluation of Producer Impact.

Carbonsafe tracks farm-level data on yields, input use, and production costs. This allows the project to:

- Monitor how regenerative practices affect farm economics year by year.
- Compare trends across different farm sizes, soil types, and management strategies.
- Provide tailored advice to mitigate negative economic impacts.
- Document positive outcomes as evidence of co-benefits for external stakeholders.

10.8.6. Risk Management and Safeguards.

Carbonsafe includes several safeguards to protect farmers against negative economic outcomes:

1. Conservative credit issuance model - this ensures that credits—and therefore revenues—remain available even in years of poor yield or negative SOC performance.
2. Flexibility policy – Farmers are allowed exemptions (e.g., one-off tillage under wet conditions, rotation adjustments) to protect crop yields without risking expulsion from the project.
3. Agronomic support – Continuous soil testing and personalized recommendations ensure that management costs are minimized, and yield risks are proactively addressed.

10.9. Do-No-Harm, Environmental Risk & Community.

10.9.1. Purpose and scope.

This Do-No-Harm (DNH) Assessment sets out how the Carbonsafe Soil Organic Carbon (SOC) Project identifies, prevents, and mitigates potential adverse environmental and social (E&S) impacts associated with project activities in the South region of Bulgaria. The assessment applies to all participating farms and operational partners (sampling teams, laboratories, logistics providers) across the full project lifecycle—enrolment, MRV execution, credit issuance, and post-issuance monitoring.

10.9.2. Process.

Carbonsafe takes into consideration the following about the participating farmers:

1. Legal tenure verification; recent conversion from forests/wetlands/HCV areas; Natura 2000 sensitivities; protected species/habitats; labor and H&S readiness; community access/use conflicts; fertilizer and plant-protection baselines.

2. Ongoing surveillance via annual MR (Monitoring Report), farm self-declarations, ERP-logged field operations, verifier site-visits, and a grievance log.

10.9.3. Legal compliance.

- Full compliance with Bulgarian law (land tenure, CAP cross-compliance, agrochemical use, occupational H&S, waste) is mandatory.

- Participation requires evidence of ownership or legally valid right to operate (lease, usufruct) and confirmation of no illegal land conversion since the relevant cut-off date.

- Where lands lie within or near Natura 2000 sites, management prescriptions are respected.

10.9.4. Land, biodiversity, and habitat safeguards.

- No-conversion. Lands converted from forests, or natural/semi-natural habitats are ineligible.

- Integrated rotations & cover. Crop rotations and cover crops are designed to enhance on-farm biodiversity (pollinators, natural enemies), minimize bare soil days, and reduce erosion.

- Pesticide risk management. Integrated pest management (IPM) implementation.

10.9.5. Water resources and quality.

- Abstraction safeguards. Irrigation, where present, must comply with permits and local restrictions.

- Water quality protection. Nutrient management planning (N, P balance, timing, placement) reduces runoff and leaching; storage/handling of agrochemicals follows legal and manufacturer guidance.

- Erosion control. Reduced tillage, cover crops, and residue retention minimize sediment loads to surface waters.

10.9.6. Soil, air, and emissions management.

- Soil protection. The project targets measurable SOC gains; compaction is avoided through controlled traffic.

- N_2O and other GHGs. Nutrient management is optimized to avoid induced N_2O increases; where risk is identified (e.g., high N rates, legume phases), mitigation is applied.

- Air quality & dust. Reduced tillage lowers dust emissions.

10.9.7. Agrochemical use and waste.

- Fertilizers. Compliance with labels and national registries is mandatory. Project guidance prioritizes reduced rates, targeted applications, and safer alternatives consistent with IPM.

- Waste handling. Empty containers and hazardous waste are collected through licensed schemes; storage is bunded and ventilated; record-keeping is mandatory and auditable.

10.9.8. Community health, safety, access, and cultural heritage.

- No displacement. The project guarantees no physical or economic displacement of communities; agricultural production continues, with practices aimed at improving, not restricting, land utility.
- Access protection. Customary access to shared resources (e.g., ways, water points) is respected.
- Cultural heritage. If cultural artifacts are discovered competent authorities should be notified.
- Nuisance prevention. Operations (e.g., soil sampling with ATVs) follow safe routes and time windows to minimize disturbance.

10.9.9. Labor and occupational health & safety (OHS).

- ILO Core Standards. No forced, child, or discriminatory labor. Equal pay for equal work; non-discrimination and inclusion (including women and young farmers) are project commitments.
- OHS plan. Soil-sampling teams use PPE; ATV operation requires training and route planning; lifting/handling protocols for cores and sample bags; lab partners operate under ISO/EN safety standards; incident reporting is mandatory.
- Training. Annual training in safe agrochemical handling, IPM, and machinery safety is offered.

10.9.10. Land tenure, FPIC, and leaseholder protections.

- Free, Prior, and Informed Consent (FPIC). Participation is voluntary, based on clear contracts and plain-language disclosures.
- Credits and revenues flow to the practicing leaseholder.

10.9.11. Data privacy, transparency, and integrity.

- GDPR. Personal data (farmer identities, parcel maps) are processed under lawful bases; access is role-based; retention limits are defined.
- Traceability. Credit serials are traceable to farm and monitoring period via BCCR; public transparency balances privacy and buyer disclosure needs.
- Anti-corruption & AML. Basic AML/KYC controls are applied to counterparties where relevant; conflicts of interest (e.g., between project developer, verifier, registry) are disclosed and managed.

10.9.12. Grievance redress and stakeholder engagement.

- Multi-channel grievance mechanism. Farmers and community members can submit concerns via website, email, or phone. Acknowledge within 5 business days, resolve or propose corrective action within 30.
- Continuous engagement. Annual meetings, surveys, and feedback loops inform adaptive management and targeted improvements.

10.9.13. Do-No-Harm Statement.

Carbonsafe concludes that project activities are not expected to cause significant adverse environmental or social impacts. Residual risks—principally nutrient runoff, occasional pesticide use, soil compaction in wet years, and potential community nuisance from field operations—are low, site-specific, and effectively managed.

The project further commits to continuous improvement: if monitoring reveals material adverse trends, Carbonsafe will adjust practice guidance, intensify training, or suspend/enforce conditions on non-compliant sites. This statement will be re-affirmed annually in the Monitoring Report, ensuring that Carbonsafe's climate outcomes are delivered without harm—and, wherever possible, with measurable co-benefits for biodiversity, water, soil health, and rural livelihoods.

10.9.14. Community impact & safeguards.

This analysis evaluates how project activities under Carbonsafe's project may influence environmental determinants of health for nearby communities.

Soil health and tillage intensity

- Positive: Reduced tillage and permanent cover lower dust generation, decrease machinery passes, and improve soil structure, infiltration, and drought resilience—indirectly lowering heat- and flood-related health risks.
- Risks: Greater reliance on targeted pesticide applications in some systems; potential for drift if unmanaged.

Nutrient management and organic amendments

- Positive: Precision application, split dosing, and organic matter build-up reduce nitrate leaching and phosphorus runoff; incorporation of manure/compost can cut ammonia volatilization and odor when done properly.
- Risks: If amendments are inadequately composted or poorly timed, there is potential for microbiological contamination (e.g., E. coli in runoff) and temporary odors; mismanaged manure can elevate NH_3.

Crop diversification, cover crops, and agroforestry

- Positive: Windbreaks and ground cover reduce wind-blown dust and soil loss; shade trees and microclimate buffering reduce heat stress exposure; enhanced pollinator and natural-enemy habitat can lower pesticide pressure.
- Risks: Allergenic pollen from certain species; unmanaged standing water near riparian plantings can create mosquito habitat.

Pesticide use and integrated pest management (IPM)

- Positive: IPM and threshold-based decisions reduce overall pesticide loads; drift-reduction technologies minimize off-site exposure.
- Risks: Pesticide substitution in low-tillage systems if not balanced by mechanical/biological controls; acute exposure risks for workers without adequate PPE and training.

Traffic, noise, and logistics

- Positive: Fewer field passes reduce traffic volume and noise over time.
- Risks: Short-term traffic peaks during soil sampling or harvest; localized noise and dust near settlements.
- Positive: Prohibition of open burning eliminates smoke-related acute respiratory exposures and fire risk.
- Risks: None significant when residues are mulched/incorporated correctly.

Assessment outcome

With good agricultural practice, the project is expected to deliver a net positive community environmental health outcome, characterized by lower dust and exhaust exposure, improved water quality protection, reduced open burning, and greater climate resilience.

Compliance alignment

The project's processes are designed to be consistent with applicable national law and relevant EU requirements.

Carbonsafe anticipates a net positive environmental health outcome for neighboring communities—characterized by lower exposure to dust and smoke, better protection of water resources, reduced heat-stress vulnerability through ecological enhancement, and strengthened trust through transparent engagement and grievance redress.

10.10. Legal Compliance Statement.

Carbonsafe affirms its unwavering commitment to the full observance of all applicable legal, regulatory, and administrative requirements relevant to the design, implementation, and operation of its carbon farming project. The company recognizes that legal compliance is not only a matter of statutory obligation but also an essential foundation for building credibility, ensuring transparency, and safeguarding the rights and interests of all stakeholders engaged in the project.

The project has been developed in alignment with the relevant national legislation governing agricultural practices, land tenure, and environmental protection. This includes adherence to statutory frameworks regulating land use, soil management, biodiversity protection, and sustainable farming practices. All project activities must uphold the dignity, well-being, and security of the farmers and workers involved.

In addition to national laws, the project acknowledges the significance of international and regional legal frameworks that establish the context for voluntary carbon markets and environmental integrity. This encompasses following of the principles set out under the United Nations Framework Convention on Climate Change (UNFCCC), as well as consideration of the Paris Agreement and the Sustainable Development Goals (SDGs) as guiding instruments. While voluntary in nature, these frameworks provide critical standards of conduct to which Carbonsafe aspires.

To guarantee ongoing conformity, Carbonsafe has instituted internal compliance mechanisms that include:

- Due diligence procedures to verify the legality of land tenure and access rights, ensuring that project activities are carried out exclusively on lands where the legal status is clear, uncontested, and formally documented.
- Monitoring of regulatory developments at both national and international levels, enabling proactive adaptation of project practices to reflect evolving legal and policy requirements.
- Transparent contracting and disclosure practices, ensuring that leaseholders, landowners, and participating farmers are fully informed of their rights and obligations under the project, and that contractual arrangements meet statutory enforceability standards.
- Data protection and confidentiality protocols, aligned with applicable national and European data privacy legislation, to safeguard the personal information of all project participants and partners.

Carbonsafe further makes sure that its carbon credit generation and trading activities will conform to the legal standards applicable to financial and environmental instruments, including alignment with the emerging EU framework for the certification of carbon removals. All project-level claims will be substantiated through verifiable evidence and presented in compliance with applicable disclosure and reporting requirements.

10.11. NDC & policy interaction statement.

Carbonsafe recognizes that voluntary carbon farming projects must operate in a manner that is both aligned with, and complementary to, the broader climate policy architecture at the national, regional, and international levels. In particular, the company acknowledges the central role of Nationally Determined Contributions (NDCs) under the Paris Agreement as the primary vehicle through which countries articulate their commitments to mitigate climate change, enhance resilience, and contribute to the collective global effort to limit warming to 1.5°C.

The Republic of Bulgaria, as a Member State of the European Union, contributes to the collective EU NDC submitted under the Paris Agreement. This NDC outlines ambitious targets for reducing greenhouse gas (GHG) emissions, enhancing carbon removals through land use, land-use change, and forestry (LULUCF) activities, and supporting sustainable agricultural practices that contribute to climate neutrality by 2050. Carbonsafe's carbon farming project has been designed to support these national and EU-level commitments by increasing soil organic carbon, improving farm-level resilience, and generating measurable environmental co-benefits that strengthen the long-term sustainability of agricultural landscapes.

The project's interventions—focused on regenerative farming practices, soil health improvement, and biodiversity protection—are consistent with the mitigation pathways identified in Bulgaria's climate and energy policy documents, including the National Energy and Climate Plan (NECP) and the strategic objectives of the Common Agricultural Policy (CAP). By incentivizing farmers to adopt practices that simultaneously enhance productivity and reduce emissions, Carbonsafe aligns its voluntary carbon credit generation with national policy frameworks that seek to balance agricultural competitiveness, environmental stewardship, and rural development.

At the same time, Carbonsafe takes care to avoid any risk of double counting or misrepresentation of carbon benefits in relation to NDC accounting. All carbon credits generated through the project are rigorously quantified, verified, and tracked within a registry to ensure full transparency and traceability. The project follows best practice principles of "corresponding adjustments" where applicable and ensures that any use of credits by external buyers for offsetting purposes does not compromise Bulgaria's or the EU's official NDC reporting. This approach safeguards environmental integrity while preserving the additionality of voluntary carbon market activities.

In addition to mitigation, the project contributes to policy objectives on adaptation and resilience. By improving soil fertility, increasing water retention, and reducing vulnerability to climate extremes, the project reinforces national priorities for climate adaptation in agriculture. Moreover, the enhancement of ecosystem services—such as pollination, erosion control, and biodiversity habitat—reflects the broader goals of the EU Green Deal, the Farm to Fork Strategy, and the Biodiversity Strategy for 2030.

Carbonsafe also engages in ongoing policy dialogue with relevant stakeholders, including agricultural institutions, regulatory bodies, and environmental authorities. This ensures that the project evolves in harmony with emerging policies, such as the EU framework for the certification of carbon removals, and remains a constructive contributor to Bulgaria's climate action landscape.

By aligning with Bulgaria's and the EU's NDC commitments, supporting the delivery of strategic policy objectives, and embedding safeguards against double counting, Carbonsafe demonstrates that voluntary carbon farming projects can serve as an essential complement—not a substitute—to state-led climate action. This approach strengthens the legitimacy of voluntary carbon markets, enhances synergies between private and public initiatives, and ensures that the project delivers real, durable, and policy-consistent climate benefits.[63][64]

10.12. Employee compensation safeguards.

Carbonsafe affirms its unequivocal commitment to ensuring that all Carbonsafe empolyees engaged in the implementation and operation of its carbon farming project receive fair, transparent, and lawful compensation for their labor. The company recognizes that equitable remuneration is not only a legal requirement but also a moral obligation that underpins social sustainability, safeguards human dignity, and enhances the trust and long-term success of the project.

All workers directly employed by Carbonsafe, are compensated in strict compliance with applicable national labor laws, European Union directives, and international standards, including the principles enshrined in the International Labour Organization (ILO) conventions. This includes adherence to statutory minimum wages, overtime compensation, social security contributions, and occupational health and safety standards. No worker is employed under conditions that fall short of these legal or ethical benchmarks.

Carbonsafe embeds principles of fairness, non-discrimination, and inclusivity into its compensation policies. Equal pay for equal work is guaranteed regardless of gender, ethnicity, age, or other personal characteristics. Workers are informed in advance, in accessible language, of the terms of their engagement, ensuring full transparency and informed consent.

10.12.1. Distributive Equity & Inclusion Statement.

Carbonsafe recognizes that the success and legitimacy of a carbon farming project depends not only on its environmental integrity but also on its capacity to equitably distribute benefits and ensure the inclusion of all relevant stakeholders.

The project has been designed with equity as a guiding principle. Carbon revenues generated through the issuance of high-quality credits are shared with participating farmers in a manner that is transparent, predictable, and proportionate to their contribution. This ensures that those who invest time, effort, and resources in adopting sustainable practices are recognized and rewarded for their stewardship. To safeguard fairness, Carbonsafe applies standardized benefit-sharing mechanisms and clear contractual arrangements, eliminating ambiguity and protecting the interests of smallholder and tenant farmers who might otherwise be vulnerable in market-driven systems.

By ensuring that project benefits are not limited to large landowners or well-capitalized enterprises, the project contributes to reducing rural inequality and building resilient farming communities.

To operationalize these commitments, Carbonsafe has established the following measures:

- Farmers of different scales, genders, and backgrounds are informed about opportunities.
- Tailored technical support, ensuring that less experienced or resource-constrained farmers can access the same agronomic guidance, training, and carbon revenue opportunities as their larger peers.
- Safeguards for vulnerable groups, guaranteeing that no farmer or community is excluded due to socio-economic status, land tenure type, or limited initial resources.

Local communities benefit from co-benefits such as improved soil fertility, biodiversity enhancement, and climate resilience. These broader benefits contribute to rural sustainability and strengthen social cohesion in agricultural landscapes.

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[63] European Commission. (2023). *Bulgaria – CAP Strategic Plan 2023–2027*. Directorate-General for Agriculture and Rural Development. Retrieved from https://agriculture.ec.europa.eu/cap-my-country/cap-strategic-plans/bulgaria_en
[64] European Commission. (2025). *Bulgaria: Final updated National Energy and Climate Plan (NECP) 2021–2030*. Directorate-General for Energy. Retrieved from https://commission.europa.eu/publications/bulgaria-final-updated-necp-2021-2030-submitted-2025_en

10.13. Health & Safety Statement.

Carbonsafe places the highest priority on the health, safety, and overall well-being of all individuals engaged in the design, implementation, and operation of its carbon farming project. The company understands that sustainable agricultural transformation is only possible when the people driving it are protected, empowered, and able to work under conditions that minimize risk and safeguard human dignity.

The project operates in strict compliance with national labor legislation, European Union directives, and internationally recognized health and safety standards, including the conventions of the International Labour Organization (ILO).

In the agricultural context, Carbonsafe acknowledges that hazards may include exposure to agrochemicals, risks associated with heavy machinery, prolonged outdoor work in variable climates, and physical strain linked to field operations. To address these, the project emphasizes regenerative practices that often reduce chemical dependency, integrates mechanization with safety training, and provides support for adaptive measures against heat stress and other climate-related health risks.

The company also upholds the principle of shared responsibility: health and safety are not treated as a one-directional obligation but as a collaborative effort among Carbonsafe, partner organizations, farmers, and workers.

10.14. Local Supply Chain and Partnership Statement.

Carbonsafe recognizes that sustainable climate action in agriculture cannot be achieved in isolation. The success of the carbon farming project depends on strong, transparent, and resilient local supply chains, as well as durable partnerships that extend across farming communities, service providers, research institutions, and market actors. For this reason, Carbonsafe has embedded a deliberate strategy to foster local value creation, strengthen rural economies, and ensure that project activities generate benefits that extend beyond participating farms.

10.14.1. Commitment to local supply chains.

Wherever feasible, Carbonsafe prioritizes the procurement of goods and services from local suppliers and contractors. This includes agricultural inputs, soil sampling and laboratory services, logistics, field equipment, training materials, and professional expertise. By sourcing locally, the project not only reduces its environmental footprint linked to transportation but also stimulates rural economies, supports job creation, and contributes to the vitality of agricultural service ecosystems.

10.14.2. Partnership with farmers and cooperatives.

Farmers are not only beneficiaries but also strategic partners in the project. Through direct engagement and collaboration with farmer associations, cooperatives, and producer groups, Carbonsafe ensures that knowledge, resources, and decision-making processes are shared. Partnerships are structured to empower farmers with access to agronomic expertise, technological tools, and carbon market opportunities, thereby reinforcing long-term resilience and competitiveness.

10.14.3. Collaboration with institutions and knowledge providers.

Carbonsafe seeks partnerships with universities, agricultural research institutes, and technical experts to follow innovative practices, methodologies, and monitoring frameworks. Such collaborations strengthen scientific rigor, enable capacity building, and ensure that farmers are supported with the most up-to-date knowledge on regenerative agriculture, soil carbon measurement, and sustainable land management.

10.14.4. Engagement with local authorities and communities.

Local municipalities and community organizations play an important role in ensuring that project activities are aligned with regional development priorities. Carbonsafe holds workshops and seminars to harmonize carbon farming initiatives.

10.14.5. Market partnerships.

On the demand side, Carbonsafe builds relationships with responsible buyers of carbon credits, emphasizing transparency, high-quality standards, and alignment with corporate sustainability goals. By connecting farmers directly to premium carbon markets, Carbonsafe ensures that local benefits are amplified by global commitments to climate action.

10.14.6. Long-term vision.

Through these partnerships, Carbonsafe aspires to establish a regional ecosystem of innovation and sustainability, where farmers, local businesses, research institutions, and communities co-benefit from the transition to regenerative agriculture. The company envisions a virtuous cycle in which local supply chains are strengthened, rural livelihoods are improved, environmental services are enhanced, and carbon markets are supplied with verifiable, high-integrity credits.

By placing local supply chains and partnerships at the heart of its strategy, Carbonsafe ensures that the project delivers not only measurable carbon outcomes but also enduring socio-economic value. This approach reflects a holistic understanding of sustainability.

10.15. Impact on cultural & ecologically significant lands.

10.15.1. Statement of commitment.

Carbonsafe acknowledges that agricultural landscapes are not only productive spaces but also repositories of cultural heritage, ecological value, and community identity. The company affirms its commitment to protecting lands that hold cultural, historical, or ecological significance, ensuring that carbon farming interventions do not cause degradation, displacement, or irreversible change to such areas. Any potential overlap with culturally or ecologically sensitive land will be treated as a matter of highest priority, guided by the principles of precaution, respect, transparency, and participation.

Carbonsafe has individual contracts with farms which operate only on registered farmland.

11. STAKEHOLDER ENGAGEMENT.

11.1. Farmer individual contracts with Carbonsafe.

11.1.1. Purpose and guiding principles.

Carbonsafe recognizes that trust, transparency, and fairness are the foundations of its relationship with participating farmers. To ensure that these principles are upheld, all farmers enrolled in the project enter into individual contracts with Carbonsafe. These contracts serve not only as legally binding agreements but also as instruments of mutual commitment, guaranteeing clarity of rights, responsibilities, and benefit-sharing.

The contractual framework is built on four guiding principles: transparency, fairness, accountability, and sustainability. Each contract is written in clear, accessible language and is explained in detail to farmers to ensure informed consent. Carbonsafe ensures that no farmer is disadvantaged by lack of legal literacy or technical knowledge and provides guidance to ensure that all parties fully understand their obligations and entitlements.

11.1.2. Structure of the contracts.

The individual contracts include the following key components:

Eligibility and land verification.

- Clear definition of the farm, fields, and land parcels enrolled in the project.
- Verification of land tenure or lease agreements to confirm the farmer's legal right to participate and receive carbon-related benefits.

Scope of participation.

- Description of the regenerative practices to be adopted
- Specification of monitoring and reporting obligations, including cooperation with soil sampling, data collection, and site visits.

Benefit-sharing and compensation**.**

- Explicit terms for the distribution of carbon revenue, ensuring farmers receive a fair share of income from the sale of credits generated through their efforts.

Support and capacity building.

- Carbonsafe's commitment to providing agronomic advice, technical assistance, and training.

Compliance and standards.

- Requirements to adhere to Carbonsafe's sustainability standards, including restrictions on practices that could compromise carbon outcomes or environmental integrity

Duration and renewal.

- Contracts are structured over 5-year renewable periods, and farmers are strongly encourage to renew, reflecting the long-term nature of soil carbon sequestration.

11.1.3. Risk-sharing and protections for farmers.

Transparent insurance or buffer mechanisms are included to manage risks of carbon reversal, ensuring that individual farmers are not unfairly penalized for uncontrollable events.

11.1.4. Building long-term partnerships.

The contract is a foundation of a long-term partnership. Carbonsafe treats farmers as co-creators of climate solutions, ensuring that their perspectives are valued and that benefits extend beyond carbon revenues to include improved soil health, reduced input costs, and stronger market opportunities.

These agreements are designed to balance rigor with flexibility, ensuring that farmers remain motivated partners in the collective pursuit of climate resilience and sustainability.

11.2. Training in regenerative practices.

The adoption of regenerative practices requires farmers to move beyond familiar routines and into a new paradigm of soil stewardship, biodiversity integration, and climate-conscious management. The agronomic recommendations and individual strategies provided connect scientific knowledge with practical application, ensuring that farmers are not only informed but also empowered to implement change at scale.

Farmers are advised on how to address soil constraints such as compaction, imbalances in carbon and nitrogen, and pH, and are guided toward interventions that improve organic carbon stocks and overall soil resilience. This foundation is immediately translated into practical strategies while protecting both yield and biodiversity.

Agronomic advice is consatantly delivered and ensures knowledge is gained at the moment of relevance.

Farmers of all scales—smallholders, tenant farmers, and larger commercial operators—are given the necessary attention. Training and one-on-one sessions with our agronomists are delivered in accessible language.

The training is comprised of a technical group composed of Carbonsafe agronomists, and when needed of external scientists, and farmer representatives.

Carbonsafe’s training transforms the abstract principles of regenerative agriculture into concrete and repeatable practices. It integrates knowledge into the natural cadence of the farming year, prioritizes inclusion and equity, and establishes a culture of peer learning and continuous improvement.

11.3. No Displacement Declaration.

Carbonsafe hereby affirms, in explicit and unequivocal terms, that the implementation of its carbon farming project does not, and will not, cause the physical or economic displacement of individuals, households, or communities. The project has been designed and operationalized on the basis of respect for existing land tenure, community rights, and the socio-economic stability of farming regions. This principle of non-displacement is central to the ethical integrity of the project and reflects Carbonsafe's broader commitment to ensuring that climate action never comes at the expense of human dignity, cultural continuity, or community well-being.

11.3.1. Land tenure and participation safeguards.

Participation in the project is entirely voluntary, and only farmers or landholders with verified and uncontested rights to their land may enroll. Prior to contracting, Carbonsafe conducts due diligence on land tenure documents, lease agreements, and customary use rights, ensuring that project activities are carried out solely on lands where legal and social legitimacy is clear.

The project explicitly prohibits the acquisition, lease, or use of land in ways that would displace local people or interfere with their access to essential resources. Communal lands, customary-use areas, and lands of cultural or ecological significance are excluded from project activities unless full, informed, and freely given consent is obtained from affected communities.

11.3.2. Protection against economic displacement.

Economic displacement, defined as the loss of income, livelihoods, or access to resources resulting from project activities, is also proactively prevented. Carbonsafe ensures that regenerative practices introduced through the project do not limit farmers' ability to grow food crops for their own consumption or for local markets. On the contrary, the project is designed to enhance soil fertility, increase resilience to climate extremes, and improve long-term productivity, thereby strengthening rather than undermining economic security.

Any temporary increases in production costs associated with the transition to regenerative agriculture are addressed through technical support, capacity-building, and the provision of additional income streams from the sale of carbon credits. These mechanisms ensure that farmers are not economically disadvantaged by participation, but rather supported through a just and equitable transition.

12. REGISTRATION, VALIDATION, AND VERIFICATION.

12.1. Registry

12.1.1. Purpose and role

At the heart of any credible carbon project lies the integrity of its accounting system. Carbonsafe recognizes that the environmental and financial value of carbon credits depends entirely on their uniqueness, transparency, and traceability. To safeguard these principles, the project operates under the framework of an independent carbon credit registry, which serves as the official ledger of issuance, transfer, and retirement of all credits generated through the project.

12.1.2. Core functions of the registry

The registry fulfills multiple critical functions:

1. Uniqueness and avoidance of double counting

   Each carbon credit is assigned a permanent, tamper-proof serial number upon issuance. This number links back to the sub-project farm parcels, vintage, and verification report, ensuring that credits cannot be duplicated, resold without record, or claimed more than once.

2. Transparency and accountability

The registry provides public-facing access to project documentation, including project design documents (PDDs), monitoring and verification reports, issuance records, and retirement records. This transparency enhances market confidence and allows stakeholders—including farmers, buyers, auditors, and regulators—to verify the provenance and status of credits.

3. Traceability across the credit lifecycle

   The registry maintains a clear chain of custody from issuance through to retirement. Transfers between accounts are logged, and final retirements are made visible to confirm that credits have been used and can no longer circulate on the market.

4. Integration with market standards

   Registry operations are designed to align with recognized international best practices, ensuring compatibility with existing voluntary carbon markets and emerging compliance systems.

12.1.3. Farmer and stakeholder access.

Participating farmers and landowners are provided with clear, accessible information about how credits linked to their farms are tracked within the registry. While registry accounts are generally held by Carbonsafe for aggregation and issuance efficiency, farmers receive transparent reporting of credit issuance and sales, ensuring that their share of revenues can be independently verified. Buyers of credits, in turn, receive registry-based retirement certificates as proof of their contribution to climate action.

12.2. Validation

Validation is the independent, ex-ante determination that the Carbonsafe project for South region, Bulgaria has been designed in conformance with the applicable standard/methodology, that its quantification logic is sound, and that the institutional controls necessary to deliver the stated climate and social outcomes are in place. It is the point at which the project's architecture—methodology selection, additionality rationale, monitoring design, safeguards, and governance must withstand external scrutiny before any issuance of credits can occur.

Carbonsafe profect for South region, Bulgaria will undergo validation by a third-party Validation and Verification Body (VVB) accredited for greenhouse gas projects under internationally recognized schemes. The VVB must demonstrate competence for land-sector and soil-organic-carbon projects, operate under an accredited quality management system, and be demonstrably independent from Carbonsafe, its buyers, and its technical advisors.

The scope of validation is defined to cover the full project boundary geographical, temporal, and functional. The validator assesses the applicability of the chosen methodology for soil carbon projects and confirms that the baseline scenario, project scenario, and leakage risks are identified and justified.

A central pillar of validation is the evaluation of the project's monitoring, reporting, and verification (MRV) design. The validator examines the soil sampling framework. Chain-of-custody controls for samples are reviewed end-to-end, from field to laboratory, including labeling, custody forms, and storage conditions. Laboratory competence is verified through accreditation status and method specifications suitable for soil organic carbon measurement. Digital data flows farm shapefiles, geotagged records, and database audit trails are assessed for integrity, version control, and user access management.

Because permanence is intrinsic to the credibility of soil carbon, the validator assesses the project's long-term management model: the contractual obligations entered into with farmers, the reversal risk analysis, and the provisions for buffer allocations at issuance. The validator confirms that the proposed buffer is conservative relative to quantified risks, and also reviews safeguards against double counting: registry integration, serialization logic, and claims controls.

Evidence for validation is organized in a structured data room. Core artifacts include: the executed project design document; methodology applicability analysis; land tenure verification and farm enrollment records; spatial boundary files; baseline justification; MRV protocols and SOPs for soil sampling, laboratory methods; registry onboarding confirmations; template farmer contracts with benefit-sharing terms; and records of stakeholder engagement where applicable. Each artifact is cross-referenced to the relevant requirement in the governing standard/methodology, creating an auditable thread from requirement to evidence to validator conclusion. Data privacy is preserved throughout, with farmer-identifying information minimized or pseudonymized as permitted.

The validation process itself proceeds in phases. A readiness review (desk) confirms completeness and identifies obvious gaps. The main assessment includes interviews with Carbonsafe management, agronomists, and the data steward; walkthroughs of the data systems; and on-site sampling of representative farms to test the operational reality behind the documented design. Where the validator identifies non-conformities, they are classified by materiality and risk. Corrective Action Requests (CARs) require documented remediation and evidence of change; Clarifications (CLs) require additional justification or minor edits; Observations (OBs) flag opportunities for improvement without blocking validation. Carbonsafe treats CARs as design improvement opportunities; responses are logged, reviewed by the internal quality lead, and resubmitted with objective evidence before the validator can conclude.

At the close of the assessment, the VVB issues a validation opinion that states the project and methodology/standard assessed, the scope and boundaries, the evidence basis, the list of CARs/CLs and their closure status, and any conditions precedent that must be met prior to crediting. If conditions apply, Carbonsafe must satisfy them and provide evidence before issuance can proceed. The final validation statement, together with a non-confidential validation report, is published through the registry interface to ensure transparency for farmers, buyers, and other stakeholders.

The project embeds change-management procedures that trigger re-assessment where material modifications are proposed such as expanding into new agro-ecological zones or introducing new practice types with different risk profiles. Scaling is governed by inclusion criteria and a standardized on-boarding protocol; the validator confirms that these controls allow additional farms to be added without reopening the entire design, provided the criteria and MRV architecture remain intact. In parallel, lessons from verification cycles feed back into design updates; significant updates are documented in revision memos and, where required by the standard, submitted to the validator for approval prior to implementation.

12.3. Verification

Verification is the independent, ex-post test of truth that stands between monitoring and market claims. Each reporting period, Carbonsafe submits its Monitoring Report and evidence pack to a Validation and Verification Body (VVB) that is accredited for greenhouse-gas verification in the land sector and demonstrably independent of the project, buyers, and service providers.

The scope of verification spans the full crediting chain for the period under review. The VVB designs a sampling plan which covers activity data (practice adoption), stock-change measurements (soil organic carbon), emission sources and deductions, permanence controls, registry safeguards, and social and environmental safeguards that are pre-conditions to crediting.

The evidence pack submitted by Carbonsafe is organized for end-to-end traceability. It links parcel boundaries and geospatial layers to farm contracts, practice declarations, and machine logs; ties soil sampling frames to field coordinates, and depth protocols; and carries sample chain-of-custody from field to laboratory. Laboratory competence is evidenced by accreditation and method sheets suitable for soil organic carbon, with internal quality control.

Field reality is verified rather than presumed. Each cycle, the VVB undertakes site visits to a subset of sampled farms—timed to observe relevant practices or, where necessary, to witness soil sampling events. The verifier interviews farm personnel to corroborate records.

Calculations for removals are checked to ensure formulas match the approved methodology and that any software updates have not altered outputs.

Findings are classified by materiality and risk. Issues that could overstate climate benefits or compromise safeguards are treated as material by default and trigger Corrective Action Requests (CARs) that must be closed—through objective evidence before a positive verification statement is issued. Lesser issues may be raised as Clarifications (CLs) where additional justification or small adjustments suffice; improvement suggestions are logged as Observations (OBs) for management attention in subsequent cycles. Carbonsafe maintains a verification response log that traces each finding to its root cause, corrective action, verification evidence, and the internal control strengthened to prevent recurrence.

The verification outcome is a formal opinion that states the standard and methodology verified, the boundaries and period covered, the assurance level applied, the sampling approach and the status of CARs/CLs/OBs. Only after all conditions are met does Carbonsafe proceed to issuance; the final Verification Statement and a non-confidential Verification Report are published through the registry interface so that farmers, buyers, and stakeholders can see the basis for crediting.

Verification is periodic by design but adaptive in practice. Carbonsafe seeks annual verification to establish a high-confidence baseline of performance and control effectiveness; as the project matures and the governing standard permits, multi-year reporting periods may be adopted for soil-stock change, with interim checks to assure practice continuity and safeguard compliance. Outside the normal cycle, event-driven verification may be commissioned when significant design changes are proposed, when allegations of non-conformance arise, or when reversal events exceed predefined thresholds.

12.4. Issuance Model: Ex-post credits, traceable to farm.

12.4.1. Ex-post principle of crediting.

Carbonsafe adopts a strictly ex-post issuance model, meaning that credits are only created and entered into the registry after the underlying carbon sequestration or emissions removal has been monitored, verified, and independently confirmed by an accredited Validation and Verification Body (VVB). This approach eliminates the risk of over-crediting based on ex-ante projections and ensures that every credit corresponds to a real, additional, and fully measured climate benefit that has already occurred in the soil and on the land.

The ex-post model reflects Carbonsafe's core philosophy: that climate integrity must come before market expedience. Farmers, buyers, and regulators can therefore trust that all issued units represent durable carbon outcomes, backed by documented field evidence and subject to rigorous permanence buffers.

12.4.2. Traceability to farm.

Each credit issued is not only linked to the project as a whole but is also traceable to the individual farm. This fine-grained traceability is enabled by the project's monitoring, reporting, and verification (MRV) architecture:

- Geospatial delineation: All enrolled fields are mapped with high-resolution geospatial data, ensuring that carbon gains are linked to exact coordinates.
- Soil sampling integration: Soil samples are stratified and collected according to defined sampling frames at the plot (cell) level, and their results feed directly into credit quantification.
- Data chain of custody: Every data point—farmer practice logs, field operations, laboratory results—is tagged to the corresponding plot.
- Registry metadata: Upon issuance, credits carry metadata linking them to the farm of origin, the monitoring period, the applied methodology, and the verification report.

This degree of traceability ensures that credits are not fungible abstractions, but auditable records tied to the real actions of identifiable farmers managing specific pieces of land.

12.4.3. Farmer benefit and transparency.

The issuance model is designed to ensure fairness and transparency in farmer compensation. Because credits are calculated and issued at the farm level, revenue shares can be allocated proportionally based on each farmer's actual contribution to sequestration. Farmers receive periodic issuance reports that specify:

- the number of credits generated from their land,
- the deductions applied (buffer contributions),
- the net credits available for revenue distribution, and
- the registry transaction references associated with their credits.

This system protects smallholders and tenant farmers, ensuring that their contributions are recognized, rewarded, and independently verifiable.

12.4.4. Market confidence and integrity.

For buyers, the ex-post issuance model provides maximum confidence. Each credit purchased is backed by a clear chain of evidence from soil measurement to registry serialization. Credits cannot be issued in advance, cannot be duplicated, and cannot be claimed by both farmers and national accounting systems due to registry safeguards. Retirement of credits is also transparently documented at the registry level, closing the loop of traceability.

12.4.5. Buffer allocation and conservatism.

Before credits are issued to the market, a proportion of verified carbon gains is set aside in a shared buffer pool to insure against risks of reversal, farmer dropout, and force majeuree events. This buffer is held at the registry level and is non-tradable. Only the net amount after all deductions and buffer allocations—is serialized and made available for distribution and sale. This ensures that credits remain conservative and that buyers are never exposed to overstated claims.

12.4.6. Adaptive governance.

The issuance model is periodically reviewed to align with evolving best practices in carbon accounting and regulatory requirements, including the European Union's emerging framework for certification of carbon removals.

12.5. Double Issuance & Double Claim Prevention.

Carbonsafe treats the uniqueness of each carbon unit and the clarity of any associated public claim as non-negotiable conditions for market integrity. The project's controls are therefore designed to prevent two distinct failure modes: double issuance (the creation of more than one credit for the same quantified climate benefit) and double claiming (two entities asserting the same climate outcome). The system integrates contractual safeguards, geospatial and data-governance controls, registry architecture, and buyer-facing claim rules to ensure that every serialized unit is unique, traceable, and used exactly once.

During enrollment, Carbonsafe establishes exclusivity at the plot (cell) level through geospatial delineation and legal/contractual attestation. Farmers warrant that enrolled parcels are not simultaneously committed to other carbon projects for the same GHG attribute.

The monitoring architecture links each data element (activity logs, soil samples, laboratory results) to an immutable plot (cell). Version-controlled data records are reconciled to issuance.

Claims are governed by Registry Terms of Use that bind buyers to a clear claim taxonomy. Offset claims require prior retirement in the buyer's name and cannot be use further.

Carbonsafe prohibits attribute stacking that would monetize the same tonne of CO_2e twice under different instruments. Soil-carbon removals credited from this project cannot be simultaneously credited as another GHG unit under a separate standard for the same period and area.

To avoid off-ledger duplication, delivery is performed either by transfer to the buyer's registry account or by immediate retirement on their behalf. Custodial or omnibus accounts used for brokerage are strictly segregated; inventory, pending delivery, and retired balances are reconciled continuously, and client-level sub-ledgers are available for inspection. OTC contracts incorporate delivery identifiers that must match the exact serial set later retired, preventing substitution or partial double use.

The project's contracts, registry terms, and buyer agreements provide for remedies in case of breach: suspension of transfer rights, cancellation of deliveries, public correction of claims, and, where necessary, retirement of buffer units to protect third parties. Intentional misconduct such as knowingly attempting to re-use retired serials or making deceptive neutrality claims may result in registry exclusion and referral to relevant authorities or standards bodies.

13. GROUPED STRUCTURE DETAILS.

13.1. Sub-project (Project participant) Definition.

Within the Carbonsafes project's architecture for South region, Bulgaria, a sub-project—also referred to as a project participant—is the smallest accountable delivery unit through which land, practices, data, and responsibilities are organized for monitoring, verification, and issuance. Sub-projects (project participants) are all the farms participating in the project for South region, Bulgaria. The sub-project concept allows the regional project to scale while preserving traceability to individual farms and plots (cells), ensuring that operational diversity across geographies and farm types can be accommodated without diluting methodological rigor.

A sub-project is constituted when an eligible legal or natural person enters into an individual contract with Carbonsafe and enrolls one or more clearly delineated agricultural parcels under a defined crediting period. Eligible participants include single farms, farm enterprises, tenant operators with documented lease rights, and group of smaller farms unified with one contract. Whatever the organizational form, the sub-project possesses three essential attributes: (i) legal standing to implement practices and receive benefits, (ii) spatial and temporal boundaries that are unambiguous and exclusive, and (iii) operational control sufficient to meet monitoring and safeguard obligations.

Boundary definition begins with geospatial delineation at the plot (cell) level. Each enrolled field is mapped to an authoritative cadastre or equivalent georeferenced dataset, assigned a persistent plot key, and linked to the participant's legal identity. Temporal boundaries are established by the sub-project's crediting period start date and synchronized with soil sampling cycles and reporting cut-offs. Parcels cannot be simultaneously enrolled in other GHG crediting schemes for the same attribute or period; exclusivity is warranted contractually

Eligibility and additionality are assessed at enrollment. The participant must demonstrate right of use (ownership, lease, or other lawful entitlement) and freedom from encumbrances that would preclude the adoption of regenerative practices. Baseline characterization confirms that targeted practices are not already mandated or common practice to a degree that would undermine additionality; evidence may include local adoption statistics, agronomic histories, and input records. Where public subsidies exist, they are reviewed to ensure they do not fully remove the need for carbon revenue to enable the transition. Only farms that meet these criteria are admitted into the sub-project boundary.

Each sub-project commits to a practice package for example, reduced or no-till, diverse cover crops, residue retention, nutrient stewardship, and integrated pest management—tailored to crop rotations and agro-ecological conditions. The package is documented through farm-level plans, and equipment configurations, creating an auditable bridge between intention and field reality. Because the project issues credits ex-post, adoption is corroborated by activity data (machine logs, and input records, photo evidence,) and by independent verification of soil organic carbon changes over time.

Monitoring, reporting, and verification (MRV) responsibilities are anchored at the sub-project. Participants maintain field records according to Carbonsafe templates, host soil sampling events, and cooperate with data quality checks and site visits. Chain-of-custody from field to laboratory is preserved through labeled sampling kits, custody forms, and secure transfer protocols. Records are stored in a version-controlled environment where each datum—practice event, input application, sampling location, laboratory result—is time-stamped and bound to the corresponding plot (cell).

Governance and change control ensure that sub-projects remain stable units of accounting even as farms evolve. Additions or removals of parcels (cells) follow documented procedures: new fields undergo the same eligibility screening and baseline logic; merged or split parcels (cells) retain lineage through plot-key inheritance; and any change that could affect sampling strata or statistical power is evaluated before the next monitoring cycle. Corporate restructurings (e.g., transfer of farm ownership) trigger due diligence to confirm continuity of rights and obligations. Throughout, Carbonsafe maintains a sub-project register with unique identifiers, contract status, parcel inventory, and verification history, enabling cross-checks against issuance volumes and retirement records.

Financial transparency and claims discipline are embedded in the sub-project relationship. Issuance reports specify the credits attributed to the participant, the deductions applied for buffer and reserve contributions, and the net amount eligible for revenue sharing. Payments follow verification and registry events, and participants receive references to serialized units or retirement certificates corresponding to their contribution. Participants are prohibited from making offsetting or neutrality claims unless credits are retired in their name.

13.1.1. New participants addition.

New participants may be added to the project, provided they meet the same eligibility, land tenure, and safeguard requirements established at project inception. Their inclusion does not trigger a full re-validation of the project; instead, the Validation and Verification Body (VVB) assesses whether the onboarding procedures, baseline logic, and MRV controls applied are consistent with the validated design. Where additions represent new agro-ecological conditions, significant expansion of scope, or material changes in risk, the VVB conducts a targeted review to confirm continued methodological applicability and environmental integrity before credits from the new participants are eligible for issuance.

13.2. PDD Amendment Rules.

13.2.1. Purpose and guiding principle

The Project Design Document (PDD) is the authoritative reference for the design, scope, and operational framework of the Carbonsafe carbon farming project for the South region, Bulgaria. Because agricultural, regulatory, and market conditions evolve, it is essential that the PDD remain both stable enough to guarantee investor and buyer confidence and flexible enough to accommodate justified improvements. To balance these needs, Carbonsafe has established clear rules governing when and how amendments may be made, the processes for their approval, and the mechanisms for transparent disclosure.

13.2.2. Types of amendments

Amendments are classified into three categories, based on their potential impact on project integrity and the eligibility of issued credits:

1. Material amendments.

Changes that alter the project boundary, methodology, quantification approach, eligibility criteria, or permanence safeguards in ways that could affect crediting outcomes require full review by the Validation and Verification Body (VVB), and in some cases re-validation, before they can take effect.

2. Substantive but non-material amendments.

Changes that refine or clarify project procedures without altering the underlying crediting logic or safeguards require documentation in a formal amendment memo, internal approval by Carbonsafe governance bodies, and review by the VVB at the next verification cycle.

3. Minor editorial amendments.

Changes limited to formatting, language clarification, or correction of typographical errors that do not alter meaning, are logged internally and disclosed in periodic reporting, but do not require VVB review.

13.2.3. Amendment process

All proposed amendments follow a standardized workflow:

1. Initiation – The proposed change is submitted by Carbonsafe staff, technical advisors, or stakeholders, supported by a justification note and evidence of necessity.
2. Screening – The Head of IMS within Carbonsafe classifies the amendment as material, substantive, or minor, and determines the required level of review.
3. Consultation – For material and substantive changes, affected stakeholders (e.g., farmers, buyers, community representatives) are informed.
4. Validation/Verification Body review – Where required, the amendment is presented to the VVB.
5. Registry update – Once approved, the amendment is recorded in the project's registry entry, ensuring transparency for all market participants.

14. DATA MANAGEMENT & IT INFRASTRUCTURE.

14.1. Purpose and design philosophy.

Carbonsafe uses an integrated software platform to serve as the digital backbone of its monitoring, verification, and farmer support ecosystem. The platform ensures that every soil sample, laboratory result, and agronomic recommendation is traceable, auditable, and actionable. By embedding data integrity and user-centered design, the software not only guarantees credibility of carbon credit issuance but also provides farmers with practical insights for continuous improvement in regenerative practices.

14.2. Sample tracking and chain of custody.

The platform manages the full lifecycle of soil samples, from field collection to laboratory analysis, ensuring transparency and reliability at every step. Each sample is assigned a unique identifier, linked to the geospatial coordinates of the plot (cell), the farmer's enrollment record, and the sampling protocol applied. When samples are collected in the field, technicians log metadata (date, time, GPS location, depth, sampler ID) via a mobile application that uploads entries to the central database.

Chain of custody is preserved through barcode, scanned at each handover point—from field to laboratory, and from laboratory to data upload. Custody forms are recorded within the system, producing an immutable log of custody events. This eliminates the risk of sample mislabeling, substitution, or tampering and provides verifiers with a clear audit trail during validation and verification.

Partner laboratories could be connected to the platform directly or could use approved template for data upload to the platform.

14.3. Data processing and agronomic interpretation.

Beyond storing laboratory data, the platform transforms raw results into actionable insights for farmers. Soil carbon content is integrated with other soil health indicators providing a comprehensive picture of soil fertility and resilience, allowing the system and Carbonsafe agronomists to generate tailored agronomic recommendations for each plot (cell) in the farm.

Recommendations are designed to be practical and plot-specific, highlighting regenerative practices that can improve soil health, increase productivity, and enhance carbon sequestration.

14.4. Farmer interface and decision support.

Farmers access their results and recommendations through a secure web portal. Dashboards present data in clear, non-technical visualizations—such as trend graphs, and maps—making complex laboratory outputs accessible to all users. Farmers can compare year-on-year results and understand how their choices influence both carbon crediting and agronomic outcomes.

14.5. Integration with MRV.

All sample and laboratory data feed directly into Carbonsafe's software. This ensures that credit issuance is backed by a digitally auditable, tamper-proof chain of evidence from soil to VVB. Data from the platform is also used to populate registry entries, linking credits to specific farms, monitoring periods, and laboratory-confirmed results.

14.6. Data integrity, privacy, and security.

Given the sensitivity of both farmer data and laboratory results, the platform incorporates robust data protection protocols. All records are secured with role-based access controls limiting visibility to authorized users. Admin logs can track all edits and access events, ensuring accountability. Compliance with the EU General Data Protection Regulation (GDPR) is mandatory, and farmers retain ownership of their farm-level data, with explicit consent required for any third-party sharing beyond crediting processes. Farm-level data could be shared with the relevant Authorities in case requested by law.

14.7. Adaptive learning and continuous improvement.

The software is not static. Carbonsafe applies an adaptive development model, updating algorithms, dashboards, and interfaces in response to farmer feedback, verifier comments, and advances in soil science.

Through its integrated software, Carbonsafe ensures that every soil sample and laboratory result is traceable, every agronomic recommendation is grounded in data, and every issued carbon credit is backed by a defensible evidence trail.

15. PROJECT DEVELOPER SUSTAINABILITY, SCALE & FINANCIAL ANALYSIS.

15.1. Project developer scale and growth trajectory.

Carbonsafe has been conceived as a scalable national carbon farming project developer capable of delivering both environmental impact and financial sustainability. As of 2025, the Carbonsafe projects have enrolled over 100 farmers across Bulgaria, covering approximately 50,000 hectares of agricultural land, with a retention rate of 99% of farm plots (cells). These early milestones demonstrate both the farmer appetite for participation and the robustness of the contractual and technical framework that underpins the project.

Looking ahead, the Carbonsafe projects are designed to grow significantly in scale. By 2027, Carbonsafe targets an enrolled area of over 100,000 hectares, expanding further to 150,000 hectares in the longer term. This trajectory positions the projects as one of the largest soil carbon initiatives in Eastern Europe, rooted in Bulgaria but with regional significance across the Balkans. The scaling strategy is grounded in two reinforcing drivers: farmer demand for regenerative farming solutions that deliver both economic and ecological benefits, and the rapidly growing appetite in voluntary carbon markets for high-quality, ex-post, soil-based carbon removals.

15.2. Estimated GHG emission reductions and carbon dioxide removals.

The projects' central climate contribution lies in removing atmospheric CO_2 through regenerative agriculture practices, measured as increases in Soil Organic Carbon (SOC) stocks. By implementing diverse crop rotations, reduced or no-till systems, cover crops, residue retention, and optimized nutrient use, participating farmers contribute to both emissions reductions (e.g., lower fertilizer use, fewer machinery passes) and removals (increased SOC sequestration).

Independent soil sampling and laboratory analysis form the basis for quantifying removals. This 100% physical measurement approach ensures that credits are based on observed, verifiable changes in carbon stocks. Based on aggregated field data and conservative accounting, Carbonsafe anticipates issuing over 500,000 verified carbon credits by 2027, each corresponding to one metric ton of CO_2 equivalent genuinely removed from the atmosphere.

The long-term sequestration potential is even greater, with annual removals expected to scale in proportion to the land area growth. At full expansion of 150,000 hectares, Carbonsafe is expected to deliver hundreds of thousands of tonnes of durable removals annually, contributing directly to both corporate offsetting commitments and the EU's and Bulgaria's net-zero pathways.

15.3. Financial sustainability and farmer incentives.

The financial model of Carbonsafe is designed to ensure sustainability at both the project and farmer levels. Farmers receive direct compensation tied to their verified sequestration outcomes, creating a new, reliable revenue stream in addition to yield improvements and reduced input costs. Field evidence already shows that regenerative practices can deliver up to 50% reductions in fertilizer use and 10% yield gains, translating into substantial farm-level economic resilience.

At the sub-project level, revenues are generated through the sale of premium, registry-backed carbon credits into voluntary markets. These credits are differentiated by their soil-based, ex-post measurement methodology, which enhances buyer confidence and enables premium pricing. With an expanding farmer network, the nationl projects's credit pipeline is both diverse and resilient.

The financial sustainability of Carbonsafe is further reinforced by its alignment with corporate sustainability and development of carbon markets. Buyers are increasingly seeking removal-based credits, which currently represent only 9% of retired credits globally but are projected to grow rapidly in demand. This demand dynamic positions Carbonsafe's credits as a scarce, high-value product in a market that could exceed $35 billion by 2030.

15.4. Long-term viability.

The combined effect of robust MRV, farmer-centered incentives, and strong market positioning ensures that Carbonsafe is financially and environmentally sustainable. Carbonsafe projects create long-term stability for both supply and demand. The use of a buffer pool, credits reserve and conservative issuance practices protects against reversal risks, ensuring that issued credits retain their integrity over decades.

Carbonsafe's financial analysis demonstrates that the projects in development are not merely a short-term initiative but a sustainable, scalable business model that balances farmer welfare, climate integrity, and market demand. By 2027, with over 100,000 hectares enrolled and more than half a million verified credits issued, Carbonsafe projects will stand as a cornerstone of carbon farming in the region—contributing measurable removals, strengthening rural economies, and offering buyers credible climate solutions grounded in science and transparency.

16. ANNEXES.

16.1. GLOSSARY

Glossary of Terms and Abbreviations

Additionality – The principle that credited climate benefits would not have occurred in the absence of the project. Demonstrated by showing practices are not common (<20% adoption), not legally required, and only possible with carbon finance.

Agronomic Team – Carbonsafe's internal technical staff responsible for field sampling supervision, practice monitoring, and farmer engagement.

Area-Weighted Mean Adoption – A method of calculating adoption rates of practices across a region by weighting farm-level adoption by their relative land area.

Baseline Year – Year 0 in which initial soil organic carbon (SOC) values are established before project activities.

BCCR (Balkan Carbon Credits Registry) – Public registry administering serialization, issuance, transfer, and retirement of carbon credits generated under the project.

BCCS (Balkan Carbon Credits Standard) – carbon credit standard in the voluntary carbon market. BCCS sets rules and requirements for carbon credit projects to ensure measurable, high-integrity outcomes, maintains a public registry of projects and issued carbon credits, and oversees rigorous independent validation and verification processes.

Buffer Pool – A pool of non-tradable credits withheld at issuance to insure against reversal, force majeuree, or systemic risk.

Bulk Density (BD) – Mass of dry soil per unit volume (g/cm^3). Required for converting SOC concentrations (mg/kg) into stock per hectare.

Carbon Credit – A verified unit representing one metric tonne of CO_2 equivalent (tCO_2e) removed or reduced, serialized in the registry.

Carbon Removal Certification Framework (CRCF) – European Union regulation establishing requirements for certification of carbon removals, including soil carbon.

Chain-of-Custody – Documented process ensuring traceability of soil samples from field collection through accredited laboratory analysis.

Conservativeness – A principle in carbon accounting that prioritizes underestimation over overestimation to maintain integrity.

Control Year – The year in which soil samples are re-measured and compared to baseline or previous control years to determine ΔSOC.

Crediting Period – The time span (e.g., 2023–2063) during which project activities are monitored and credits may be issued.

ΔSOC (Delta SOC) – The change in soil organic carbon between baseline and control years, expressed in mg/kg or converted to tonnes of CO_2.

Durability – The capacity of stored carbon to remain in the soil over time, supported by safeguards, buffer allocations, and ongoing monitoring.

ERP (Enterprise Resource Planning system) – Carbonsafe's digital system linking field IDs, lab batches, GPS data, and calculation workbooks. (ISACO2- Specialized software for Integrated Administration, Control and Reporting System.)

Ex-Post Issuance – Credits are only issued after verified SOC gains are measured, avoiding over-crediting or reliance on projections.

Farm Balance – The net CO_2 removals per farm after deducting on-farm emissions (fuel) and applying conservativeness rules.

FPIC (Free, Prior and Informed Consent) – Safeguard ensuring that farmers and communities participate voluntarily, with full information.

GHG (Greenhouse Gas) – Gases contributing to climate change, primarily CO_2, CH_4, and N_2O.

GPS Tracks – Geospatial files confirming that soil sampling occurred within the defined plot boundaries.

ICVCM / ICROA – Integrity initiatives (Integrity Council for Voluntary Carbon Markets / International Carbon Reduction and Offset Alliance) providing guidelines for high-integrity carbon credits.

Issuance Ratio – Portion of verified removals immediately credited (e.g., 25%) with the remainder held in reserve for prudence.

Laboratory Accreditation – Certification (ISO/EN standards) that ensures soil analysis methods are credible and reproducible.

Leakage – The displacement of emissions outside the project boundary as an unintended consequence of project activities.

Materiality Threshold – The significance level at which discrepancies or errors are deemed to affect credit issuance.

MRV (Monitoring, Reporting, and Verification) – System covering sampling, lab analysis, calculation, reporting, and independent verification.

Net Removals – Gross CO_2 removals from SOC minus on-farm emissions and uncertainty deductions.

Non-Conformity (NC) – A deviation from prescribed procedures, categorized as minor, major, or critical depending on severity.

OC (Organic Carbon) – Carbon contained in soil organic matter, measured in mg/kg.

Permanence – The duration over which credited CO_2 removals are expected to remain stored.

Plot (Cell) – The smallest monitoring unit in the project, georeferenced and linked to farm contracts.

Registry – Independent system ensuring credit uniqueness, traceability, and transparency.

Reversal – A verified net loss of SOC at the final year of the crediting period. Covered by reserves and buffer pools.

SOC (Soil Organic Carbon) – Carbon stored in soil organic matter, the key reservoir targeted by the project.

Sub-Project (Project Participant) – An individual farm or group of farms enrolled under a contract, forming the delivery unit for monitoring and issuance.

tC (Tonne of Carbon) – Measurement unit of carbon mass. Used for conversion to CO_2 via IPCC factor.

tCO_2e (Tonne of Carbon Dioxide Equivalent) – Standardized metric for quantifying GHGs.

Uncertainty Deduction – A fixed % (e.g., 5%) or statistical adjustment applied to credit issuance to account for measurement variability.

Validation – Initial third-party assessment of the PDD and methodology alignment.

VVB (Validation and Verification Body) – Independent accredited auditor responsible for validating and verifying project results.

Verification – Ex-post review of evidence packs and site visits confirming project outcomes before credits are issued.