



CREDIBLE
EU carbon farming



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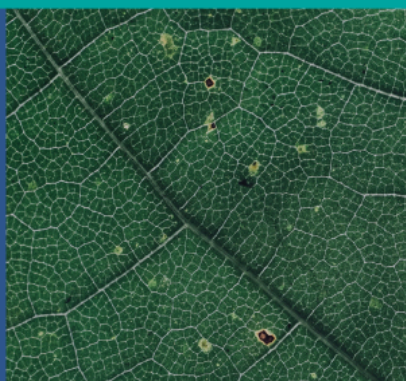
How long-term monitoring sites could support robust MRV systems

Project CREDIBLE: “Building momentum and trust to achieve credible soil carbon farming in the EU”.

Funded by the European Union under the Grant Agreement n° 101112951.

www.project-credible.eu

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Executive summary

This document is part of the EU-funded project CREDIBLE, Grant Agreement 101112951, and it captures the main outputs of the first round of conversations within the Focus Group on “How long-term monitoring sites could support robust MRV systems”.

The main goal of this Focus Group is to generate recommendations or opinions that could be used in the development or deployment of relevant policies around carbon farming, and particularly in the definition of the Carbon Removal Certification Framework. These informed opinions have emerged through the active participation of experts (details provided in Tables 1 and 2) in a number of activities (with the main ones listed in Table 3).

In order to convey the recommendations to the broader possible audience, the following sections have been included in the document: i) an introduction, which helps clarifying the problem and why addressing this topic was considered important by the CREDIBLE consortium; ii) a short process report, which summarises the conversations held by the Focus Group, highlighting the key points and tensions that emerged and; iii) a summary of recommendations, listing in a concise way the opinion of the Focus Group on how to best solve some of these tensions.

1. Focus Group participation and activities

Table 1 - Partners of CREDIBLE who participated in the Focus Group.

Name of the expert	Affiliation	Role	Country
Hui Xu	ILVO	Lead	BE
Tommy D'Hose	ILVO	Lead	BE
Greet Ruyschaert	ILVO	Member	BE
Maria Fantappie	CREA	Member	IT
Hannes Mollenhauer	UFZ	Member	DE



Panagiotis Tziachris	ELGO	Member	GR
Vasileios Aschonitis	ELGO	Member	GR

Table 2 - Members of the Focus Group external to CREDIBLE.

Name of the expert	Affiliation	Role	Country
Lars Juhl Munkholm	Aarhus University	Member	DK
Nathalie Cools	INBO	Member	BE
Eric Ceschia	INREA	Member	FR
Lucia Perugini	Euro-Mediterranean Center on Climate Change (CMCC)	Member	IT
Greta Formaglio	eAgronom	Member	CZ
Christoph Wohner	Umweltbundesamt GmbH (EAA)	Member	AU
Genk Donmez	Leibniz Centre for Agricultural Landscape Research (ZALF)	Member	DE
LANCKRIET Edouard	Agrosolutions consulting	Member	FR
Richard Ostler	Rothamsted Research	Member	UK
Arthur Monhonval	SOIL CAPITAL	Member	BE
Judit Torres	INIA-CSIC	Member	ES
Laura Hernandez MATEO	INIA-CSIC	Member	ES

Table 3 - List of main activities carried out to steer the conversations.

General description of the activity	Date of execution
Inaugural Focus Group online meeting	23/01/2024
Second Focus Group online meeting	22/02/2024
Breakout session during the European Carbon Farming Summit	06/03/2024



2. Introduction

Robust Measurement, Reporting, and Verification (MRV) is pivotal for ensuring the environmental integrity of carbon removals, necessitating accurate, measurable, and reliable assessment methods to balance the trade-off between MRV accuracy and its associated costs. **This Focus Group (FG) aims to consolidate experiences from various networks to establish guidelines for managing long-term monitoring sites (LTMs) that effectively support regional carbon schemes, despite the current challenges of scattered or incomplete data for carbon model calibration or validation.**

This report focuses on **three major aspects**: the potential **role of LTMs in MRV**, identifying the **major challenges and barriers to effective use of LTMs data**, and the potential **solutions and recommendations**.

3. Short process report

The insights that are described in this report are derived from discussions during two FG meetings and a breakout session and a survey during the Carbon Farming Summit in Valencia (5-7/3/2024). The FG includes 17 members from research institutes, universities, corporations, international organisations and SMEs. Two primary groups were identified: data providers—LTM network representatives from such as eLTER, ICOS, ICP Forest, BonaRes, GLTEN, and LUCAS; and MRV system developers—data users from initiatives and projects such as EJP Soil, MARVIC, MRV4SOC, ORCaSa, Label Bas-Carbone, Soil Capital, eAgronom, JRC, etc. During the Carbon Farming Summit, 50 participants attended our breakout session, out of which 23 completed the survey. Among the participants, 70% of them were identified as Data users only and 13% as Data providers only, while 17% considered themselves as both data providers and users (results of the survey see in Annex).



3a. Role of LTM sites

From the discussions, several vital functions from LTMs in the context of carbon farming were pointed out:

- **Calibration, Validation, and Simplification of Models:** LTMs provide a quality-controlled data resource for refining and validating carbon/crop models, ensuring their accuracy in diverse contexts, and identifying the key parameters that could help in simplifying the models.
- **Validation of MRV Approaches:** LTMs are instrumental in validating MRV approaches, particularly concerning the uncertainty associated with measuring the potential impacts of carbon farming practices.
- **Evidence of Carbon Farming Effects:** They offer empirical evidence on the effects of different carbon farming practices on soil organic carbon (SOC) changes, enabling a measurable understanding of these practices' efficacy.
- **Long-term Impact Evaluation:** LTM sites are crucial for assessing the long-term impacts of carbon farming, considering the ongoing influences of climate change and ensuring that the practices are sustainable and effective over time.
- **Upscaling Use:** The LTM data are essential for upscaling, enabling the extrapolation of results from local to regional levels, thus informing broader-scale carbon farming policies and practices.
- **Support for Digitalisation:** They could facilitate the digitalisation of carbon farming practices, such as calibrating new sensors, which are essential for modern, precise, and efficient agricultural monitoring.

3b. Challenges from data users' and data providers' perspectives

From the data user's view, mainly challenges including representativeness of the existing LTMs, data quality and management, and technical challenges were noticed.

The representativeness of LTM networks is the first major challenge of using LTM data for carbon farming, including poor spatial resolution, and a lack of comprehensive coverage across different management practices, land use types,



climatic zones, and soil types. This inadequacy undermines the data's applicability to specific regions. Additionally, the carbon models are not suitable for specific management practices or land use types, limiting their effectiveness and the accuracy of the data collected.

Another challenge lies in the realms of **data quality and management**, mainly the findability, accessibility, interoperability, and reusability of data. The findability of (meta)data, especially from completed LTM sites, is often compromised, which is further complicated by the use of different vocabularies in storing (meta)data, thereby affecting interoperability across different platforms and studies. Additionally, the presence of incomplete or entirely missing metadata or management data limits the effectiveness of using LTM data, alongside concerns regarding the accuracy of the available metadata. Unreported changes in methodology over time, such as in sampling strategies or analysis methods also complicate the upscaling process. Moreover, restrictive access due to licensing and the limited availability of data primarily to the scientific community, with minimal availability for private sector use, further restrict its broader application and utility.

Thirdly, the **technical challenges** include inadequately small plot sizes for effective remote sensing ground truth data and conflicts between open science principles and GDPR, particularly regarding farm data, complicating data sharing and application in research.

From the data providers' perspective, challenges in providing FAIR data from the LTM sites for MRV design include the necessity for **new skills in data management** among LTM site owners, the **time and resource-intensive nature of data management processes** and **the diminishing or lacking long-term funding for LTM sites**.

3c. Potential solutions

After identifying the key challenges for data users and providers in using LTM data, we collected potential solutions aimed at enhancing data quality and management. These solutions span from employing living labs to adopting FAIR data principles, promoting



open access, advancing data publication, embracing technological innovations, and ensuring standardisation and quality control. More specifically,

1. Enhancing Data Quality and Accessibility

Use of Living Labs and Soil Lighthouses: The EU Soil Mission aims to establish 100 living labs and lighthouses to lead the transition towards healthy soils by 2030, which could enhance the temporal and spatial resolution of LTM sites and also serve as a platform for testing new management techniques and innovations in real-world settings.

Adoption of FAIR Data Principles: Implement FAIR (Findable, Accessible, Interoperable, Reusable) data principles, focusing on enhancing the findability and accessibility through better metadata management, and improving interoperability and reusability at the data level. It will also be important to train LTM owners with data management skills.

Standardisation and Harmonisation Efforts: Increase efforts to standardise and harmonise (meta)data, ensuring consistency, compatibility, and ease of integration across various datasets and systems. More recommendations see the report of FG3.1 which focuses on the standardisation and harmonisation of public and private data.

2. Promoting Open Access and Data Sharing

Open Access to Scientific Research: Advocate for making scientific research, including publications, data, physical samples, and software, as open access as possible to facilitate wider sharing and utilisation of research outputs,

Public Availability of CAP Data: Ensure that data collected at the farm level, such as Common Agricultural Policy (CAP) data, is made publicly available to enhance transparency and facilitate broader research and analysis.

3. Advancing Data Publication and Utilisation

Emphasis on Data Papers: Encourage the publication of data papers to highlight the significance of datasets, facilitating their reuse and providing justification for the efforts made by the LTE owners.



Use of Digital Object Identifiers (DOIs): Implement DOIs for datasets, methodologies, etc., to ensure better traceability, credibility, and accessibility of research data.

4. Technological and Methodological Innovations

Leveraging New Data Processing Techniques: Utilise advanced data processing technologies, such as artificial intelligence (AI), to enhance data analysis, interpretation, and application in various aspects of LTEs and carbon farming.

Investment in Data Management Tools: Invest in sophisticated (meta)data management tools to assist LTE owners in efficiently collecting, organising, storing, and managing data, thereby enhancing the overall quality and utility of the data collected.

5. Standardisation and Quality Control

Fixed Vocabulary and Quality-Controlled Databases: Adopt a fixed vocabulary, like FAO Agrovoc, and ensure that datasets are published in quality-controlled data resources, such as community data repositories, to maintain high data quality and facilitate ease of use.

4. Summary of recommendations

Robust Measurement, Reporting, and Verification (MRV) is pivotal for ensuring the environmental integrity of carbon removals, necessitating accurate, measurable, and reliable assessment methods to balance the trade-off between MRV accuracy and its associated costs. This Focus Group (FG) aims to consolidate experiences from various networks to establish guidelines for managing long-term monitoring sites (LTMs) that effectively support regional carbon schemes, despite the current challenges of scattered or incomplete data for carbon model calibration/validation.

This report focuses on three major aspects: the potential role of LTMs in MRV, identifying the major challenges and barriers to effective use of LTMs data, and the potential solutions and recommendations.

In terms of MRV, the LTMs are crucial for assessing the long-term impacts of carbon farming practices and could serve as a test bed for the calibration and validation of



SOC models. Besides, they could facilitate the digitalisation of carbon farming practices, such as calibrating new sensors or providing ground truth data to support remote sensing research and development which are essential for modern, precise, and efficient agricultural monitoring. LTMs could therefore form vital components of national and international MRV platforms for SOC change.

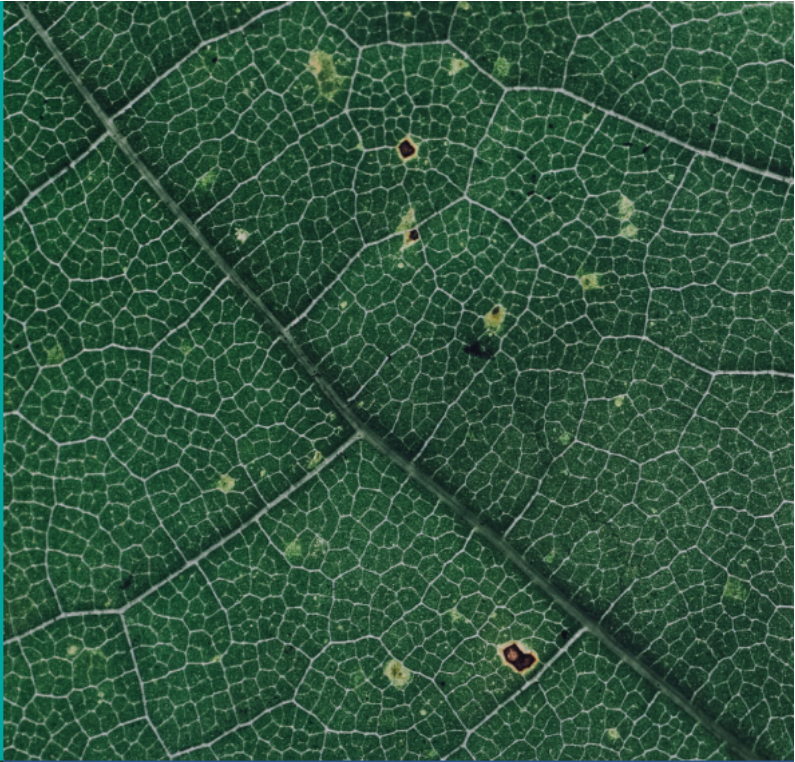
Among the challenges to the effective use of LTM data, three main categories were identified: (i) the lack of comprehensive coverage across different (new) management practices, land use types, climatic zones, and soil types in the existing LTMs, (ii) the FAIRness of the available (meta)data and (iii) technical challenges for both data users and providers such as GDPR and required skills for data management.

To tackle the lack of representativeness of the existing LTMs, efforts should be made to start new LTMs in under-represented regions and to maximise the use of the Living Labs and Lighthouses which are initiated by the EU Soil Mission and could enhance the temporal and spatial resolution of LTMs and also serve as a platform for testing new management techniques and innovations in real-world settings.

To increase the FAIRness of the available (meta)data, the focus should be placed on standardisation and harmonisation by e.g., adopting a fixed vocabulary and ensuring that datasets are published in quality-controlled data resources, such as community data repositories, to maintain high data quality and facilitate findability by both humans and computers. Besides, efforts should be made to make scientific research, including publications, data, physical samples, and software, as open access as possible to facilitate wider sharing.

Investments in sophisticated (meta)data management tools and training to assist LTMs owners in efficiently collecting, organising, storing, and managing data, thereby enhancing the overall quality and utility of the data collected, could help overcome the technical challenges. Finally, the publication of data papers should be encouraged and valorized to reward the efforts made by the LTMs owners.





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