LIFE 20 PRE IT/017

C·FARMs
CARBON FARMING CERTIFICATION SYSTEM

BROCHURE_ RESULTS AND RECOMMENDATIONS FOR THE APPLICATION OF CARBON FARMING PRACTICE IN CROPLAND AND LIVESTOCK MANAGEMENT

ACTION A.2

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1. Description of Action A2 - Goals and Expected results

Action A2 aims at identify, select and quantify **carbon-farming practices for the main existing crop systems for the Lombardy Region that can contribute to mitigation targets.** Main results will be used in Action A4 to assess the potential of carbon farming practices performance in terms of mitigation against a "business as usual" scenario in the Region.

The **main goals and expected results** of action A2 include:

- **Assessing the quality and quantity of data available for crop management practices**, with particular regard to effects on organic carbon in mineral soils as well as in woody biomass in orchards.

- **Identify carbon-farming practices** and **associated estimates of carbon sequestration or climate mitigation potential** for Lombardy pedo-climatic conditions

- Implementation of a **carbon-farming database**

- **Analyses of on-line survey** for selected experimental Lombardy farms

This action is necessary to provide the basic information on the **carbon stock content and emissions** related to the different land use types, climate, soil and management practices including livestock systems, to assess the mitigation potential of selected carbon farming practices. Moreover, this action will provide **a further contribution to carbon farming and mitigation knowledge.** In fact, while the contribution to mitigation of some practices is relatively well understood (e.g. no-till versus tillage), other carbon farming practices that may have a positive impact in terms of climate change mitigation are not yet fully characterised (e.g. pruning techniques, diets for livestock or manure management).

2. Methodology and Tools

A **systematic review of the scientific literature** has been conducted aimed at identifying the potential of carbon-farming practices for carbon dioxide sequestration and/or emissions reduction in European agricultural soils.

- The search was conducted on 'Google Scholar' using a combination of **keywords**.
- Only studies that calculated the **carbon sequestration/retention rate (ΔSOC)** by applying either the **STOCK difference method (IPCC, 2006)** were included, which aims at gauging carbon stock increases over time for a given agricultural practice, or the pairwise comparison method, which is aimed at comparing the ability of two different practices to contribute to organic carbon soil retention. The included studies had to report the ΔSOC (t C ha-1 yr-1) or, alternatively, the experimental difference in either the concentration of soil organic carbon (SOC) (g/kg) or soil carbon stocks (t C/ha) with respect to baseline SOC (STOCK difference method) or to the control (pair comparison method).
- Only **European experimental studies conducted in arable land or perennial crops** were selected, whereas extra-European studies and experiments conducted in laboratory spaces, greenhouses or pots were excluded together with studies concerning natural ecosystems (such as primary grasslands, shrublands or woods).
- The **literature cited by reviews and meta-analyses** was in turn reviewed whenever it met the inclusion criteria. Reviewed articles include peer reviewed papers, conference proceedings, and project reports.
- In the case of longitudinal studies performed by the same research group at the same experimental site, the **publication with the longest study duration** was selected. Similarly, for each study reporting **the carbon stock or organic carbon concentration at different soil sampling depths** (e.g.: 0-20; 0-30; 0-40; 0-50 cm), the **carbon sequestration/retention rate** was calculated using the deepest sample.
- For each experimental study included in this systematic review, descriptive parameters were collected into a **common database**.
- **Data on climate and soil texture** were harmonized according to European climatic stratification, USDA texture classification and ΔSOC measurements were reported at 0-30 cm soil profile.
- Only **carbon-farming practices according to Lombardy pedo-climatic context and performed descriptive statistics** were selected by clustering separately absolute and relative ΔSOC in order to obtain carbon sequestration or retention rates for identified carbon-farming practices.

3. Main Results

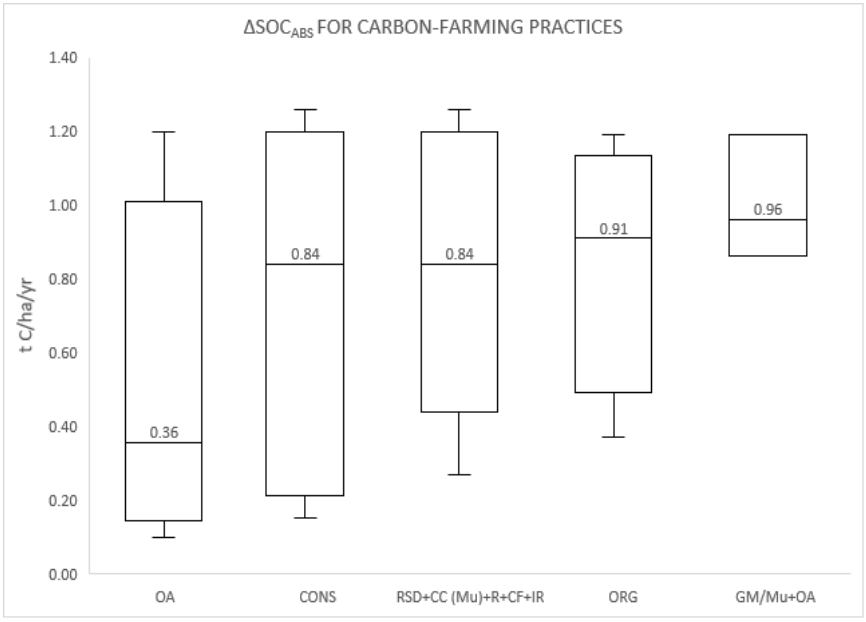
- **Quantifying the carbon sequestration potential for carbon-farming practices** for Lombardy under all representative pedo-climatic conditions is limited by the quality and quantity of the available data in the scientific literature.

- **The best-case scenario for annual cropland** is achieved by the combination of cover crops, organic amendment, crop residue maintenance, improved rotations, intercropping and reduced tillage with an **average carbon sequestration rate of 1 ton of organic carbon per hectare per year**.

- The **presence of woody crops**, such as in orchards or silvoarable systems, show the largest carbon sequestration potential for cropland: almost **3 tons per hectare per year stored in soil and biomass** when permanent cover crops, no-till and organic amendment are applied.

The boxplot in graph 1 shows the farm-scale farming practices that lead to an annual increase in the carbon stock.

Graph 1. Median values of ΔSOCABS (net carbon sequestration rate expressed in tons of organic carbon / hectare / year) for annual crops associated with single agronomic practices, combinations of practices and agronomic management. OA: Organic soil improver (compost, manure); CONS: conservation agriculture (reduced soil disturbance, cover crops with biomass left on the surface, maintenance of crop residues, crop rotations; RSD+CC (Mu)+R+CF+IR: reduced soil disturbance, cover crops with biomass left on the surface, maintenance of crop residues, application of chemical fertilizer and crop rotations); ORG: Biological agriculture; GM/Mu +OA: green manure or mulch cover crops and application of organic soil conditioner.



The results achieved will be used to simulate carbon sequestration scenarios through the implementation of best practices for Lombard agriculture, compared to current management.

4. Final Recommendations

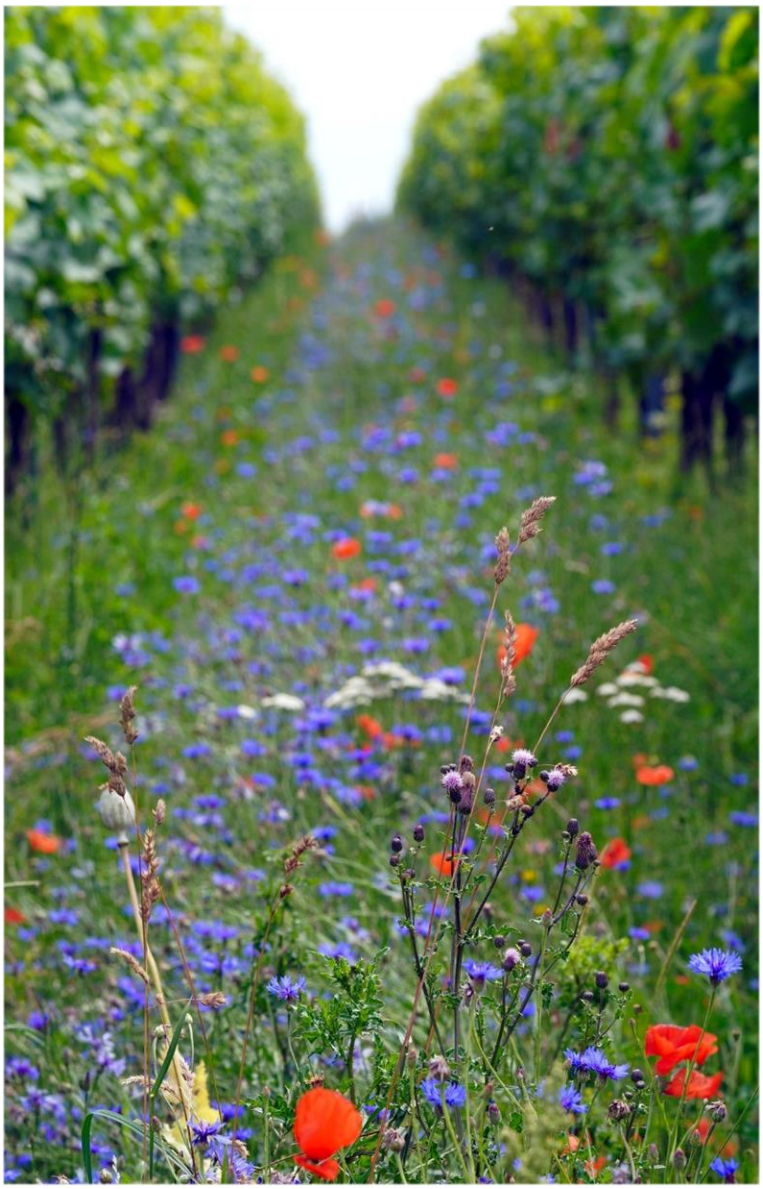
We stress the importance of **defining a standard protocol for soil organic carbon (SOC) analysis** so as to:

I. Promote the **coupling of SOC analysis with LCA studies** aimed at investigating the net impact of carbon-farming practices on climate change along with other environmental impact categories

II. Ensure **several measurements of real bulk density and organic carbon concentration** through standard methodologies, both at the beginning and at the end of the experimentation as well as for each soil layer

III. Set a **sufficiently representative sampling depth**, e.g., full soil-profile (0-100 cm), in order to fully evaluate the effect of a practice on SOC dynamics

IV. Clearly indicate the **method for calculating the carbon sequestration rate** and clearly distinguish **absolute from relative carbon sequestration**



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The **project C-FARMs**, **co-funded by the 2020 LIFE Programme of the European Commission**, supports the design and implementation of targeted payments for the application of Carbon Farming practices through the development of a **regulatory framework for the certification of Carbon removals** (or Carbon non-emissions) based on a robust and transparent carbon accounting scheme **in connection with the national GHG inventory.**

Objectives of the Project:

1. Creating a **high-resolution demonstrative geospatial information system** (GIS-FARMs), which will identify the mitigation potential of the agricultural sector of Lombardy region

2. **Systematising existing knowledge and data** with relevance for the area of interest useful for the creation of the high-resolution demonstrative geospatial information system (GIS-FARMs)

3. **Identifying information and research gaps**

4. **Supporting the development of a regulatory framework for a carbon certification system** in collaboration with relevant actors and institutions

5. **Exploring the possibility of use of common methods and/or reference data and/or data sets** in combination with GHG reporting institutions as well as an exchange and information mechanism related to greenhouse gas inventories from the agricultural sector

6. **Supporting the design and implementation of targeted payments** for the application of Carbon Farming practice

The project aims to work in close connection with:

- the **Institutions with the official responsibilities of GHG reporting**
- the **offices from Regional authorities dealing with agricultural themes** (e.g. CAP payments)
- the **Institutions dealing with the certification systems**

C-FARMs also involves **public Institutions, Universities and research centres, private companies and farmer and woodworking industry associations** working specifically on themes related to the **LULUCF sector** (Land-use, Landuse change and Forestry)