

Carbon speciation and isotopic characterization of soils of managed temperate forests in the Apennine chain of the Emilia-Romagna region (Northern Italy)

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THE PARTNERSHIP



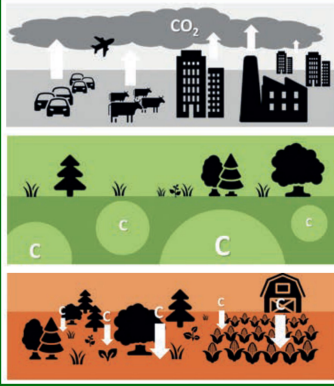
PSR (Programma di Sviluppo Rurale) of the Region Emilia Romagna is a funding program dedicated to the development of the agrifood system. In particular, the Save SuoBo project (Save Soil Organic Carbon) is included in the specific focus area 5E, which supports actions that foster carbon conservation and sequestration in agriculture and forestry.

The project includes researchers of the University of Ferrara and Bologna, Institutions dedicated to dissemination of scientific results (CFR-Consortio Futuro in Ricerca), formation of agricultural workers (Dinamica), and the Association of farmers of Emilia-Romagna Region (Confagricoltura). The project also includes private agro-forestry farms that accepted to participate in the research testing their soils, i.e., Azienda Agricola Branchicciolo, Azienda Agricola Beghelli, and Società Cooperativa Montana Valle del Senio.



AIMS OF THE SUOBO PROJECT

The problem



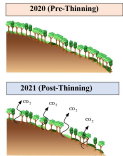
Globally, forest soils store more than 40% of the organic carbon, which means that forests play a major role in the C cycle. Forest degradation is estimated to account for 20% of global greenhouse gas emissions, thus increasing the global warming problem. However, if well managed, forests and forests provide a high carbon (C) capture potential from the atmosphere, thereby decreasing the increase in the greenhouse effect and contributing to climate change mitigation.

The aims of SuoBo

- 1) Determination of pedodiversity of forest in the three farms
- 2) Determination of the physico-chemical characteristics of soils in the three farms
- 3) Determination of the quantity and quality of SOM in 2020 and 2021 of soils
- 4) Determination of the ¹³C/¹²C and ¹⁵N/¹⁴N in bulk soils and the extracted fractions of humic substances (POM, FA-like, HA-like, NEOM)
- 5) Evaluation of the soil carbon sequestration or soil and the possible causes (soil texture, climate, unsustainable practices)
- 6) Evaluation of C-CO₂ emission from the forestal soils
- 7) Ecofisiological functionality (Biological Fertility Index) and efficiency of soil C sequestration of soils in the three farms

THINNING INTERVENTION

In order to investigate any soil organic carbon variations during time, for each forest farm two sampling surveys were performed after one year and after the annual thinning intervention.

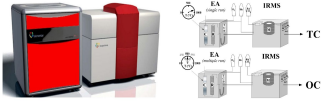


Such practises are used in agro-forestry which implies the removal of forest material like stems, understory bushes, small and low-quality trees.



ANALYTICAL FACILITIES

EA-IRMS
Elemental Analyzer
Isotopic Ratio
Mass Spectrometer



The wt% and δ¹³C (‰) of the total and organic fractions of the soil carbon pools are carried out by EA-IRMS according to the method proposed for soil samples:

TC: Total Carbon carried out combusting at 950°C the bulk sample

TOC: Total Organic Carbon carried out combusting at 500°C the bulk sample

Soli-TOC

The Soli-TOC cube determines the wt% of different fractions of C in soil by using a temperature ramping program. The sample is heated at the designated temperature, which is maintained for the given hold time. The CO₂ produced at the different temperatures represents the various C fractions:

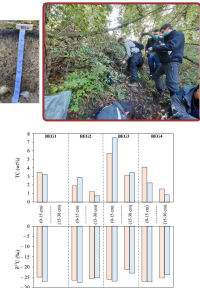
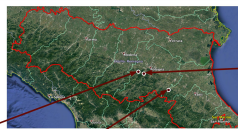
TOC₄₀₀: Total Organic Carbon released at 400°C;

ROC: Residual Oxidizable Carbon released at 400-600°C;

TIC₉₀₀: Total Inorganic Carbon released at 900°C.

RESULTS: EVALUATION OF CARBON IN SOILS OF AGROFORESTRY FARMS IN THE NORTHERN APENNINE

Azienda Agricola Beghelli Fabio
 Altitude: 550 m a.s.l
 Vegetation: chestnut
 Slope: from 20 to 45%

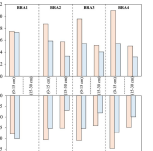
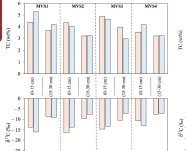


Legend: 2020 (orange), 2021 (blue)



Azienda Agricola Montana Valle del Senio
 Altitude: 260 m a.s.l
 Vegetation: sparse forest
 Slope: from 3 to 22%

Azienda Agricola Senio
 Altitude: 225 m a.s.l
 Vegetation: mixed forest
 Slope: from 3 to 35%



In one year Branchicciolo farm lost more C than the others because 1) of the texture of the soil less clayey that does not preserve the organic substance and 2) of the anomaly of high temperature recorded in 2021 that hit the most soils at lower altitudes. The results of this study is reported in the scientific article of Brombin et al. (2023).

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