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Carbon Farming and Nature-based Solutions

Carbon farming application in a group of mountain dairy farms on the Emilian Apennines. First results of LIFE18/CCM/IT/001093 agriCOlture

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Introduction

LIFE agrCOlture has been implementing carbon farming (CF) applications as carbon removal (sequestration and permanent storage of carbon in soils and biomass), avoided emissions, and emissions reductions, in a network of 15 farms of Emilian Apennines. This area is exposed to landslide and erosion, so the measures introduced in farms boost the conservation of carbon stocks.

A characterisation of soil conditions, biology, productivity as forage was carried out to address best practices for CF introduced in farm.

Methods

3 soil and biomass samples from 3 plots were collected per farm in a field representative for farm's altitude, slope and cropping system. Parameters evaluated for soil are: textural classification, water-stability of aggregates, pH, conductivity, porosity, total limestone, total nitrogen, assimilable phosphorus, exchangeable potassium, FAO World Reference Base classification, land capability, biological quality index (QBS-ar). Organic carbon, organic matter, total extractable carbon and carbon stock were evaluated both for 0-15 and 15-30 cm soil layers. For topsoil information was collected about agronomic use (arable, pastures, permanent meadow), year from last plowing, animal waste use. The biomasses used for phytocoenose evaluation were classified per % of Fabacae, Poacae, other species. Dataset was processed for Cluster analysis and Principal component analysis (IBM SPSS Statistics 27).

Results and discussion

Cluster analysis of data groups the 15 fields in 5 clusters from: higher sheep and goats dairy farms (DFs); higher cow DFs; cow DFs with and efficient forage system (FS); cow DFs with pour FS; no use of animal waste

Principal component analysis identifies 3 main components able to explain 63.93% of the variance between the 5 clusters. Component 1 (42,89% of variance) segregates for: phytocoenose, Fabacae and other species *vs* Poacae, porosity, water-stability of aggregates, carbon stock and total nitrogen content. Component 2 segregates for: altitude, land capability, agronomic use, textural classification. Component 3 segregates for: stability of the aggregates, total limestone, altitude.

Table 1 – Description of clusters

Cluster	Farms	Plot characteristics
1	Castellari, Lavacchielli, La Fazenda	Clusters 1 and 2 bring together the plots of medium-sized hill farms, where the soil and topsoil characteristics appear to be more related to the agronomic management of the plots, rich in potassium and calcium, where grasses predominate and, in the case of cluster 1, receive a greater input of manure.
2	L'Arcobaleno, Bonacorsi, Giavelli	
3	Casa Minelli	The soil and topsoil characteristics of the Casa Minelli farm plot identify a cluster of its own cluster. This is the only farm without animals.
4	Grisanti e Spagnolo, I Casoni, Begani, Rossi	Clusters 4 (plots of farms rearing dairy cows) and 5 (plots of farms rearing sheep and goats) soil and topsoil characteristics are definitely linked to permanent meadows and pastures, with a vegetation richer in biodiversity and a soil richer in organic carbon and nutrients. 4 and 5 are also the highest plots, although cluster 5 differs from cluster 4 in altitude.
5	Le Cornelle, La Fattoria di Tobia La Valle dei Cavalieri Le Capre della Selva Romanesca	

Figure 1 – Farm distribution

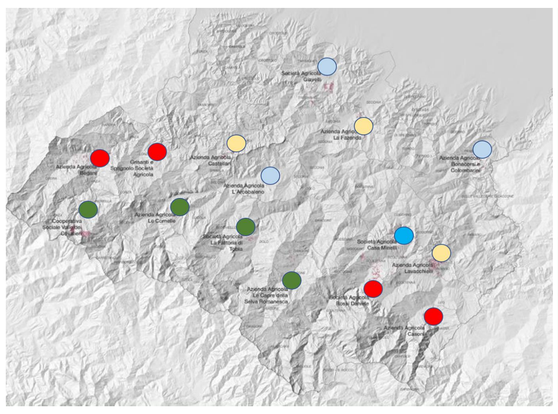

Table 2 - Medium field parameters for each cluster

Cluster	Farms n.	Total limestone (%)	pH	Assimilable P (mgP_2O_5/kg)	Exchangeable K ($mg\ K_2O/kg$)	C stock (Mg/ha)	QBS	Poacae (%)	Fabacae (%)	Others (%)
	3	12.68	8.07	82.78	569.16	62	159	85	6	9
	3	23.23	8.01	96.15	260.28	70	166	56	19	25
	1	15.90	8.08	30.93	279.56	76	94	-	-	-
	4	3.60	7.76	32.36	303.66	101	153	55	12	33
	4	1.92	7.26	26.86	132.70	87	125	35	20	45

Conclusions

The characteristics highlighted in this ex-ante analysis allowed the planning of 15 mitigation and soil protection protocols attached to the farms and currently being implemented. These have been designed taking into account the common elements of the clusters, the effects of which will be appreciated in the ex-post evaluation, scheduled for spring 2023.

Keywords: Carbon farming, soil protection, carbon stock, LIFE18/CCM/IT/001093

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