With technical support of Food and Agriculture Organization of the United Nations

MITIGATION OF CLIMATE CHANGE THROUGH CONSERVATION AGRICULTURE IN EUROPE

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ABSTRACT

Agriculture and climate change are closely related. In this communication, the European Conservation Agriculture Federation (ECAF) presents how the European agricultural sector can respond to climate change through Conservation Agriculture (CA). It is based on the outcomes and the realization of several European (LIFE) public-funded projects based on the assessment of CA performance in Europe, and on a literature review on the topic. In terms of contribution, approximately 10% of greenhouse gases (GHGs) globally emitted come from the European Union (EU). Within the GHGs emitted in Europe, around 10% derive from agriculture. In order to reduce these emissions the 21st meeting of the Conference of the Parties (COP21) and the 11th meeting of the Conference of the Parties serving as the meeting of the Parties to the *Kyoto Protocol* (CMP) was held at the end of 2015 in Paris. It concluded with the adoption of a historic agreement to combat climate change and promote measures and investments for a low-carbon, resilient and sustainable future, the so-called Paris Agreement. Scientific studies, carried out in different European biogeographic regions and countries, agree that the less soil is tilled, the more carbon is sequestered and stored in it. These studies show that, during several years of Conservation Agriculture, it is possible to sequester large amounts of CO_2 per hectare and year in soils, when compared to systems based on soil tillage. In relation to conventional tillage systems the implementation of CA in EU-28 countries in both annual and perennial crops could result in an annual sequestration of almost 190 millions of tons CO_2 as soil organic carbon. The amount of CO_2 sequestered into the soil through the application of the CA would contribute significantly to reach the targets committed in Paris Agreement by 2030. Considering accepted European emission reduction targets, carbon sequestration that could take place on farmland under Conservation Agriculture would amount to 22% of reductions committed in all diffuse emission sectors by 2030, which corresponds to 10% of total annual diffuse emissions. This would allow for some flexibility in the reduction of emissions in other sectors such as housing or transport.

KEYWORDS: climate change mitigation, Conservation Agriculture, Best Management Practices, SOC, no-till, groundcovers.

BACKGROUND

Agriculture and climate change are closely related. In terms of contribution, approximately 10% of greenhouse gases (GHGs) globally emitted come from the European Union (EU). Within the GHGs emitted in Europe, around 10% derive from agriculture. In this short communication, the European Conservation Agriculture Federation (ECAF) presents how the European agricultural sector can respond to climate change through Conservation Agriculture (CA). It is based on the outcomes of several public-funded European LIFE projects on the assessment of CA performance in Europe, and on a literature review on the topic. The full paper (González-Sánchez et al., 2017) can be downloaded from ECAF's website (www.ecaf.org).

APPLICATIONS AND IMPLICATIONS FOR CONSERVATION AGRICULTURE

Today, in order to achieve sustainability in agriculture a multidimensional approach is essential to attain a balance, or best compromise, between preservation and improvement of the environment, social equity and economic viability, and therefore improve the welfare of society. It is widely recognized that this can only be achieved if natural resources are maintained or even improved, i.e. used responsibly and efficiently. Not only in agriculture, soil is a key resource as it mediates a wide range of ecosystem services both provisioning, regulating and supporting services. To this end, soil quality, and in particular the amount of organic carbon stored in it are essential. Scientific studies carried out in different agro-ecological regions and countries agree that the less soil is tilled, the more carbon is sequestered and stored in it. Plants absorb carbon dioxide from the air and transform it through the process of photosynthesis into organic carbon. This organic carbon becomes the source for soil organic matter, contributing thus to an enhanced soil fertility and to an improved productive capacity. On the other hand, any action aimed at saving energy and fuel, such as reducing the number of tillage operations, optimizing the use of agricultural inputs and proper execution of operations, directly reduces emissions of greenhouse gases. Therefore, a sustainable agricultural system that responds to these requirements is of particular importance: Conservation Agriculture.

DESCRIPTION

Different studies in Europe show that during several years of application of CA principles it is possible to sequester large amounts of CO_2 per hectare and year in both annual and permanent crops, when compared to tillage-based cropping systems. Average sequestration rates per biogeographical region in Europe are summarized in Table 1.

Based on these assumptions the estimation for EU-28 countries of the potential soil organic carbon (SOC) sequestration through the adoption of CA in annual crops when compared to conventional tillage systems is given in Figure 1 for the different biogeographical regions in Europe.

In relation to CA in permanent crops (groundcovers), there are no official data for Europe as a whole. Due to that, the data on the current adoption of this practice derive from reports of the European national associations of Conservation Agriculture. Although scientific data for carbon sequestration are only available for the Mediterranean biogeographic region (except France), we present a calculation of the C sequestration potential in permanent crops for EU-28 in Figure 2, based on a considered conservative annual sequestration rate of 0.4 t ha-1yr-1 (Table 1).

In order to quantify the CO_2 emission reduction achievable through the sequestration of organic C in the soil and not released through the microbiological oxidation processes of organic matter, we are using the ratio of 3.7 tons of CO_2 that are generated from 1 ton of organic C. Therefore, taking into account the increase in soil organic matter (SOM) observed in CA systems (both annual crops and groundcovers in permanent crops) in comparison to the management systems based on conventional tillage, it is possible to calculate the total CO_2 emission offset potential through the implementation of CA in Europe (Table 2). The amount of CO_2 sequestered in the soil through the application of the CA, would reach the targets committed by 2030 in the Paris Agreement (UN, 2017) with greater ease. Considering overall European figures, carbon sequestration that could take place on farm land under Conservation Agriculture would help achieve around 22% of the necessary reductions in the non-ETS sectors by 2030, and almost 10% of the total emissions still allowed in the non-ETS sectors. This achievement would give the signing member countries some margin in the emission reduction in other sectors such as housing or transport.

Table 1. Average carbon sequestration rates in annual and permanent crops by biogeographical region.

		Biogeographical region			
Crop type		**Atlantic**	**Boreal**	**Continental**	**Mediterranean**
Annual	**Increase of soil organic carbon (t ha-1 yr-1)**	0.32	0.02	0.42	0.81
Permanent		0.40	ND	0.40	1.30

* estimation; ** not defined

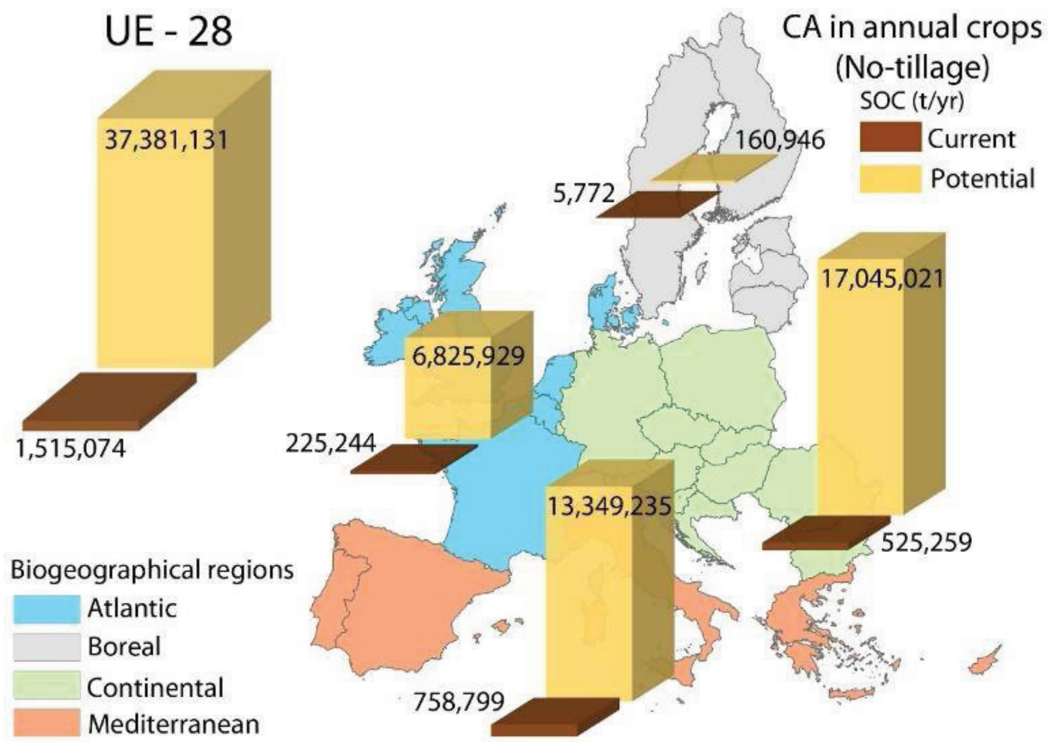

Figure 1. Current and potential SOC fixed by CA in annual crops compared to systems based on conventional soil tillage in EU-28 and for the different biogeographical regions in Europe.

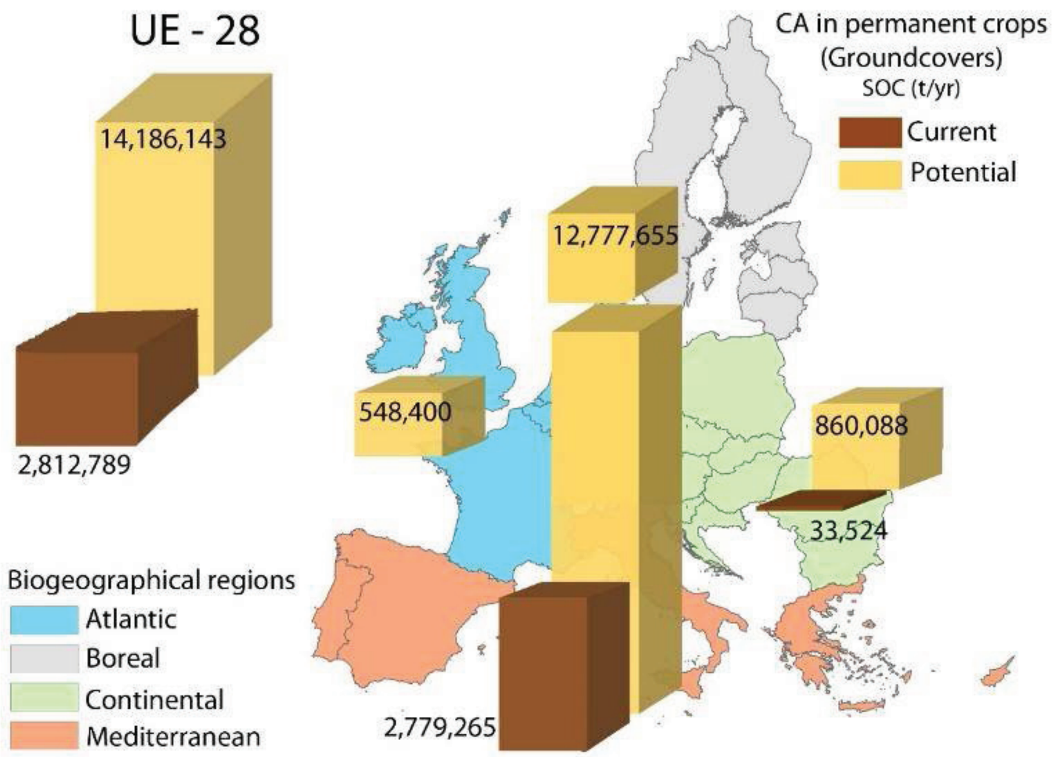

Figure 2. Current and potential SOC fixed by groundcovers compared to systems based on soil tillage in EU-28 and in the different biogeographical regions.

Table 2. Current and potential fixation of CO_2 in Europe.

	Biogeographical region	Current CO_2 fixation through CA (t yr^{-1})	Total Potential CO_2 fixation through CA (t yr^{-1})	Remaining Potential for CO_2 fixation through CA (Potential - current) (t yr^{-1})
Austria	Continental	43,731	2,019,403	1,975,672
Belgium	Atlantic	320	782,291	781,971
Bulgaria	Continental	25,470	5,145,996	5,120,526
Croatia	Continental	28,619	1,432,719	1,404,101
Cyprus	Mediterranean	803	341,213	340,410
Czech Republic	Continental	63,010	3,752,510	3,689,499
Denmark	Atlantic	2,959	2,632,794	2,629,835
Estonia	Boreal	3,090	42,435	39,345
Finland	Boreal	14,667	140,265	125,599
France	Atlantic	220,000	14,358,615	14,138,615
Germany	Continental	232,617	17,723,982	17,491,365
Greece	Mediterranean	2,309,258	9,729,155	7,419,897
Hungary	Continental	103,051	5,809,954	5,706,902
Ireland	Atlantic	2,367	1,186,900	1,184,533
Italy	Mediterranean	1,322,806	26,374,586	25,051,780
Latvia	Boreal	832	80,788	79,956
Lithuania	Boreal	1,414	156,173	154,759
Luxembourg	Continental	679	96,532	95,853
Malta	Mediterranean	0	23,611	23,611
Netherlands	Atlantic	8,700	874,935	866,234
Poland	Continental	603,650	15,391,891	14,788,241
Portugal	Mediterranean	205,142	6,382,238	6,177,096
Romania	Continental	901,191	11,916,910	11,015,719
Slovakia	Continental	43,024	2,052,459	2,009,435
Slovenia	Continental	3,828	309,713	305,885
Spain	Mediterranean	9,134,893	52,947,794	43,812,901
Sweden	Boreal	1,160	170,474	169,314
United Kingdom	Atlantic	591,548	7,203,670	6,612,122
Total Europe		**15,868,829**	**189,080,005**	**173,211,176**

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