SmartSOIL

Sustainable farm Management Aimed at Reducing Threats to SOILs under climate change

Newsletter

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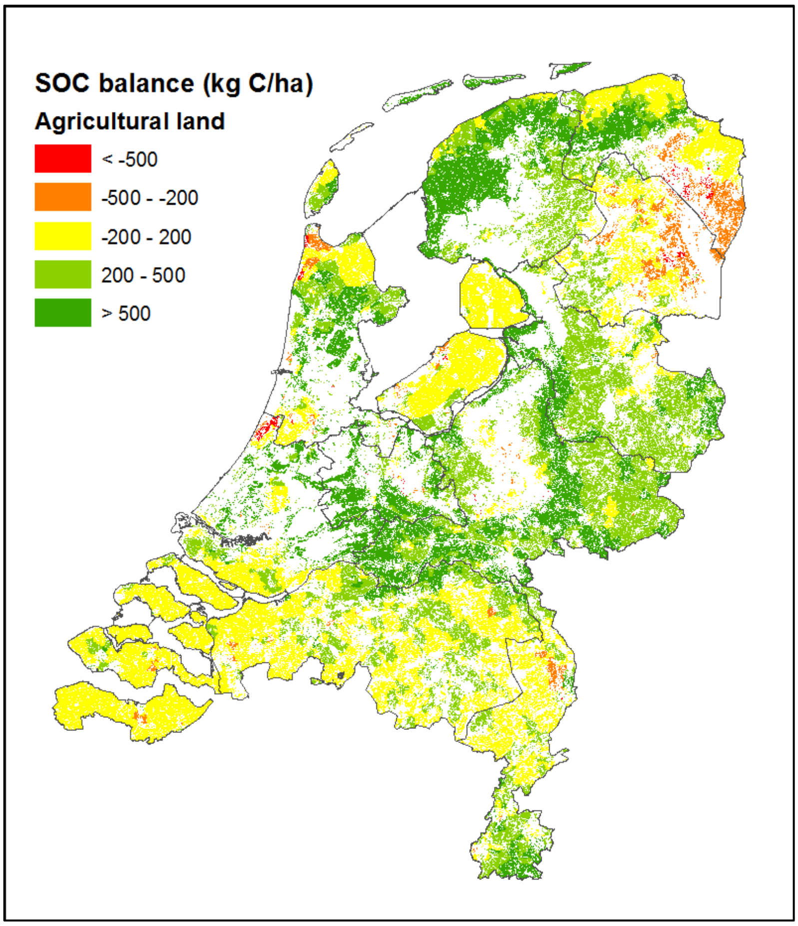
SmartSOIL (Sustainable farm Management Aimed at Reducing Threats to SOILs under climate change) is a research project in the European Commission Seventh Framework Programme. It aims to contribute to reversing the current degradation trend of European agricultural soils by improving soil carbon management in European arable and mixed farming systems covering intensive to low-input and organic farming systems. SmartSOIL will identify and develop options to increase C stocks and optimise C use (flows) whilst maintaining sustainable Soil Organic Carbon (SOC) stocks. http://smartsoil.eu/

Is soil organic carbon content in Dutch agricultural soils actually decreasing?

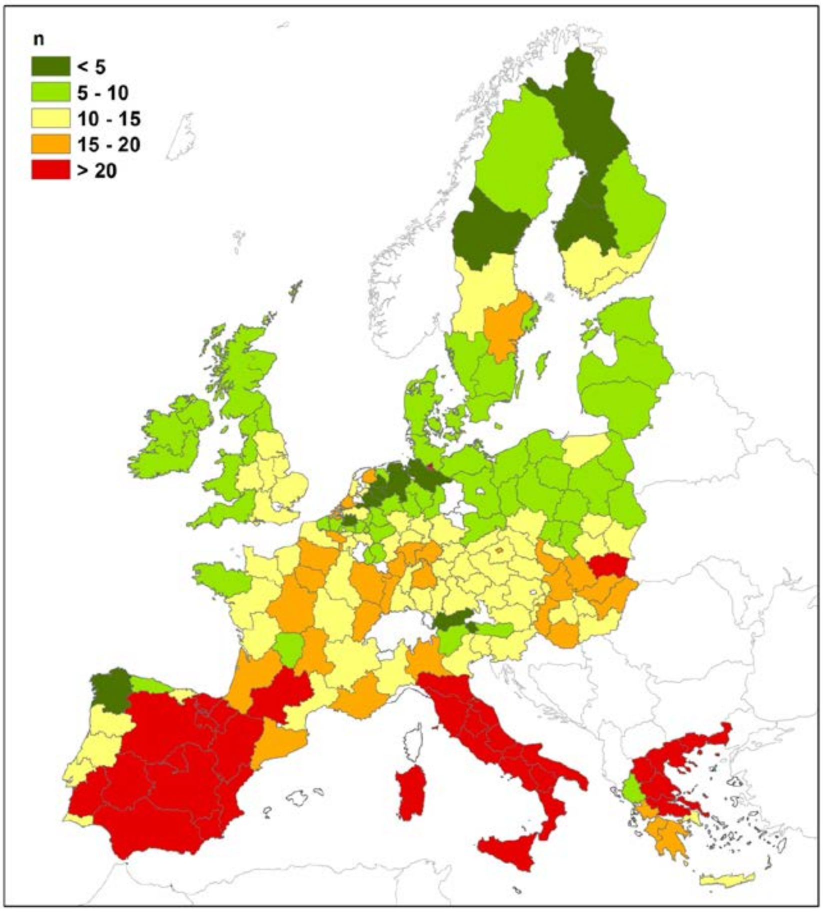
In the Netherlands there is a debate among farmers, scientists and policy makers about whether the soil organic carbon (SOC) content of Dutch agricultural soils is decreasing. Some of the farmers say it is decreasing, however, analysis of about two million soil samples from farmer fields did not reveal such a decrease overall. In fact it revealed a slight increase in most regions. Based on the modelling approach developed in the SmartSOIL project, SmartSOIL scientists calculated a SOC balance for the Netherlands. They also used modelling to estimate carbon inputs from crops, crop residues and manure across the country. The results show a slightly negative overall SOC balance for arable land and a positive balance for grassland. This results in an overall positive SOC balance for agricultural land in the Netherlands. However, as shown on the map, certain areas have a negative SOC balance; these are mainly areas on poor sandy soils under arable land. As the chosen modelling approach has its uncertainties, an absolute answer to the question about the decrease or increase of SOC content in Dutch soils cannot be provided yet. However, the map identifies those regions and activities with a higher risk of soil carbon decline. This allows for region specific policies to address actual decline in soil organic carbon.

Further reading: See Deliverable 2.4



Soil Organic Carbon: a great potential for improvement in Southern Europe soils

Soil organic carbon plays crucial roles in determining and maintaining important soil functions. The relationship between clay and soil organic carbon can indicate soil physical quality and stability and therefore conditions for crop production. A soil stability indicator (n) provides information on soils in terms of their physical quality and potential capacity to protect carbon. This indicator (n) can be derived from the ratio clay: soil organic carbon (SOC). A study conducted at the University of Florence compared soil stability indicator values for European countries. The study results show that most of southern EU-region soils are characterized by high n values ($n \geq 10$) which undermines their physical quality and reduces the availability of SOC per unit of clay. Whereas northern EU-region soils had lower n values ($n < 10$) so had more stability and availability of SOC per unit of clay. This suggests a better soil physical quality with positive impacts on soil functions and thus on crop productivity in northern EU-region soils. However unstable soils associated with southern countries do have a great potential for improvement by implementing practices encompassing SOC amendments. For more information, see Deliverable 2.4 "Report on critical low soil organic matter contents which jeopardize good functioning of farming systems" on Deliverable 2.4



n indicator values of EU-27 arable lands soils. Clay and SOC values referred to arable lands were extracted from LUCAS database. The n indicator was calculated as the ratio between the percentages of clay and SOC and averaged at NUTS 2 level.

The most promising measures to increase soil carbon contents

Research conducted at Alterra/ Wageningen University in the Netherlands found that both reduced tillage intensity and frequency and avoiding fallow periods take time to result in a clear increase in soil carbon content. Over the long-term, however, and under the precondition that the productivity level is sustained, these two measures will have a considerable positive effect on the soil carbon content. On the other hand, management practices such as optimizing crop production and leaving behind crop residues will have an instant and clear positive effect on soil carbon content, as well as the supply of organic matter from outside the farm. However, this measure is not sustainable on a long-term basis because availability of off-farm organic matter can become limited. Read more..

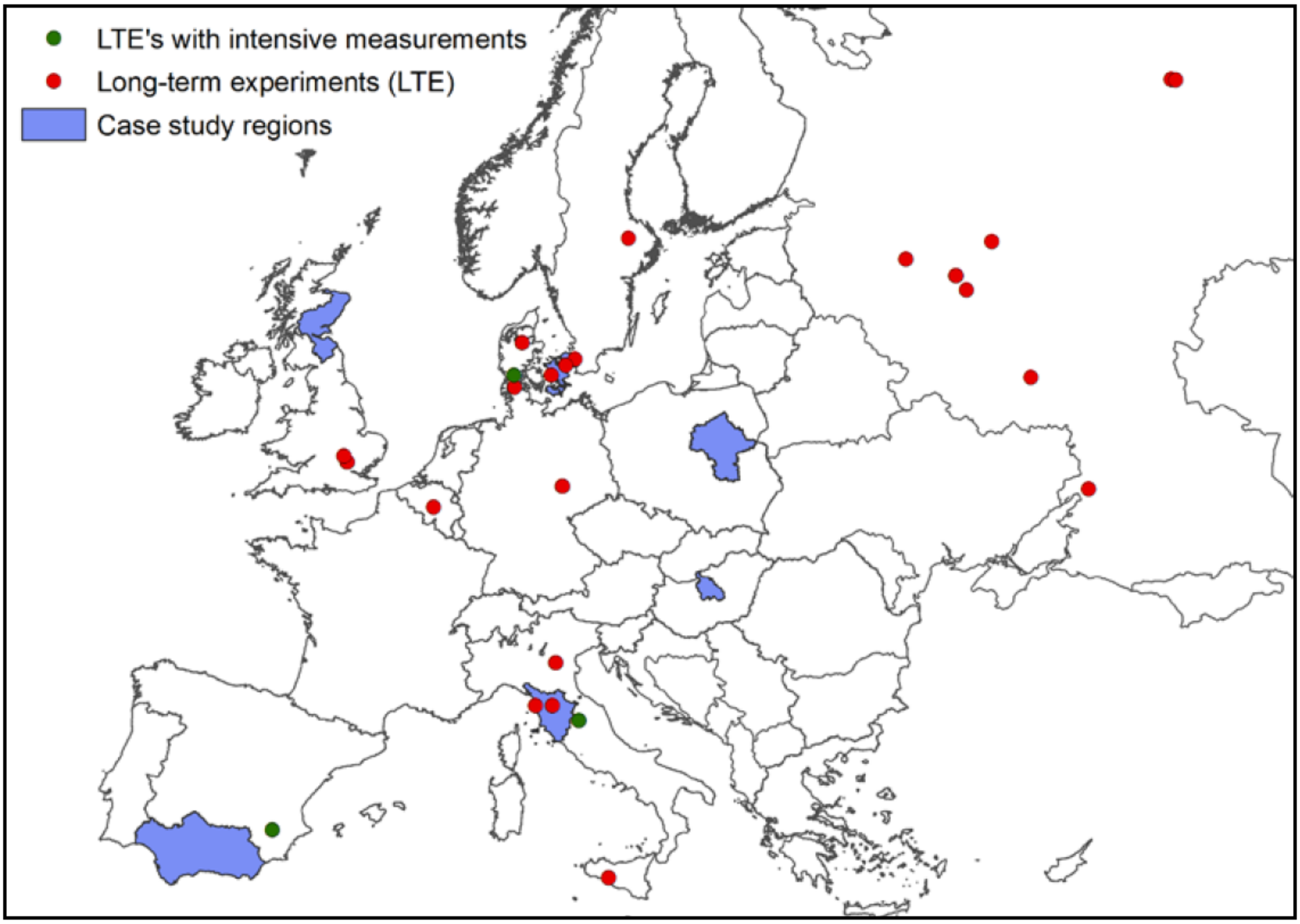
Photo: Reduced tillage intensity has positive effect on soil carbon content over the long term

What soil organic carbon measures are the most cost-effective?

Conducted under SmartSOIL, the cost-effectiveness analysis[1] considered the range of crops and applicable soil organic carbon (SOC) management measures across the 6 case study regions (see map below). Cost-effectiveness was assessed in terms of the impact on typical gross margin per crop of each SOC measure. The results indicate that in each of the case study regions there is potential for the uptake of SOC measures that can produce benefits to farmers in terms of improved gross margins. Whilst the specific measures and crop combinations vary across the case study regions, it is possible to group measures into three broad categories:

1- *Reduced input costs*. Measures such as minimum tillage and use of manures are estimated to be highly cost-effective even where modest reductions in yield occur because of the potential to reduce inputs costs. These input costs include, the fuel and time required for cultivation relative to conventional tillage (minimum tillage), and reduced mineral fertiliser costs (manures). Zero tillage performs less well as there is a cost incurred for increased crop protection spraying. The inclusion of legumes in rotations also appears to be cost-effective due to the reduced need for mineral fertiliser input; however, our analysis does not consider impacts over the course of a rotation.
2- *Loss of revenue from by-products*. Residue management has a high potential for SOC increase in most case study regions, but this could only be achieved at a loss of revenue from selling straw as a by-product.
3- *Increased input costs*. Under assumptions of unchanged or reduced yield impacts, cover crops were estimated to result in a large reduction in gross margin due to the additional costs of seeds and cultivation. But, where yield was assumed to increase the cost-effectiveness improved for some crops in some regions. This highlights the potential role for good agronomic advice to ensure that the benefits of SOC measures can be fully realised.

For more information, see Deliverable 3.2 – report on the cost-effectiveness of SOC measures.



Case study regions are: Zealand, Denmark; Central Region, Hungary; Tuscany Region, Italy; Mazovia (Mazowieckie Voivodeship), Poland; East Coast, Scotland; and Andalucía, Spain [INSERT MAP]

[1] Author: Alistair McVittie (SRUC). Contributing partners: Bhim Bahadur Ghaley (UCPH), Andras Molnar (AKI), Camila Dibari (UNIFI), Zbigniew Karaczun (SGGW), Berta Sanchez (UPM)

What stakeholders told us about managing soil carbon

Throughout the SmartSOIL project the farming community (agricultural advisers, farmer representatives, leading farmers, policy makers) are being consulted so that their perspectives can be taken into account. Interviews and workshops have been held in six case study regions (see map above) to assess the level of awareness and implementation of practices that enhance soil carbon; and the barriers to, and incentives for, implementation. The practices which were discussed were crop rotation, legumes, cover crops, manure application, residue management and reduced tillage. These were identified in the project as having the most potential to enhance soil carbon.

Managing manure

A clover ley enhances soil organic carbon

Sowing cover after winter wheat

A significant barrier to implementing soil carbon management is that most farm production related decisions are taken in the short-term, whereas managing soil carbon effectively needs a long-term approach. Key barriers to uptake of practices include: perceived scientific uncertainty about the efficacy of practices; lack of real life 'best practice' examples to show farmers; difficulty in demonstrating the positive effects of soil carbon management practices and economic benefits over a long time scale; and advisers being unable to provide suitable advice due to inadequate information or training. Most farmers are unconvinced of the economic benefits of practices for managing soil carbon. Incentives are therefore needed, either as subsidies or as evidence of the cost effectiveness of practices. Any new soil carbon measures and advice should be integrated into existing programmes to avoid a fragmented policy approach

The article *Managing Soil Organic Carbon: A Farm Perspective* can be read in the journal Eurochoices[2].

When the cost effectiveness analysis (reported above) for case study regions were presented to stakeholders it became apparent that some practices assessed as cost effective are subject to a number of technical/agronomic; economic/policy and social/cultural barriers. For example, in some case studies there is a scarcity of organic inputs which prevents some practices being implemented, in Poland and Hungary a reduction in livestock systems has limited the availability of animal manure, furthermore in Hungary crop residues are often sold for horse bedding, especially in dry years. Farm size, farmer age and farm ownership can also present social and cultural barriers. Older farmers can be reluctant to change from traditional (sometimes degrading) practices and often have limited expertise about managing the soil and poor access to good quality advice. The responses from the workshops have highlighted that, although cost effectiveness is important, there are other barriers to the uptake of soil carbon management practices that neeed to be considered[3].

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[2] See to Julie Ingram, Jane Mills, Ana Frelih-Larsen, McKenna Davis, Paulo Merante, Sian Ringrose, Andras Molnar, Berta Sánchez, Bhim Bahadur Ghaley, Zbigniew Karaczun Eurochoices 13 (2), 12-19

[3] More information: SmartSOIL Deliverable 5.2 Overview of socio-economic influences on crop and soil management systems

Spotlight on farmers: Real Life Case Studies

The project, in response to requests from stakeholders, will be preparing Real Life examples of farmers in each region already carying out effective managing of soil carbon.

Rafael Alonso Aguilera runs the family owned Oro del Desierto farm in Andalucia, Spain. It is a 650ha organic, mixed farm with 110ha olive groves, cereal, vineyard, and pasture for the livestock (irrigated systems). He has loam, sandy-loam and sandy soils but avoids the soil erosion problems and water shortages common in the area due to managing the organic matter in the soil using minimum tillage, gutters or infiltration canals; terraces; control furrows; cover crops, inert cover (mulch) and adding organic matter (their own compost).
Rafael said *"We have analysed our soils and we have recorded that the soil organic matter is increasing compared to the beginning. We realise that leaving the pruning debris and grass and the application of composts have largely contributed to an increase in the soil organic matter and in turn soil fertility. Thanks to these practices, the soil water retention is much better, the erosion is reduced and the microorganism population is larger. You can obtain many advantages from sustainable management."*

Finca Oro del Desierto in Andalucia, Spain

Farmer in his olive-tree field

Mitigating climate change at farm level: existing barriers to good practices implementation

Recent research in Spain shows that small changes in agricultural practices have a large potential for reducing greenhouse gas emissions. However, the implementation of such practices at the local level is often limited by a range of barriers, like changes in fertilization management, use of cover crops or reduced tillage adoption. Understanding the barriers is essential for defining effective measures, the actual mitigation potential of the measures, and the policy needs to ensure implementation. Results show that farmers' environmental concerns, financial incentives and access to technical advice are the main factors that define their barriers to implementation. The dissemination of scientific advances, technical information and agricultural policies relating to these mitigation practices will play an important role in encouraging the agricultural population to adopt. The article *Towards mitigation of greenhouse gases by small changes in farming practices: understanding local barriers in Spain* can be read in the Journal of Mitigation and Adaptation Strategies for Global Change[4].

[4] Berta Sánchez, Jorge Álvaro-Fuentes, Ruth Cunningham, Ana Iglesias. Published in: J Mitigation and Adaptation Strategies for Global Change, April 2014 http://smartsoil.eu/dissemination/scientific-publications/

Rewards for sequestering carbon can help improve food security

The global food supply could be made more secure by actively encouraging smallholder farmers in countries that have an insecure food supply to sequester carbon in the soil by altering their cultivation practices. This can also improve soil quality and reduce greenhouse gas emissions.

Although changes in cultivation practices can provide larger and more reliable yields, it can still be difficult to convince farmers to change their traditions. Cash rewards for changing such management practices would be a good incentive.

This entails, however, the acquisition of evidence that the change in practice actually builds up carbon. To generate this knowledge for each individual situation would take far too long and undermine the farmer's desire to become involved in the scheme.

In a recent article in Nature Climate Change, SmartSOIL scientists suggest research-based verification of the effect that change in management type has on carbon sequestration in different agroecological systems and soil types. This could help to significantly lower the costs and barriers to the restoration of higher carbon stocks and a more stable food supply.

The article *Enabling food security by verifying agricultural carbon* can be read in Nature Climate Change, H. Kahiluoto, P. Smith, D. Moran and J. E. Olesen. Nature Climate Change, Vol 4, May 2014.

2014.05.06 | JENS GRØNBECH HANSEN

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