SoilCare
SOILCARE FOR PROFITABLE AND SUSTAINABLE CROP PRODUCTION IN EUROPE

NEWSLETTER ISSUE #7

Testing and promoting the adoption of soil-improving cropping systems across Europe

December 2020

Welcome to the 7th SoilCare newsletter.

Whilst the last few months have been a challenging time for the SoilCare project due to the on-going COVID-19 situation, some exciting findings from our SICS experiments are starting to emerge which we look forward to sharing with you in the next newsletter. In the meantime, we are able to report on a number of fact sheets and policy briefs that have been produced recently and some activities from the Study Sites.

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The SoilCare project is funded by the European Union’s Horizon 2020 research and innovation programme under grant agreement No. 677407.

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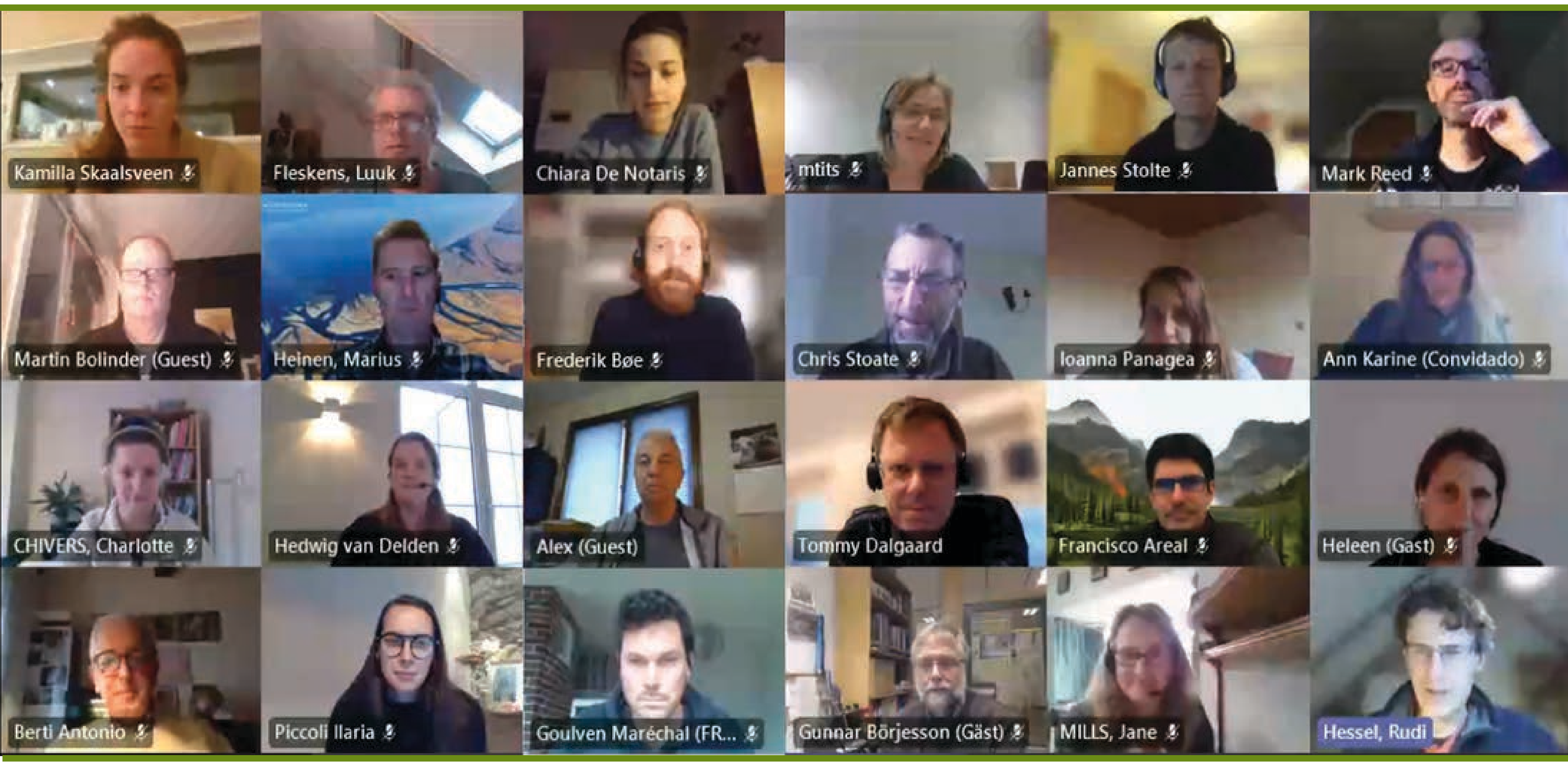
SOILCARE PLENARY MEETING: DECEMBER 2020



An online SoilCare plenary meeting was held on 7th December 2020. The agenda included updates from the thematic clusters (alleviation of compaction, fertilisers/amendments, soil-improving crops). Each cluster provided an overview of their progress and explained their forthcoming plans. The partners are currently preparing publications, some of which will be submitted to SoilCare's special issue.

Each work package also provided updates on their status' and explained how they plan to achieve their deliverables by the new deadline for the end of the project (August 2021).

THE IMPACTS OF COVID-19 ON SOILCARE

The emergence of COVID-19 has led to unprecedented change on global scale. It is, therefore, unsurprising that SoilCare, a European-wide project, was impacted by the pandemic. Labwork was forced to slow down due to lockdown restrictions and several deliverables were inevitably delayed.

As a result, the EU Commission have agreed to extend the deadline for SoilCare. The project will now finish at the end of August 2021.

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FIELD DAY AT 'BRANDVALL PRESTGARDEN', NORWAY - 04/08/2020

On 4th August 2020, the extension service in Solør Odal, Norway (Norsk Landbruk-srådgivning Øst) arranged a field day and gathered a group of around 40 advisors and farmers. The aim of the day was to present the field trials and discuss the latest research results and experiences from the 2020 season.

Picture credit: T. Seehusen

Picture credit: T. Seehusen

Till Seehusen (NIBIO Apelsvoll) presented the ongoing SoilCare trial in Solør (Title: Soil compaction and possibilities for soil loosening by plant roots). The presentation consisted of three different parts: (a) soil compaction, causes and consequences, results from the presented field trial; (b) SoilCare, plant production and soil improving cropping systems and (c) a presentation of the field trial, plant roots and soil structure (including pictures for illustration) as well as the preliminary results from the trial.

Many questions and comments from the audience led to some good discussions about soil structure, plant roots and agronomics to establish cover crops and succeed with crop rotations and improved soil structure. This presentation was part 2 of a series of presentations about soil compaction and SoilCare. The first one was held in combination with a seminar about cereal production that the extension service arranged in March 2020.

Picture credit: Norsk Landbruk-srådgivning Øst

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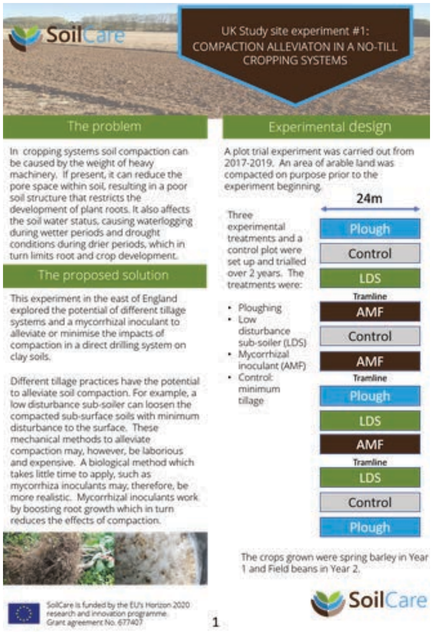
NEWS FROM THE UK CASE STUDY

In preparation for the upcoming stakeholder workshops at each study site, experiment fact sheets and policy summaries based on the results of each experiment are being produced. These fact sheets and policy summaries will be available on the SoilCare website once the workshops have been completed.

Conclusions from the compaction alleviation experiment

Overall, when soil compaction forms in a direct drill system traditional methods such as ploughing work well to alleviate compaction and increase yield. However, there are soil health benefits of reduced tillage. These benefits include less greenhouse gas emissions, more worms, and better soil structure.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UK Study site experiment #1:
COMPACTION ALLEVIATON IN A NO-TILL CROPPING SYSTEMS

The problem

In cropping systems soil compaction can be caused by the weight of heavy machinery. If present, it can reduce the pore space within soil, resulting in a poor soil structure that restricts the development of plant roots. It also affects the soil water status, causing waterlogging during wetter periods and drought conditions during drier periods, which in turn limits root and crop development.

The proposed solution

This experiment in the east of England explored the potential of different tillage systems and a mycorrhizal inoculant to alleviate or minimise the impacts of compaction in a direct drilling system on clay soils.

Different tillage practices have the potential to alleviate soil compaction. For example, a low disturbance sub-soiler can loosen the compacted sub-surface soils with minimum disturbance to the surface. These mechanical methods to alleviate compaction may, however, be laborious and expensive. A biological method which takes little time to apply, such as mycorrhiza inoculants may, therefore, be more realistic. Mycorrhizal inoculants work by boosting root growth which in turn reduces the effects of compaction.

Experimental design

A plot trial experiment was carried out from 2017-2019. An area of arable land was compacted on purpose prior to the experiment beginning.

Three experimental treatments and a control plot were set up and trialled over 2 years. The treatments were:

- Ploughing
- Low disturbance sub-soiler (LDS)
- Mycorrhizal inoculant (AMF)
- Control: minimum tillage

The crops grown were spring barley in Year 1 and Field beans in Year 2.

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Conclusions from the grass leys experiment

The aim of this experiment was to see if deep-rooting grass cultivars (festuloliums) could perform better than a rye grass clover mix control for sheep forage, and help alleviate some compaction across the field. We hoped to see improvements in SOC, infiltration and reduced penetration resistance due to the deep-rooting grasses, but we found very little difference. After the SoilCare experiment had finished, we dug deep trenches (70 cm depth) in the soil and found that in an area that was fenced-off so no grazing could occur, the festulolium cultivar (Fojtan) did have more roots at 70cm than the control, but under grazing pressure this difference wasn't seen, which could explain the lack of differences between the grass cultivars measured in the grazed field for the SoilCare results.


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Policy analysis: PROMOTING SICs ADOPTION IN ENGLAND

SOIL-IMPROVING CROPPING SYSTEMS FOR INCREASING SOIL HEALTH AT LODDINGTON

The following Soil-Improving Cropping systems (SICs) were tested in Loddington, England to address the main soil threats identified above:

1. **Introducing deep-rooting grass cultivars into the rotation**
2. **Compaction alleviation through sub-soiling and mycorrhizal inoculation**

The SICs above present important practices that might benefit soil health if widely taken up. The main aim of this study was to formulate policy alternatives and actions and to facilitate the adoption of SICs.

Evidence gathered through desk research, interviews and a stakeholder workshop show that several factors affect SICs uptake. These include:

- Lack of soil-specific policies
- Extent of farmer input to policymaking
- Limited coherence between policy instruments
- Lack of monitoring and enforcement
- High adoption costs
- Limited flexibility of financial instruments
- Pressure from market demands
- Lack of education and training

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COMPACTION ALLEVIATION EXPERIMENT

Factors encouraging the adoption of subsoiling and mycorrhizal inoculation:

- Subsoiling is a well-known and accepted agronomic practice

Barriers preventing the adoption of subsoiling and mycorrhizal inoculation:

- Limited knowledge of costs/benefits
- Not applicable to shallow/stony soils
- Lack of knowledge surrounding the practical application of the inoculant
- Lack of equipment availability for subsoiling

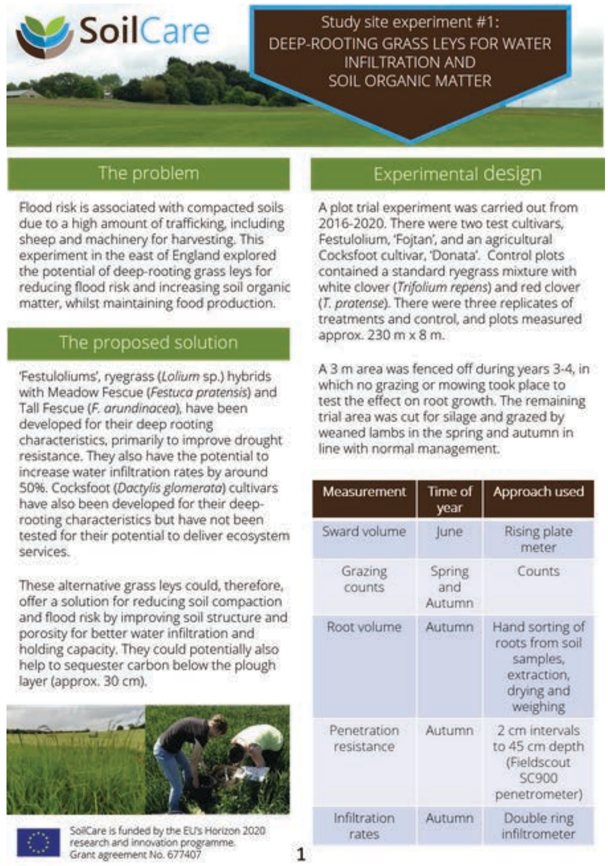
DEEP-ROOTING GRASS CULTIVARS EXPERIMENT

Factors encouraging the adoption of grass leys in the rotation:

- Simple to implement with existing practices
- May help with blackgrass control

Barriers preventing the adoption of grass leys in the rotation:

- Limited knowledge about costs/benefits
- Lack of awareness about financial support
- Lack of legislation protecting the soil
- Lack of knowledge about soil
- Crops grown in unsuitable places due to market demand
- Lack of monitoring of funding schemes
- May not be attractive to wholly arable farmers
- Conflict with the goal of increasing food supply (cereal yields may decline at catchment scale)
- 5-year rule for permanent pastures
- Countryside Stewardship prevents conservation of forage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Study site experiment #1:
DEEP-ROOTING GRASS LEYS FOR WATER INFILTRATION AND SOIL ORGANIC MATTER

The problem

Flood risk is associated with compacted soils due to a high amount of trafficking, including sheep and machinery for harvesting. This experiment in the east of England explored the potential of deep-rooting grass leys for reducing flood risk and increasing soil organic matter, whilst maintaining food production.

The proposed solution

'Festuloliums', ryegrass (*Lolium* sp.) hybrids with Meadow Fescue (*Festuca pratensis*) and Tall Fescue (*F. arundinacea*), have been developed for their deep rooting characteristics, primarily to improve drought resistance. They also have the potential to increase water infiltration rates by around 50%. Cocksfoot (*Dactylis glomerata*) cultivars have also been developed for their deep-rooting characteristics but have not been tested for their potential to deliver ecosystem services.

These alternative grass leys could, therefore, offer a solution for reducing soil compaction and flood risk by improving soil structure and porosity for better water infiltration and holding capacity. They could potentially also help to sequester carbon below the plough layer (approx. 30 cm).

Experimental design

A plot trial experiment was carried out from 2016-2020. There were two test cultivars, Festulolium, 'Fojtan', and an agricultural Cocksfoot cultivar, 'Donata'. Control plots contained a standard ryegrass mixture with white clover (*Trifolium repens*) and red clover (*T. pratense*). There were three replicates of treatments and control, and plots measured approx. 230 m x 8 m.

A 3 m area was fenced off during years 3-4, in which no grazing or mowing took place to test the effect on root growth. The remaining trial area was cut for silage and grazed by weaned lambs in the spring and autumn in line with normal management.

Measurement	Time of year	Approach used
Sward volume	June	Rising plate meter
Grazing counts	Spring and Autumn	Counts
Root volume	Autumn	Hand sorting of roots from soil samples, extraction, drying and weighing
Penetration resistance	Autumn	2 cm intervals to 45 cm depth (Fieldscout SC900 penetrometer)
Infiltration rates	Autumn	Double ring infiltrometer

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A NEW POLICY BRIEF: HOW DO SOIL-IMPROVING CROPPING SYSTEMS CONTRIBUTE TO THE UN'S SUSTAINABLE DEVELOPMENT GOALS?

To synchronise the SoilCare project with international frameworks, we have assessed the project's Soil Improving Cropping Systems against the UN's Sustainable Development Goals (SDGs). These SDGs refer to soil and land both directly and indirectly and therefore have areas in which SICS can contribute positive progress.

Looking at SDGs 2,3, 6, 11, 13 -15 (which range from zero hunger, to clean water and life systems), we have highlighted what potential soil threats affect each SDG and how complementary SICS can aid in achieving each one. For example, the threat of soil organic matter (SOM) loss can be tackled through using minimum tillage, returning residue to the soil after harvest, and applying mulch and manure. This feeds into zero hunger and good health and wellbeing (SDG 2 & 3) through building soil health and therefore the ability to produce good and plentiful food, a greater SOM which helps to absorb and filter water (SDG 6), helps store carbon in the ground (SDG 13) and creates a healthier environment for both land and water (through reducing soil erosion) and that on life (providing a rich habitat for below and above ground organisms), (SDGs 14 & 15).

The table below presents further examples of how SICS contribute to SDGs. The more holistic the set of practices (SICS) used on each farm, the greater the potential for contributing to each SDG.

SOIL THREATS	SICS TYPE	2 ZERO HUNGER	3 GOOD HEALTH AND WELL-BEING	6 CLEAN WATER AND SANITATION	11 SUSTAINABLE CITIES AND COMMUNITIES	13 CLIMATE ACTION	14 LIFE BELOW WATER	15 LIFE ON LAND
Erosion (wind and water)	Zero-tillage, landscape management, Contour traffic							
Decline in organic matter	Minimum tillage, Residue return, Mulching Manuring							
Compaction	Controlled traffic Low wheel load, low tyre pressures							
Decline in biodiversity	Minimum tillage, residue return, No pesticides, Minimal fertilizer							
Floods and landslides	Drainage Landscape management							
Local and diffuse contamination	No use of polluted inputs Trees to scavenge air-born pollution							
Salinisation	Drainage Targeted irrigation Ridging							
Acidification	Liming, manuring							
Desertification	Landscape management							

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A NEW POLICY BRIEF: HOW DO SOIL-IMPROVING CROPPING SYSTEMS CONTRIBUTE TO THE UN'S SUSTAINABLE DEVELOPMENT GOALS?

Some key policy options that came from this assessment included:

• The adoption of SICS is an effective way to contribute to SDGs as they contribute to multiple SDGs.
• Creating a methodology to monitor SICS contribution to SDGs, starting with baseline assessments of soil and land properties (such as SOM). Having a standard approach, whilst maintaining a level of flexibility for farmers, will help in being able to compare changes.
• Member States need to have guidelines and support on how best to undertake SICS, which work towards achieving SDGs.
• Long-term perspectives, suited to different regions, need to be created and fostered for more effective use and uptake of SICS
• In order to transition to SICS and therefore more sustainable soil management, farmers require strong support from policy through funding, creating and encouraging advice networks and knowledge transfer. It is vital to listen to farmers needs in respect to changing management practices.

The policy brief is available here and the full report here. The report, 'Providing support in relation to the implementation of soil and land-related Sustainable Development Goals at EU level', was written for the EU Commission.

READ MORE OF SOILCARE'S POLICY BRIEFS HERE:

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Soil health policies towards SDGs

POLICY BRIEF
September 2020
by Dr Jasmine Black, Countryside and Community Research Institute

SUMMARY

Soil degradation is a major EU and global challenge. Many of the Sustainable Development Goals (SDGs) put forward in the UN Agenda 2030 refer to land and soil either directly (SDG 2, 3, 15) or indirectly (SDG 6, 11, 13, 14). The European Commission has stressed its intention to mainstream SDGs into EU policies and recognises the need for a concrete, long-term strategy in order to progress.

SoilCare investigates and promotes the use of Soil-Improving Cropping Systems (SICS) to improve soil quality for positive effects on sustainability and profitability. SICS are a holistic approach to soil management, consisting of long crop rotations and an 'integrated' combination of inputs and management techniques. Here we present how SICS contribute to SDGs and the need for their concrete monitoring and long-term planning.

Mulch and direct drilling

Landscape mosaics

POLICY OPTIONS

Political leadership is needed to operationalise a transition into sustainable land management, inclusive of SDGs. The following options can help provide a policy-led transition:

- **Clearly define a methodology for monitoring the SDGs - coordinate a standard approach**
- **Incorporate guidelines and quantitative targets at Member State level to reduce soil degradation**
- **Promote regionally-specific good practice via SICS with long-term vision**
- **Enable transitions to holistic SICS methods for all farmers through policy support**

SICS address soil health threats and contribute to SDGs through a holistic approach to farming

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Farmer networks - social capital for soil health advice & policies

POLICY BRIEF
November 2020
by Dr Niki Rust, Newcastle University & Dr Jasmine Black, Countryside and Community Research Institute

SUMMARY

Despite economic and regulatory incentives to transition to more sustaianble soil management, many farmers across Europe have still not tried such practices or been motivated to change behaviour for the long-term. Complex social factors affecting farmers can be a cause of this.

SoilCare investigates and promotes the use of Soil-Improving Cropping Systems (SICS) to improve soil quality for positive effects on sustainability and profitability. SICS are a holistic approach to soil management, consisting of long crop rotations and an 'integrated' combination of inputs and management techniques.

Here we present how policy makers can support farmer networks to strengthen social capital in order to encourage the uptake of SICS practices.

Advice sharing

Demonstration farms

POLICY OPTIONS

Building social capital has been shown to positively affect the uptake of innovative practices in farming. The following can increase uptake of sustainable soil management:

- **Support information providers that farmers respect and trust e.g. farmer influencers or advisers**
- **Support development of diverse networks which include farmers and non-farmers**
- **Support farmer networks that are open to trying new things – e.g. innovative farmer networks**
- **Address power inequalities (e.g. farmer to landowner) through expert facilitation of multi-stakeholder groups and long-term contracts**

Building trust through long-term contact and contracts can help SICS uptake

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THE SOCIAL FACTORS THAT INFLUENCE FARMER'S UPTAKE OF SUSTAINABLE SOIL-IMPROVING CROPPING SYSTEMS

Despite economic and regulatory incentives to transition to more sustainable soil management, many farmers across Europe have still not tried such practices or been motivated to change behaviour for the long-term. Complex social factors affecting farmers can be a cause for this lack of action. A SoilCare paper led by the University of Newcastle explored how building social capital (the glue that binds us together) can positively affect the uptake of innovative practices in farming.

The research highlighted four main components of social capital which affect the uptake of sustainable soil management:

TRUST is key; if a farmer does not trust the person or institution providing information, they will probably think it is not trustworthy either. Farmers trust information from those who they feel are in a similar position e.g., other farmers. This is partly because they feel other farmers know and understand their goals and values more than "outsiders" (e.g., government officials, researchers). Distrust can occur through lack of information or contact consistency, whilst reciprocating trust in farmers can help to build relationships.

CONNECTEDNESS affects our behaviour. Having diversity within a network really helps spur innovation. For instance, if farmers are part of a wider community network, such as EU Operational Groups, they learn from other farmers as well as agronomists and environmental advisers. Not being connected with a wider network outside of their immediate locale can stifle innovation.

NORMS are shared expectations about how people should act. The norm for innovation – feeling it is OK to try something new – is important for encouraging farmers to try more sustainable soil practices. Studies across several countries have shown that farmers are more willing to change practices if their peers also do so. However, this can also present a barrier if peers have had negative past experiences or perceptions of more sustainable practices, e.g., conventional farmer group views of organic farming.

POWER is linked to position and knowledge. Power and trust can be seen in agricultural landlord - tenant relationships, where landlords make overarching farm management decisions. Longer-term contracts and encouraging transparent knowledge exchange are good ways to redistribute power equality and create greater transparency, fairness, and procedural justice.

A policy brief based on this research identified some policy options for increasing the uptake of sustainable soil management:

- Support information providers that farmers respect and trust e.g., farmer influencers or advisers
- Support development of diverse networks which include farmers and non-farmers
- Support farmer networks that are open to trying new things – e.g., innovative farmer networks
- Address power inequalities (e.g., farmer to landowner) through expert facilitation of multi-stakeholder groups and long-term contracts
- Incentivising cooperation and collaborative approaches in a range of contexts can be effective for fostering the four key components of social capital. EU grants are available and some national government programmes and advisory systems facilitate interactive groups. For example, EU Operational Groups on soils provide support to enhance connections between farmers, to advisors and researchers. However, SICS need to become the norm whilst addressing power inequalities for managing soil health. Supporting trusted, unbiased external agencies as facilitators will aid the development of multi-stakeholder soil management groups.

Read the full paper here and the full policy brief here.

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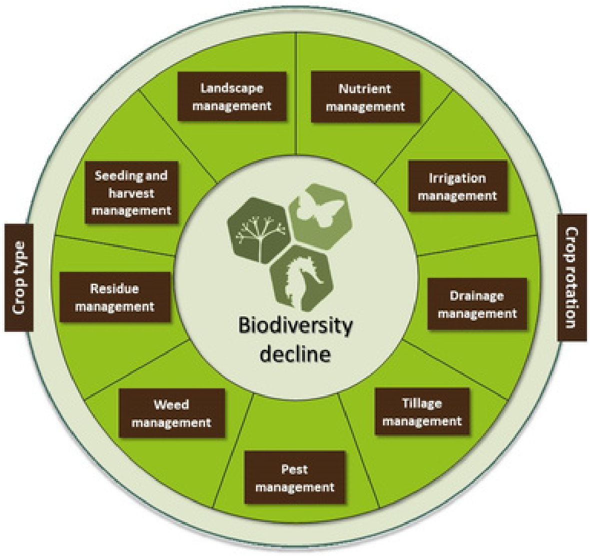
WORLD SOIL DAY 2020

This years' UN World Soil Day was held on 5th December. This years theme was 'Keep soil alive, protect soil biodiversity'. SoilCare recognises the importance of soil biodiversity and that it is affected by all soil-improving cropping systems (see infographic).



Project co-ordinator Dr Hessel of Wageningen Environmental Research said; "*In SoilCare we are working with farmers and scientists to identify the practices that will benefit the soil biodiversity as we know these organisms keep the soil healthy and fertile which in turn benefits the crops. The results of all our trials will be available by the end of the year and we are very excited to be able to identify potential practices that not only improve farm profitability but also benefit the living soil. One of the most important goals of the SoilCare project now is to ensure that farmers and the agricultural industry know about the results of these trials so that there can be a shift to soil-improving cropping systems across Europe.*"

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Factsheet #5:
SOIL IMPROVING CROPPING SYSTEMS FOR BIODIVERSITY

THE PROBLEM

Soil biodiversity is crucial for soil health and crop success. Soil biodiversity is simply defined as the variety of life that exists in the soil. Soil biodiversity is threatened by many agricultural practices, the decline of which results in a loss of species diversity and abundance in the soil. These losses then have implications at higher trophic levels and low soil biodiversity can be detrimental for crop growth. In addition, where there is low soil biodiversity, soil borne diseases are more likely to spread, thus maintaining diversity is crucial for maintaining high crop yields and quality.

Activities of the soil biota are essential to most soil functions and provide most of the ecosystem services that are considered typical of the wider landscape. These range from supporting food and fibre production, to controlling erosion and attenuating pollution.

HOW CAN SOIL-IMPROVING CROPPING SYSTEMS PREVENT & REMEDIATE BIODIVERSITY LOSS?

Soil improving cropping systems (SICs) are specific combinations of (1) crop types, (2) crop rotations and (3) management techniques aimed at halting soil degradation and/or improving soil quality and at the same time having positive impacts on profitability and sustainability.

Biodiversity-specific SICS may involve three mechanisms: (i) changes in inputs, (ii) substitution, and (iii) redesign. The first mechanism relates to inputs of energy–increasing organic matter as substrate, changing the available nitrogen source used. The second mechanism relates to possible substitution of chemical (pesticides), physical (tillage) and/or biological measures (mycorrhizal amendments). Thirdly, the redesign mechanism relates to the diversification of crop rotations, i.e., various crop types in sequence and/or in mixtures (intercropping), cover crops, fallow crops, set-aside, and the inclusion of hedges and other landscape elements.

Most promising biodiversity-specific SICS relate to the diversification of crop rotations, increasing soil organic matter, and reducing the build-up of soil-borne pathogens. Reducing the intensity of tillage will also reduce soil biodiversity loss (conventional tillage is known to have a detrimental effect on many groups of organisms from mycorrhizal fungi to earthworms). Reducing pesticide use also helps, as well as controlled traffic (due to less compaction).

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To celebrate the occasion, SoilCare released a press release and a new soil biodiversity factsheet, both of which were shared widely across social media. You can read the press release here and access the full biodiversity fact sheet here.

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NEW FACT SHEETS ON SOIL-IMPROVING CROPPING SYSTEMS

SoilCare has produced several new fact sheets which explore the ability of soil-improving cropping systems (SICS) to improve various aspects of soil health. You can access the full fact sheets by clicking on the images below.

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Factsheet #2: SOIL IMPROVING CROPPING SYSTEMS FOR POLLUTION

THE PROBLEM

Soil pollution can result in a loss of soil function, making it important to minimise contamination by chemicals and other pollutants. Some crops and crop varieties are more sensitive to pollution than others, with pollution generally affecting crop quality (and health) more than crop yield. Specific soil amendments and liming can alleviate contamination and certain crops can withdraw some pollutants from soil through phytoremediation.

Pollutants can enter soil via two pathways:

1. Point pollution, where pollutants enter the soil from a single source, often during a contamination event. These sources are usually easy to identify and as a result, easier to prevent.
2. Diffuse pollution, where pollutants enter soils over wide areas, often over extended periods of time. This often occurs due to the application of fertilisers and pesticides in farming and it is difficult to identify individual sources.

How does soil pollution affect soil function?

- Reduced productivity which results in less soil biomass, thus affecting the soil's ability to support plants
- Disrupted storage, filtering, and transformative functionality, affecting the cycling of nutrients needed by plants
- Decline in soil biodiversity due to the reduced activity of enzymes, micro-organisms and plants as a result of contamination
- Physical and cultural environment for humans and human activities.
- Soil contaminants may also limit the biodegradation of organic matter and may cause nutrient imbalances and deficiency.

HOW CAN SOIL-IMPROVING CROPPING SYSTEMS PREVENT & REMEDIATE SOIL POLLUTION?

Pollution-specific SICS may involve the following three mechanisms:

1. Changes in inputs
2. Substitution
3. Redesign

The first mechanism relates to a drastic lowering of pollutant inputs (and to withdrawal of pollutants with harvested crops through phytoremediation, where possible). The second mechanism involves soil amendments which stimulate the biological breakdown of organic pollutants, and/or the lock-up of pollutants in soil in a less mobile and less toxic form. The third mechanism involves the growth of crops that are less sensitive to pollutants and/or the change of food and feed crops to bio-energy crops and set-aside land. Certain crops are called hyperaccumulators, i.e., these crops accumulate pollutants in the plant tissue, or degrade or render pollutants in less harmful contaminants.

SICs component	Basic principle
Nutrient management	Prevents the application of excess agrichemicals which contaminate soils
Integrated pest management	
Smart irrigation	Minimises delivery of pollutants to the soil
Phytoremediation	Withdraws pollutants from the soil

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Factsheet #3: SOIL IMPROVING CROPPING SYSTEMS FOR REMEDIATING WATERLOGGING

THE PROBLEM

Water logging can result in the soil becoming saturated, either due to flooding or by the water table reaching the soil surface. Most crops require a soil with at least 10 to 15% volume of air-filled and connected pores. Water logging replaces the air with water, which hampers aeration of the root zone for cropping systems, leading to anoxic conditions for the roots.

How does waterlogging affect soil functions?

- Reduced productivity as crops become stressed, reducing development and growth.
- Severe water logging leads to leaf yellowing, wilting, senescence, root and tuber rotting.
- Decline in the soil macro pores and soil biodiversity that create a soil's structure, making the soil more susceptible to compaction, crusting, and high bulk-density problems

HOW CAN SOIL-IMPROVING CROPPING SYSTEMS PREVENT & REMEDIATE WATERLOGGING?

Soil improving cropping systems (SICs) are specific combinations of (1) crop types, (2) crop rotations and (3) management techniques aimed at halting soil degradation and/or improving soil quality and at the same time having positive impacts on profitability and sustainability. They need to be suited individually to each farm's local environment.

The key principles for remediating water logging are:

- Preventing water logging by removing excess water or lowering the groundwater table
- Improving the structure and water infiltration capacity of the soil

SICs component	Basic principle
Drainage management	Prevents waterlogging by removing excess water or lowering the water table
Landscape management	
Tillage management	Improves soil structure and water infiltration capacity

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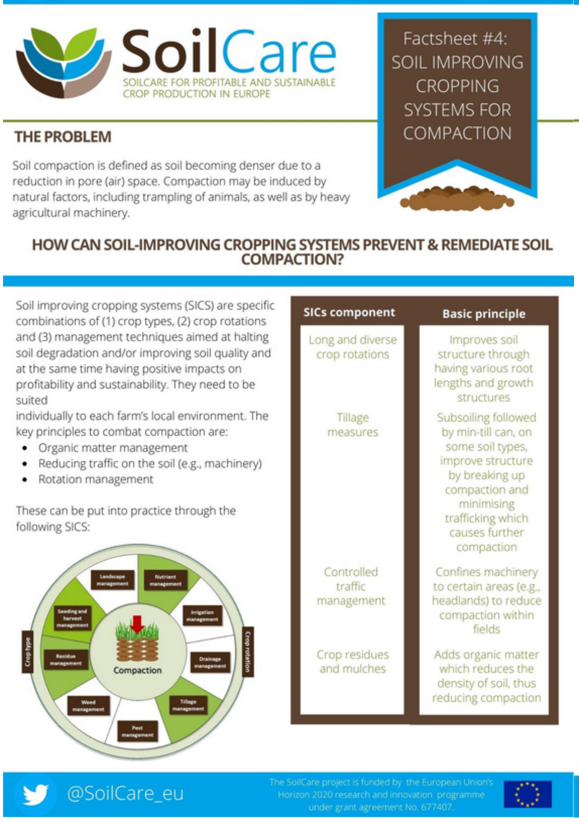

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Factsheet #4: SOIL IMPROVING CROPPING SYSTEMS FOR COMPACTION

THE PROBLEM

Soil compaction is defined as soil becoming denser due to a reduction in pore (air) space. Compaction may be induced by natural factors, including trampling of animals, as well as by heavy agricultural machinery.

HOW CAN SOIL-IMPROVING CROPPING SYSTEMS PREVENT & REMEDIATE SOIL COMPACTION?

Soil improving cropping systems (SICS) are specific combinations of (1) crop types, (2) crop rotations and (3) management techniques aimed at halting soil degradation and/or improving soil quality and at the same time having positive impacts on profitability and sustainability. They need to be suited
individually to each farm's local environment. The key principles to combat compaction are:

- Organic matter management
- Reducing traffic on the soil (e.g., machinery)
- Rotation management

These can be put into practice through the following SICS:

SICs component	Basic principle
Long and diverse crop rotations	Improves soil structure through having various root lengths and growth structures
Tillage measures	Subsoiling followed by min-till can, on some soil types, improve structure by breaking up compaction and minimising trafficking which causes further compaction
Controlled traffic management	Confines machinery to certain areas (e.g., headlands) to reduce compaction within fields
Crop residues and mulches	Adds organic matter which reduces the density of soil, thus reducing compaction

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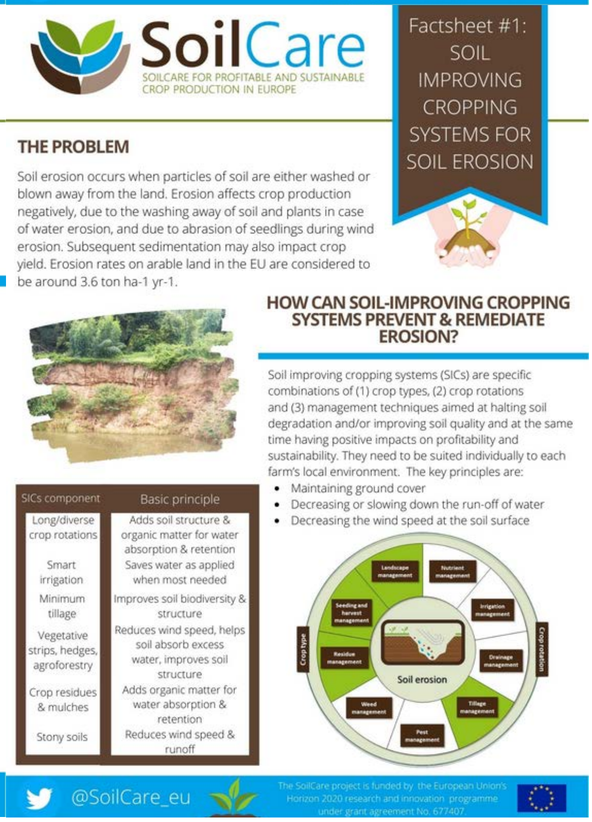

SoilCare
SOILCARE FOR PROFITABLE AND SUSTAINABLE CROP PRODUCTION IN EUROPE

Factsheet #1: SOIL IMPROVING CROPPING SYSTEMS FOR SOIL EROSION

THE PROBLEM

Soil erosion occurs when particles of soil are either washed or blown away from the land. Erosion affects crop production negatively, due to the washing away of soil and plants in case of water erosion, and due to abrasion of seedlings during wind erosion. Subsequent sedimentation may also impact crop yield. Erosion rates on arable land in the EU are considered to be around 3.6 ton ha-1 yr-1.

HOW CAN SOIL-IMPROVING CROPPING SYSTEMS PREVENT & REMEDIATE EROSION?

Soil improving cropping systems (SICs) are specific combinations of (1) crop types, (2) crop rotations and (3) management techniques aimed at halting soil degradation and/or improving soil quality and at the same time having positive impacts on profitability and sustainability. They need to be suited individually to each farm's local environment. The key principles are:

- Maintaining ground cover
- Decreasing or slowing down the run-off of water
- Decreasing the wind speed at the soil surface

SICs component	Basic principle
Long/diverse crop rotations	Adds soil structure & organic matter for water absorption & retention
Smart irrigation	Saves water as applied when most needed
Minimum tillage	Improves soil biodiversity & structure
Vegetative strips, hedges, agroforestry	Reduces wind speed, helps soil absorb excess water, improves soil structure
Crop residues & mulches	Adds organic matter for water absorption & retention
Stony soils	Reduces wind speed & runoff

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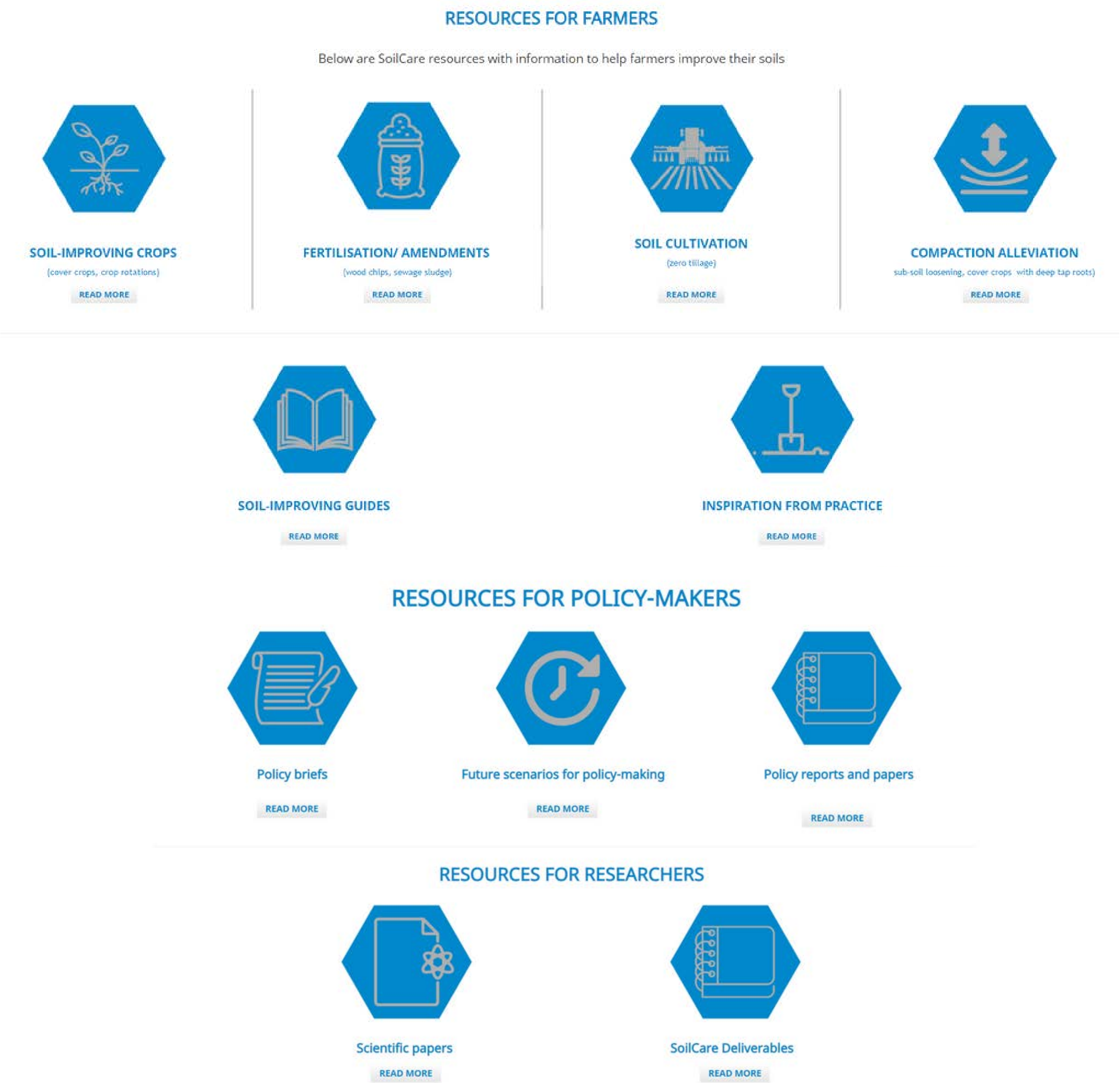
RELAUNCHING THE SOILCARE WEBSITE: RESOURCES FOR FARMERS, POLICYMAKERS AND RESEARCHERS

The SoilCare website has now relaunched with a new look and additional resources for farmers, policymakers and researchers. Click on the images below to explore the multitude of informative resources now available on the website.



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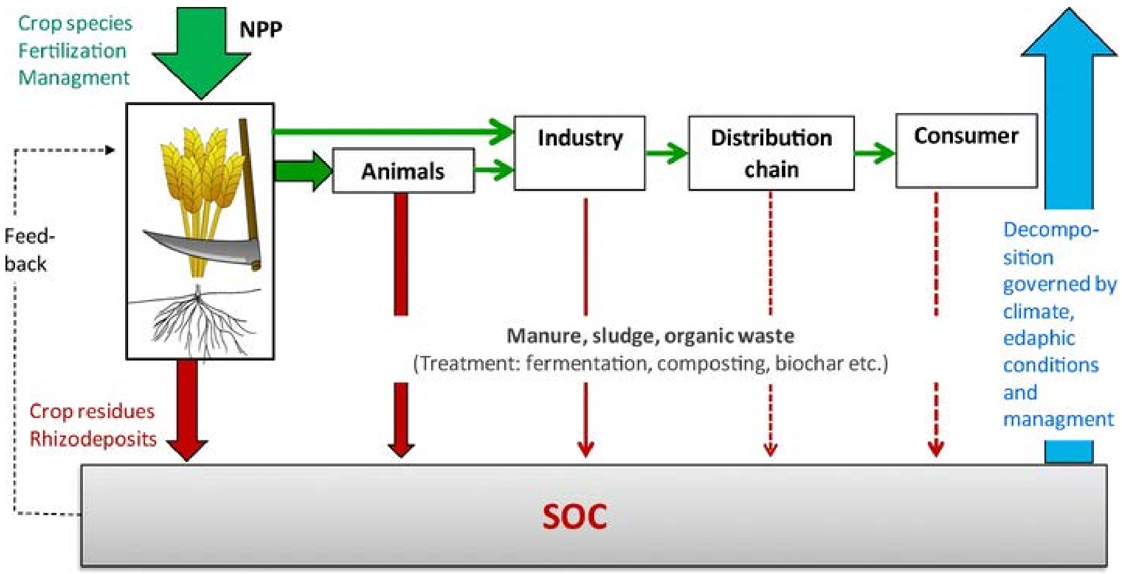
The effect of crop residues, cover crops, manures and nitrogen fertilization on soil organic carbon changes in agroecosystems: a synthesis of reviews

Martin A. Bolinder, Felicity Crotty, Annemie Elsen, Magdalena Frac, Tamás Kismányoky, Jerzy Lipiec, Mia Tits, Zoltán Tóth & Thomas Kätterer

International initiatives are emphasizing the capture of atmospheric CO2 in soil organic C (SOC) to reduce the climatic footprint from agroecosystems. One approach to quantify the contribution of management practices towards that goal is through analysis of longterm experiments (LTEs). Our objectives were to analyze knowledge gained in literature reviews on SOC changes in LTEs, to evaluate the results regarding interactions with pedo-climatological factors, and to discuss disparities among reviews in data selection criteria. We summarized mean response ratios (RRs) and stock change rate (SCR) effect size indices from twenty reviews using paired comparisons (N). The highest RRs were found with manure applications (30%, N = 418), followed by aboveground crop residue retention and the use of cover crops (9–10%, N = 995 and 129), while the effect of nitrogen fertilization was lowest (6%, N = 846). SCR for nitrogen fertilization exceeded that for aboveground crop residue retention (233 versus 117 kg C ha−1 year−1, N = 183 and 279) and was highest for manure applications and cover crops (409 and 331 kg C ha−1 year−1, N = 217 and 176). When data allows, we recommend calculating both RR and SCR because it improves the interpretation. Our synthesis shows that results are not always consistent among reviews and that interaction with texture and climate remain inconclusive. Selection criteria for study durations are highly variable, resulting in irregular conclusions for the effect of time on changes in SOC. We also discuss the relationships of SOC changes with yield and cropping systems, as well as conceptual problems when scaling-up results obtained from field studies to regional levels.



You can read the full article here.

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SOILCARE PROJECT PARTNERS

The SoilCare project has brought together a transdisciplinary team of 28 different organisations to identify, test and promote the adoption of soil-improving cropping systems across Europe.

PROJECT PARTNERS

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Research Institute for Knowledge Systems, The Netherlands
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