SoilCare
SOILCARE FOR PROFITABLE AND SUSTAINABLE CROP PRODUCTION IN EUROPE

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

Newsletter 5 November 2019

WELCOME to the fifth newsletter of the SoilCare project.

In this issue:

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Database created for monitoring SICS experiments

Monitoring of the Soil-improving Cropping Systems (SICS) experiments in each of the 16 study sites is complex. The agricultural cropping systems and experiments in SoilCare include complex interactions of processes and various management practices and/or treatments under a wide range of environmental and climatic conditions. SoilCare is using standardised formats to monitor and document these systems and experiments in order to help the researchers and stakeholders to efficiently exchange data, promote interdisciplinary collaboration and to simplify the modelling and analytical procedures.

A data collection and data storage system has been developed by the WP5 team from the University of Leuven to make the data readily available in a way that information is useful, easy to access and download, and safe, relying only on open source software. The database is designed to allow for:

- the storage of data and metadata regarding the experimental set-up;
- associated people and institutions;
- information about field management operations and experimental procedures which are clearly separated for making analytical procedures faster;
- links between system components; and
- information about the environmental and climatic conditions.

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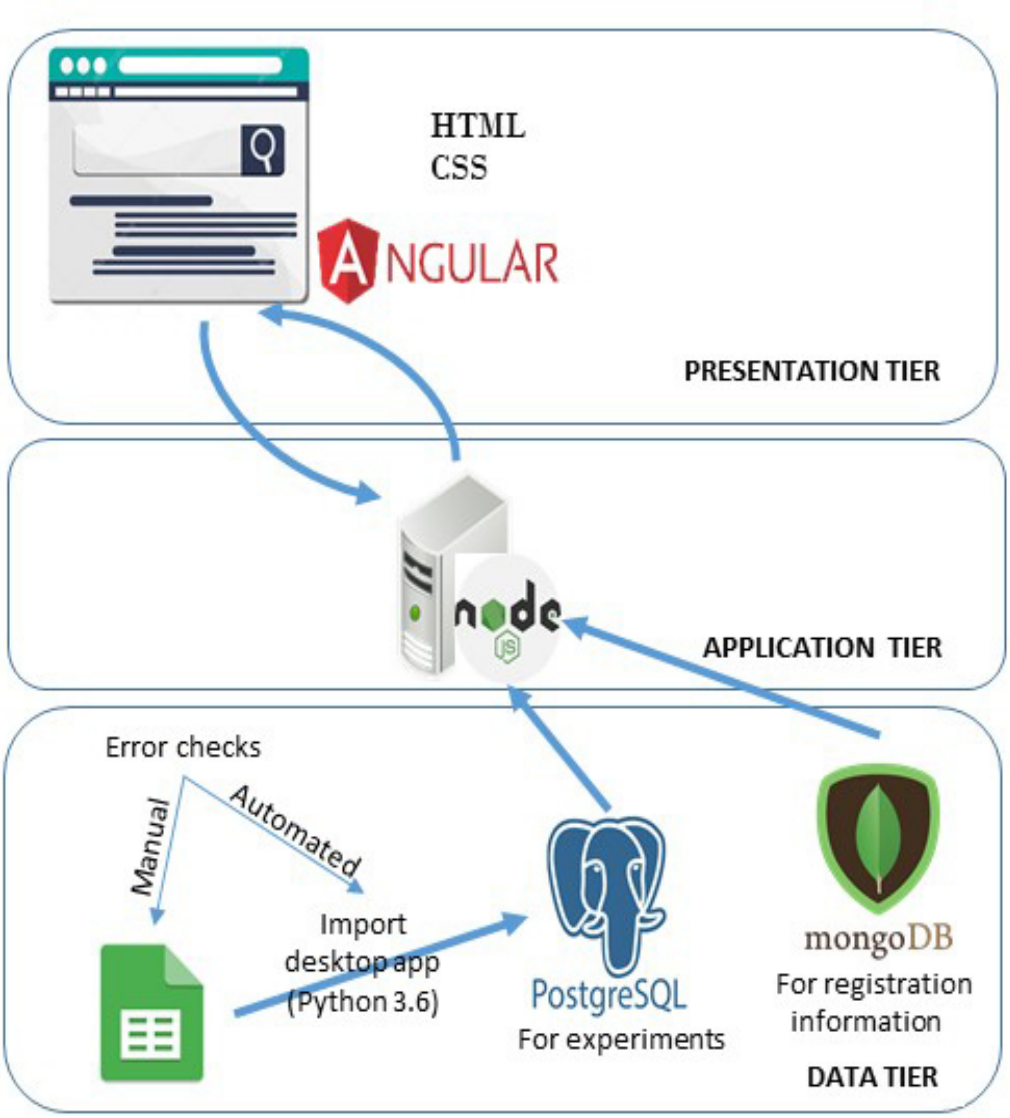
Raw data are entered by the users into structured spreadsheets. The quality is checked before storing the data into the database. A desktop import application has been created to upload the information from spreadsheets to the database, which includes automated error checks of the relationship tables, data types, data constraints, etc. The final component of the design is the database web application interface, which enables users to access and query the database across the study sites without the knowledge of query languages and download required data.

In the figure below, the physical model of the monitoring system architecture is presented. The data tier contains two kinds of databases to promote the safety of the users' personal data. PostgreSQL that contains the data about the cropping system and MongoDB that contains users' authentication data. In the application tier 'Express' a minimal and flexible Node.js web application framework is used as a middleware between web-application and databases to communicate with the databases and return the responses to the web application. In the presentation tier, Angular is used for the front-end development, HTML (Hyper Text Markup Language) is used to define the content and structure of the web page and CSS (Cascading Style Sheets) for the styling of the content.

For more information about the SoilCare monitoring database, please contact Ioanna Panagea ioanna.panagea@kuleuven.be



System structure

News from the field: Portuguese Study Site Spring legume Open Day

The Portugal Study Site held an Open Day this April to show local farmers the progress of their SICS trials on green manures.

Green Manures

Yellow lupins flowering in the Portugal Study Site
Photo credit: Anne Karine Boulet

One SICS includes growing green manure to look at the effect on soil quality and was particularly well received by the farmers and technicians. The Open Day was perfectly timed for the full flowering of the legumes, which caused a very enthusiastic reaction from the participants. It was suggested that besides monitoring the change in soil quality, calculating the nutrient release of the legumes would be a good idea. This in turn would help calculate only the necessary amount of mineral fertilization needed for application. The hopes would be to cut both cost and reliance on chemicals.

Discussions on farm during the open day. Photo credit: Anne Karine Boulet

Following the Open Day, the nutrient release was determined for 5 species of legumes: Pea, Yellow Lupin, Red Clover, Balansa Clover and Arrowleaf Clover. In addition to improving SOC and weed control, the green manures supply an average of 35%, 25% and 100% of the NPK extraction of the grain maize. A paper publishing these results was released recently (September 2019) in a national agricultural technical-scientific Journal.

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Urban waste applications

Stakeholders assessing the different green manures. Photo credit: Anne Karine Boulet

The second SICS, a soil amendment consisting of urban sludge, is used by some farmers in the region. Despite its use, this practice is very controversial, and stakeholders felt it needed to be thoroughly tested before there is a wider uptake. Concerns include the waste containing too many heavy metals leading to disease for crops and potentially consumers. The study sites involved 2 trial fields, one field fertilized every spring for 3 years with urban sludge and a control field fertilized exclusively with a conventional mineral amendment. Soil sampling results point to a significant increase of many indicators of soil quality for the trial field with the urban sewage sludge amendment, confirming the effectiveness of the technique. In terms of heavy metals, the concentration in soil is slightly higher for sludge experiment than for the control, however, it is still below the maximum concentration authorized by law. The release of these results is very important due to the polemic surrounding urban sludge fertilization. So far, the results are encouraging and point towards this being a viable waste resource to be reused as fertiliser for food growth. A poster about the trial and results has been presented to academics at the European Geosciences Union (EGU) conference and is further planned for publication in a national paper in order to reach a larger public audience.

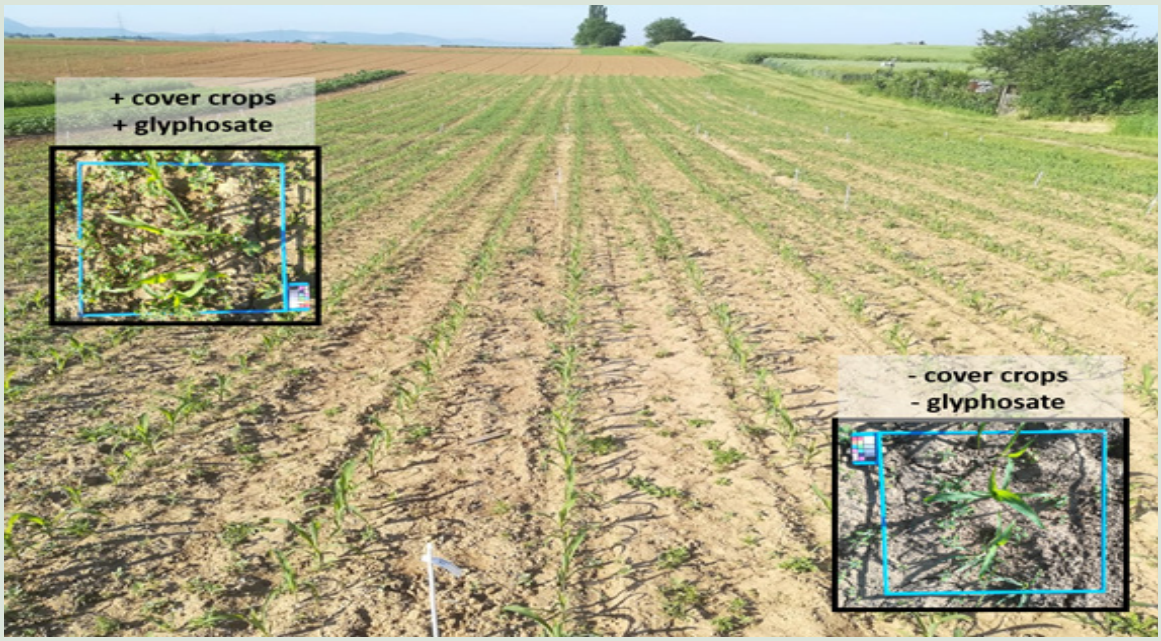
Advice and details on the benefits of green manures being given. Photo credit: Anne Karine

For more information about this Study Site, please contact Anne Karine Boulet anne.karine@esac.pt

Developments in the German Study Site and creation of Applicability Maps

The German Study Site at the Tachenhausen research farm is investigating the effects of glyphosate in a cropping system with cover crops and reduced tillage without ploughing. The use of glyphosate is currently highly debated, with public opinion pushing towards prohibition of this herbicide. Currently, as conventional conservation agriculture systems depend on herbicide use for weed control, it is important to understand the effects of glyphosate on soil biology. It is also important to develop alternative management practices to eliminate its use in the event that it is banned. This conflict illustrates a common structural problem of farming in industrialised countries, requiring research projects and stakeholder panels to avoid polarisation and destructive dynamics.

In the field experiment the four treatments consist of: cover crops and glyphosate application, cover crops without glyphosate application, glyphosate application without cover crops and no glyphosate with no cover crops. All four treatments are replicated four times (= 16 Plots) on 12m² plots.



In June the maize plants were growing and weed infestation was monitored. It was highest in treatments where cover crops were grown over winter, irrespective of glyphosate application. We had 25% weed coverage in treatments with cover crops compared to 9 -13% weed coverage in treatments without cover crops.

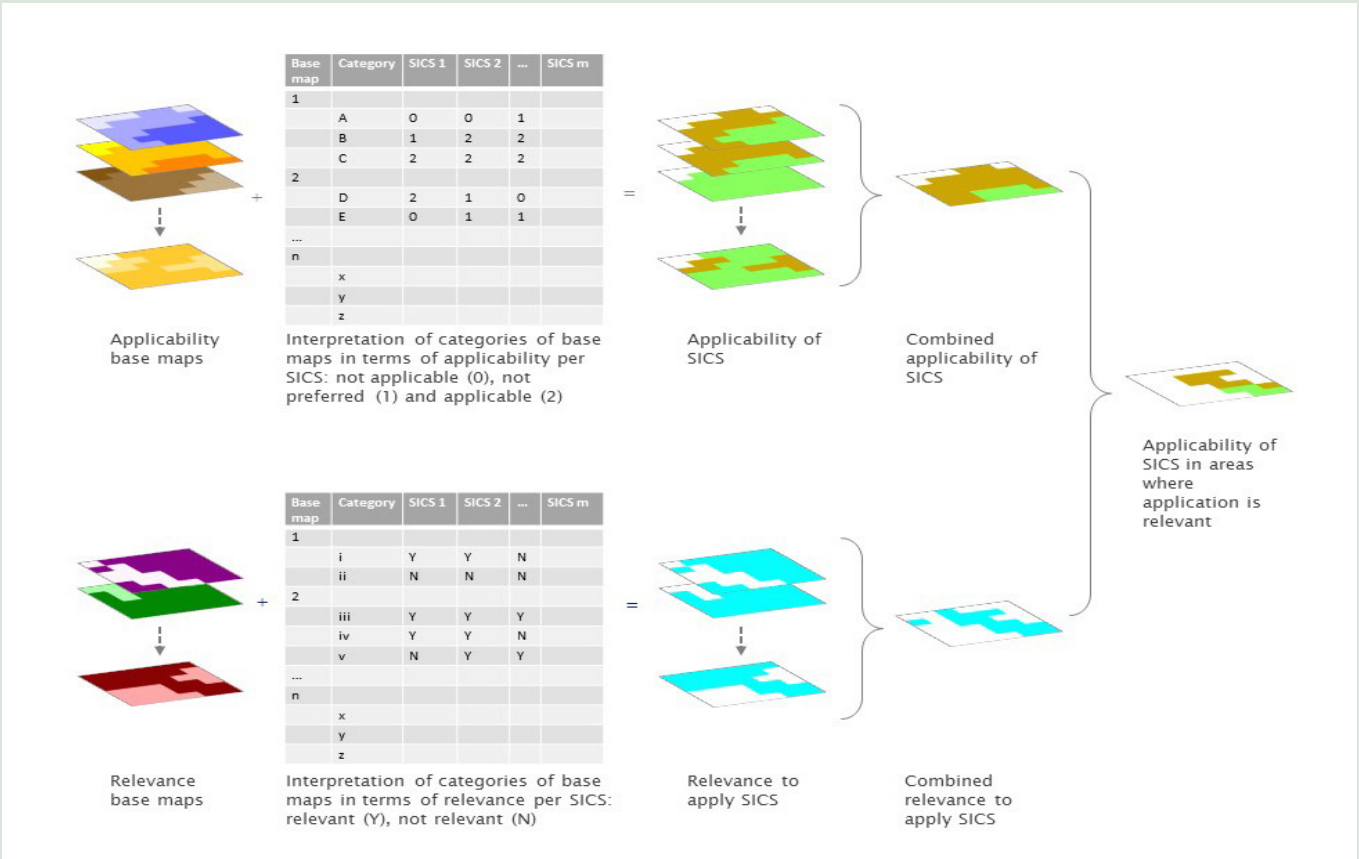
This year's season in Tachenhausen began on February 20th, when the cover crops were mulched on frozen soils. All plots were tilled with a rotary harrow 5 cm deep on March 26th. Glyphosate was applied on the corresponding treatments for seedbed preparation on April 12th. The maize variety "Figaro" was planted on April 25th on every plot, with a density of 9.5 plants/m².

In May, monitoring started with students from agro-biological sciences at the University of Hohenheim. In the video, the collection of abundance and biomass data on earthworms is presented. Please see here. For this date, the results showed around 36-60 earthworms/m². In sandy loam soils this corresponds to a medium abundance level. Abundance was highest on plots where previously cover crops were grown, although this observation was not statistically significant.

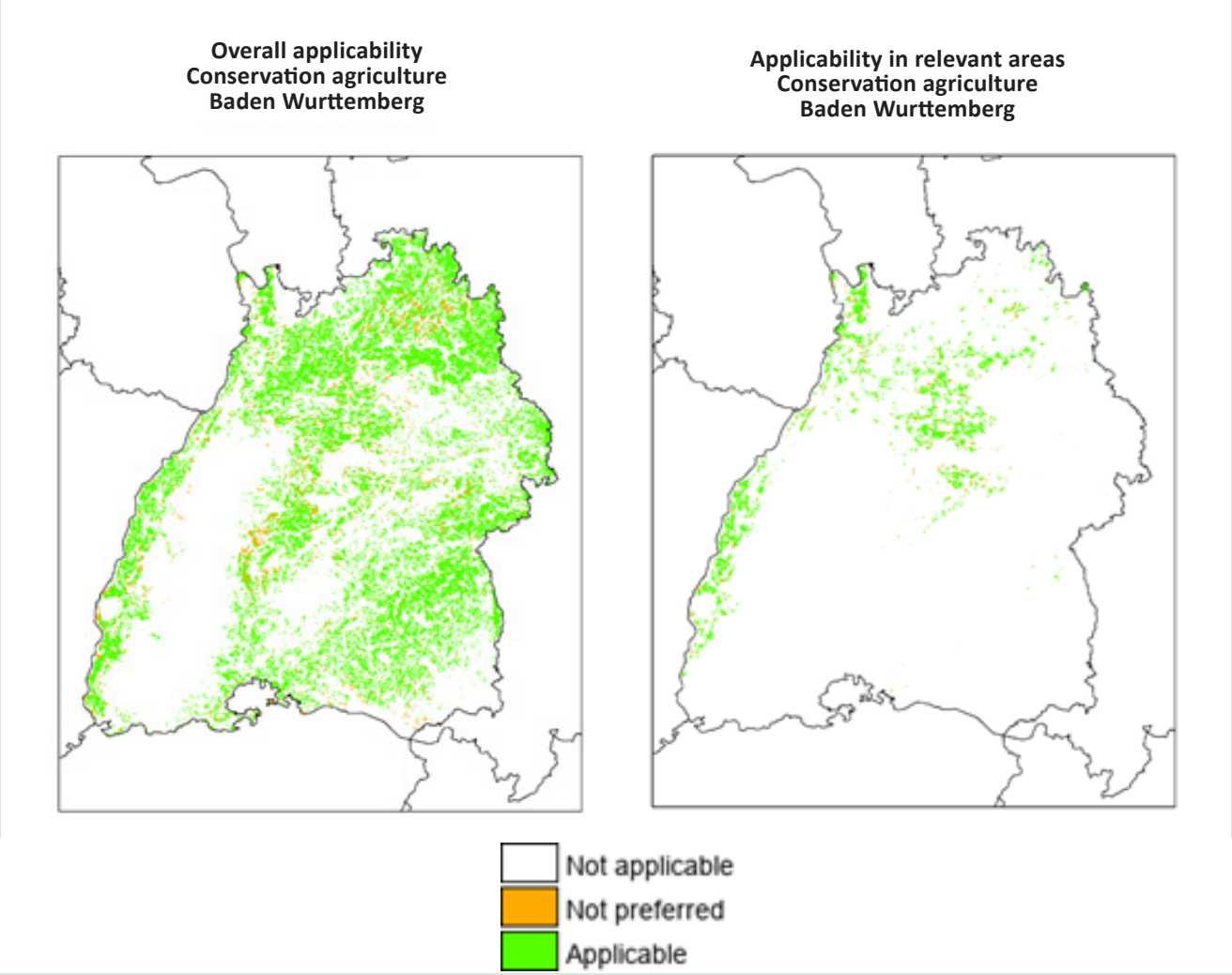
At the end of June, a stakeholder meeting was held with 18 participants including farmers, researchers, agricultural administration and industry.

Part of the discussion was based around a first set of applicability maps produced by the WP6 team. These maps were developed to identify where in Baden-Württemberg conservation agriculture can be applied and where it is relevant to apply conservation agriculture to combat organic matter decline in Germany.

The applicability maps are created as part of the upscaling activities in the project. As part of the process of constructing the applicability maps, Study Site partners were asked to complete a questionnaire about relevant soil, climate and land use characteristics for application of their SICS. This information was combined with European climate, soil and land use data in order to create maps indicating where in Europe the SICS could be applied. Furthermore, the question was raised where it would be relevant to apply the SICS. Are there specific locations with threats the SICS can mitigate or specific soil characteristics the SICS can improve, such as water erosion, compaction, soil organic matter levels? Again using European maps together with questionnaire data, relevance maps for the selected SICS were developed. By combining both maps, information is provided on the locations where it is relevant and possible to apply the SICS. For use during the Study Site workshops, regional cut-outs of the maps were provided as these were found more relevant to discuss with local and regional stakeholders than maps for Europe. Base maps selected for the creation of the applicability maps included: land use, soil fertility and soil texture. For the relevance map only soil organic matter was included.



Approach to the development of applicability maps



During the discussions it was agreed that the term 'conservation agriculture' on which the maps are based is sometimes too broad and may in fact include practices that do not necessarily have a positive impact on soil organic matter. It was also suggested that including other soil threats, such as water and wind erosion as relevance base maps would be of interest. The outcome of the discussion was to ask for additional and updated maps for cover crops and for direct seeding, separately. These maps are currently being developed and will be presented for discussion at the next stakeholder meeting this month. When the process is finished, the maps will have multiple uses, including use in planning and dissemination activities.

For more information about the German study site, please contact Paula Mayer-Gruner: p.mayer-gruner@uni-hohenheim.de

For more information about the applicability maps, please contact Hedwig van Delden: hvdelden@riks.nl

Norwegian workshop on adopting SICS farm management

The 4th Norwegian stakeholder workshop took place at NIBIO's office in Oslo on the 13th of March 2019. Twelve people participated all together; five from NIBIO and seven external stakeholders. These included farmers, the board leader of the National Farmers Union, advisory service representatives and a representative from the Royal Norwegian Society for Development.

The workshop started with an introduction by researcher Kamilla Skaalsveen and a presentation of the SoilCare project by Jannes Stolte as a general reminder and an update on the progress of the project since last stakeholder meeting. Frederik Bøe and Till Seehusen followed by providing an update from the two study sites (Solør-Odal and Øsaker) to inform the participants about activities and results from 2018 and experimental plans for 2019.

Frederik presents findings from the Øsaker study site. Photo credit: Kamilla Skaalsveen

The participants were asked to describe the SICS being tested in the Norwegian study sites (cover crops in general and cover crops to alleviate compaction) and the expected benefits/impacts. Some of these included getting subsidies, improving yield via N input and both cutting costs and increasing income as a result as well as improving soil quality and carbon storage. Risks were associated with competition between cover crops and the main crop, pests and diseases increasing, and the need to apply glyphosate to kill off cover crops.

Following this, the participants were then asked to identify enablers and barriers to the adoption of cover crops in Norway. Different categories were written on a flip chart including economic conditions, biophysical conditions, technical barriers, knowledge/information, social/cultural factors, institutional and policy environment and "other". For each of the categories, the different enablers and barriers were written down on post-it notes that were attached to the sheets.

Subsidies were seen to be the greatest enablers, followed by advice and farm visits as well as climate change allowing a longer growing season. The main barriers were seed costs and a lack of necessary equipment.

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Potential measures to remove barriers to cover crops were then identified and discussed:

Barriers	Measures
Lacking experience under Norwegian conditions - need to develop a guidance for farmers	- Large scale trials with farmers - Need more research - Publish research results (make available) - Provide funds to develop a cover crop guideline for - Need long term experiments (minimum 15 years) to understand the long-term effects of cover crops in Norway
Lacking information dissemination	- Farm walks with the agricultural advisory service - Dissemination through different information channels – e.g. news letters - Study trips to learn from others' experience
Economic risk	- Increased subsidy rates - Increased knowledge about effects
Lack of subsidies for when cover crops are sown by seed drill	- Change of legislation

Measures to improve the facilitation of cover crops were further identified as:

Enablers	Measures
Subsidies	- Increase the subsidies for cover crops in the Regional Environmental Programme (legislation) - Other subsidies (for e.g. biodiversity, prevention of pests, crop rotation)
Compaction damage (increasing the incentives for change amongst farmers)	- More research and awareness (preventive, repairing)
Experiences from e.g. the Agricultural advisory service – farm visits	- More farm walks that clearly show the results of sowing cover crops - Reportages for dissemination
Changing climate – longer growth season	- Better chances of establishing cover crops

Currently, there is no legislation in Norway to protect and enhance soil quality. Therefore, the final part of the workshop was spent discussing how this could be improved.

The participants identified that there is a need for improved legislation, reaching beyond the aim of the existing National Soil Protection Strategy (which aims to ensure that the annual reassignment of fertile soil is limited to 400 ha by 2020). The overall aim for policies and instruments should seek to protect and conserve soil and soil quality for future generations rather than short term effects – either through educational or financial support.

To ensure policy makers are well-informed in developing new legislations for soil health the participants identified the following:

- Better disseminate soil health research
- Include soil quality and health in agricultural education
- Give more advice and training to farmers and farmer organisations on soil health
- Have more detailed advice about soil available i.e. not just about degradation, and give a wider perspective of its importance beyond farming
- Better inform policy that soil is dynamic and living, not static so that policy can reflect this
- Policy should be developed with long-term thinking

Concluding remark: There is a general lack of attention towards protection of soil quality in Norway. The focus is on area protection (loss of agricultural land to urbanization) in the public as well as politically.

For more information about the Norwegian Study Site, please contact Jannes Stolte Jannes.Stolte@nibio.no

SICS Focus: Desertification-specific SICS

Each issue of the SoilCare newsletter focuses on soil threat-specific SICS. In this newsletter the focus is on desertification-specifc SICS.

Desertification is the degradation of land in arid and semi-arid areas, as a result of loss of vegetation due to climatic fluctuations and human activities, including over-grazing, fires, soil erosion, salinization, and/or nutrient depletion through withdrawal of harvested crop without return of nutrients. Degraded soils lose their ability to capture and store water, nutrients and carbon, and to support biological processes.

The SoilCare review of SICS (see Newsletter 2) has identified SICS that prevent/mitigate desertification. These measures mainly involve mechanisms that change input-output ratios and may involve redesign mechanisms. External inputs of water and nutrients may be needed to enhance the soil fertility and productivity of the soil and thereby to prevent degradation (Table).

However, the main mechanism is redesign of the land-use and incorporating suitable landscape elements. For instance, whenever possible C-4 grasses (such as maize and millet) and crops with high water use efficiency (WUE) should be grown, whereas overgrazing must be prevented, as well as long-term animal camping sites (to improve nutrient recycling). Measures to minimize or control runoff are needed to minimize erosion risk and downstream flooding during incidental rains. Landscape elements such as tree lines and hedges may also contribute to minimizing erosion and land degradation, and to water harvesting.

The most promising desertification-specific SICS aim at reducing (i) the risk of desertification and (ii) the impacts of desertification. They may have a significant impact on landscape and resource use efficiency.

Components of cropping system	Components of desertification-specific SICS	Change in profitability
Crop rotations	When possible/ needed: +permanent vegetation & crops with high WUE	+
Nutrient management	optimal	
Irrigation management	Targeted (drip) irrigation	+
Drainage management	optimal	
Tillage management	Reduced tillage	+
Pest management	optimal	
Weed management	optimal	
Residue management	Surface mulching, to reduce evaporation	+/-
Mechanization management	optimal	
Landscape management	Treelines, hedges, agroforestry	+

For more information about these different SICS, please visit the SoilCare website https://soilcare-project.eu/soil-improving-cropping-systems

Study Site Films

During the April meeting, short films were recorded with each study site leader to explain what SICS trials are being carried out in their study sites and with local farmers. Alongside photos and footage from the field, these clips are being worked into short films and being posted to Vimeo. Watch this space as more videos are uploaded!

New SoilCare Booklet for Farmers

The **"10 common practices and their harmful impact on soil"** booklet mentioned in the last newsletter is now available in several languages online including: French, Spanish, Greek, Polish and English. These are available for downloading and printing. There are further languages coming so watch this space! The study sites are printing the booklets to take to events and meetings and tailoring them to the issues most pertinent to their country and study location.

New Publications

New Journal articles

Cuevas, J., Daliakopoulos, I.N., del Moral, F., Hueso, J.J. and Tsanis, I.K., 2019. A review of soil-improving cropping systems for soil salinization. Agronomy, 9(6), p.295. https://www.mdpi.com/2073-4395/9/6/295

Alarcão, C., Boulet, A.K, (2019) Avaliação do interesse da incorporação de leguminosas forrageiras no solo como "adubação verde". Dossier Prados, pastagens e forragens, Revista Agrotec nº32: 66-69.

Past Events/Presentations

During August and September, SoilCare researchers presented talks and held workshop discussions at the Wageningen Soil Conference, and TERRAenVISION conference. These covered topics such as bringing stakeholders who are usuallly hard to reach into the project, what SICS are and their effects as well as how to get policy makers interested and actively putting support tools into policy.

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

1 Wageningen Environmental Research (Alterra), The Netherlands
2 University of Newcastle upon Tyne, United Kingdom
3 KU Leuven, Belgium
4 University of Gloucestershire, United Kingdom
5 University Hohenheim, Germany
6 Research Institute for Knowledge Systems, The Netherlands
7 Technical University of Crete, Greece
8 Joint Research Centre, Italy
9 University of Bern, Switzerland
10 Milieu LTD, Belgium
11 NIBIO, Norway
12 Bodemkundige Dienst van België, Belgium
13 Aarhus University, Denmark
14 Game & Wildlife Conservation Trust, United Kingdom
15 Teagasc Research Institute, Ireland
16 AgroCares Research, The Netherlands
17 Escola Superior Agrária de Coimbra, Portugal
18 National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection, Romania
19 University of Padova, Italy
20 Institute of Agrophysics of the Polish Academy of Sciences, Poland
21 Wageningen University & Research, The Netherlands
22 University of Pannonia, Hungary
23 Swedish University of Agricultural Sciences, Sweden
24 Agro Intelligence ApS, Denmark
25 Crop Research Institute, Czech Republic
26 University of Almeria, Spain
27 Fédération Régionale des Agrobiologistes de Bretagne, France
28 Scienceview Media B.V., The Netherlands

Participants at the SoilCare 4th Plenary meeting 2nd - 5th April 2019 in Almeria, Spain (Photo: LA VOZ)

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For further details about the project please email rudi.hessel@wur.nl

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