SoilCare
SOILCARE FOR PROFITABLE AND SUSTAINABLE CROP PRODUCTION IN EUROPE

List of cropping systems selected for testing in WP5

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SoilCare

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5	University Hohenheim	UH	Germany
6	Research Institute for Knowledge Systems	RIKS	Netherlands
7	Technical University of Crete	TUC	Greece
8	Joint Research Centre	JRC	Italy
9	University of Bern	UNIBE	Switzerland
10	Milieu LTD	MLTD	Belgium
11	Norwegian Institute of Bioeconomy Research	NIBIO	Norway
12	Bodemkundige Dienst van België	BDB	Belgium
13	Aarhus University	AU	Denmark
14	Game & Wildlife Conservation Trust	GWCT	United Kingdom
15	Teagasc	TEAGASC	Ireland
16	Soil Cares Research	SCR	Netherlands
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18	National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection	ICPA	Romania
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Deliverable 3.2

Mark Reed and Liz Oughton
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Contents

1. Introduction

In the SoilCare project, cropping systems and agronomic techniques were selected in stakeholder workshops in each study site, from a list of options identified by multi-stakeholder advisory panel members and WP2. The selected measures will be further developed and tested in WPs 4 and 5. Workshops were facilitated in local languages and run by study site teams with local facilitators, with training and guidance provided by the WP3 team.

2. Methods

2.1 Research design

Cropping systems were identified and selected for testing in a three-step participatory process (Table 1):

1. **Workshop 1:** Multi-stakeholder advisory panels were convened in each study site to identify shared goals and scope soil-improving cropping systems that could be considered for later selection (in Workshop 3)
2. **Workshop 2:** A stakeholder analysis was performed, to agree the scope, scale and focus of SoilCare research in each study site, and identify and characterise organisations and groups with a stake in improving soils whilst increasing the profitability and sustainability cropping systems (see Deliverable 3.1 for the outputs of this workshop)
3. **Workshop 3:** Based on the stakeholder analysis, a representative range of stakeholders were invited to critically discuss soil-improving cropping systems identified in Workshop 1 and WP2, and rank and short-list those they would like to see tested in the study site

2.2 Multi-stakeholder advisory panel establishment (workshop 1)

The main aim of this initial workshop was to introduce members of the panel to each other and the project, identify shared goals and scope soil-improving cropping systems that could be reviewed alongside systems identified from scientific literature (in WP2). The workshop also gave participants an opportunity to check and (if necessary) supplement the membership of their multi-stakeholder advisory panel. A sample agenda for this workshop can be found in Appendix 1.

2.3 Stakeholder analysis (workshop 2)

To ensure systematic representation of stakeholders in the selection of cropping systems for train in workshop 3, a stakeholder analysis was performed in each study site. This was an important step, because the choice of researchers and other stakeholders invited to this workshop could have a significant effect on the decisions made. For more information about this, see Deliverable 3.1.

Table 1: Overview of stakeholder workshops in WP3

Workshop 1: First multi-stakeholder panel meeting (full details in section 2.1)
When held: months 2-4
Aims: • Introduce members of the panel to each other and the project • Scope shared goals and soil-improving cropping systems that can be reviewed alongside systems identified from scientific literature (in WP2) for later selection in field trials (in Workshop 3) • Check and (if necessary) supplement the membership of multi-stakeholder advisory panels
Methods overview: • Problem tree analysis to identify causes and effects of soil degradation in the study area, and potential solutions • Meta-plan and discussion to identify innovations/interventions that could be trialled • Ask for suggestions of missing stakeholders to join panel
Workshop duration: approximately 1-2 hours
Outputs: • List of potential innovations/interventions with explanatory notes based on discussion • Finalised stakeholder panel composition
Workshop 2: Stakeholder analysis workshop (full details in section 2.2)
When held: months 5-7
Aims: • Update on project progress • Clarify/agree the scope, scale and focus of SoilCare research in the study site • Identify and characterise organisations and groups with a stake in improving soils whilst increasing the profitability and sustainability cropping systems in this study site
Methods overview: • Stakeholder analysis (see section 2.2 for full details)
Workshop duration: approximately 3-4 hours
Outputs: • Completed stakeholder analysis matrix
Workshop 3: Selection of soil-improving cropping systems for trial (see section 2.3)
When held: months 8-12
Aims: • Critically discuss soil-improving cropping systems that could be trialed in the study site • Rank and short-list soil-improving cropping systems • Identify key influencers and preferred modes of communication that will enable effective dissemination of research findings by WP8 • Evaluate the extent to which participants learned from the workshop
Methods overview: • Introduce options based on Workshop 1 report and soil-improving cropping systems identified for the site from WP2 • Structured discussion exercise to understand options • Matrix ranking and shortlisting • Exit questionnaires
Workshop duration: approximately 3-4 hours
Outputs: • Workshop report including: o Summary notes from discussion of options o Matrix ranking results o Shortlist of options for trial o Questionnaire responses

2.4 Selection of soil-improving cropping systems for trial (workshop 3)

The main focus of this Deliverable Report is the outcome of the third workshop. The aim of this workshop was to critically discuss soil-improving cropping systems that could be trialed in each study site, based on options identified in workshop 1 and outputs from WP2, and to rank and short-list soil-improving cropping systems. An additional aim was to identify key influencers and preferred modes of communication that will enable effective dissemination of research findings by WP8. An agenda for this meeting can be found in Appendix 2.

The workshop proceeded with the following steps:

- **Overview of options:** An overview was provided of soil-improving innovations/interventions identified in Workshop 1 and that had been suggested from WP2 for each site (Figure 1). The group was given an opportunity to identify any important missing options at this stage to supplement this initial list of options
- **Structured discussion of trial options:** Rotating small group discussion was facilitated around tables dedicated to each cropping system (with similar systems clustered for study sites with many options). This was designed to ensure all participants fully understood each option, could critically discuss and enhance options where relevant, and identify reasons why they might want to prioritise or de-prioritise the cropping system
- **Agreement of criteria for matrix ranking:** based on reasons for prioritizing or de-prioritising options identified in the previous exercise, participants were asked to agree criteria against which cropping systems could be prioritized, for example, farmer profitability, improvement to soil quality, maintenance of the cultural landscape, fits existing farming system and so on. All sites included at least two criteria: the profitability and sustainability of the cropping system. However, based on discussion with stakeholders, additional criteria were added in some sites. These additional criteria differed between sites, to ensure decisions reflected the priorities of stakeholders, whilst retaining a degree of consistency across sites due to the use of two core criteria in all sites. Criteria were all given the same weight (or importance).
- **Matrix ranking of trial options:** Cropping systems discussed by small groups earlier in the workshop were placed in an options:criteria matrix (on flip chart paper, with options along the top and criteria down the side, creating a grid). Each participant, including both SoilCare researchers and other stakeholders, was given 10 sticky dots (or similar) to prioritise their preferred cropping system option. Using the matrix, participants were able to indicate the reasons why they prioritied one option over another, based on the criteria identified in the previous step. In other words, rather than just placing their sticky dots on their preferred Soil Improving Cropping System (SICS), they placed their dots in the column of their preferred SICS, but in the cell(s) that indicated the criteria against which they had prioritized the SICS e.g. one stakeholder may prioritise SICS 1 because it would be more profitable, while another may prioritise the same SICS for a different reason, such as an improvement in sustainability (Figure 2)
- **Discussion and shortlisting of top ranked options**: Finally, participants discussed the ranking of options that emerged from the matrix ranking exercise, to short-list a smaller number of options that could be implemented in trials. In most cases this was a simple

arithmetic ranking, based on the number of sticky dots allocated to each SICS across all criteria. In some cases, a large number of SICS received similar scores, and so the reasons why stakeholders preferred one SICS over another, based on the criteria against which each SICS had been prioritized, was used to facilitate discussion to help choose the most important SICS for field trial. The goal was to shortlist 2 or 3 options. There was flexibility in the number that could be short-listed, based on the level of resources required to trial different SICS.

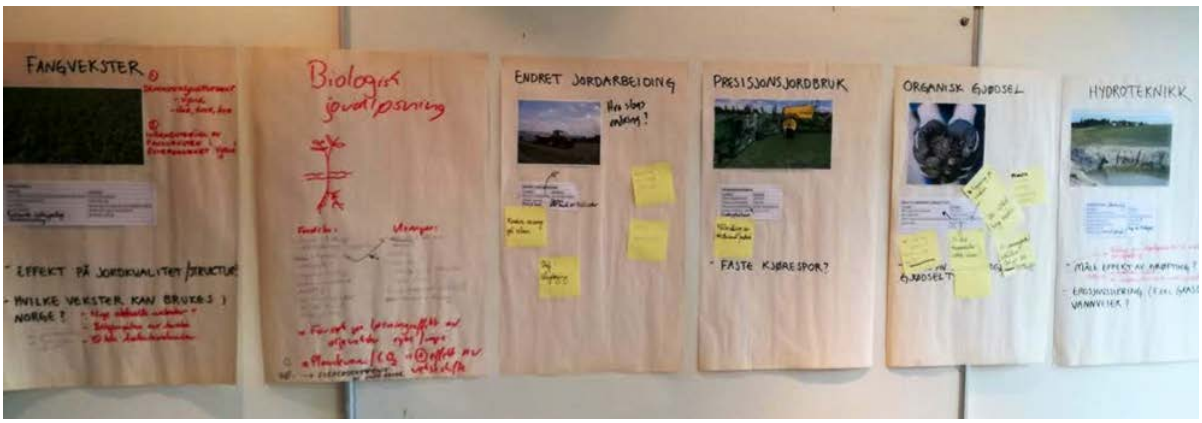

Figure 1: Overview of cropping system options in Norway

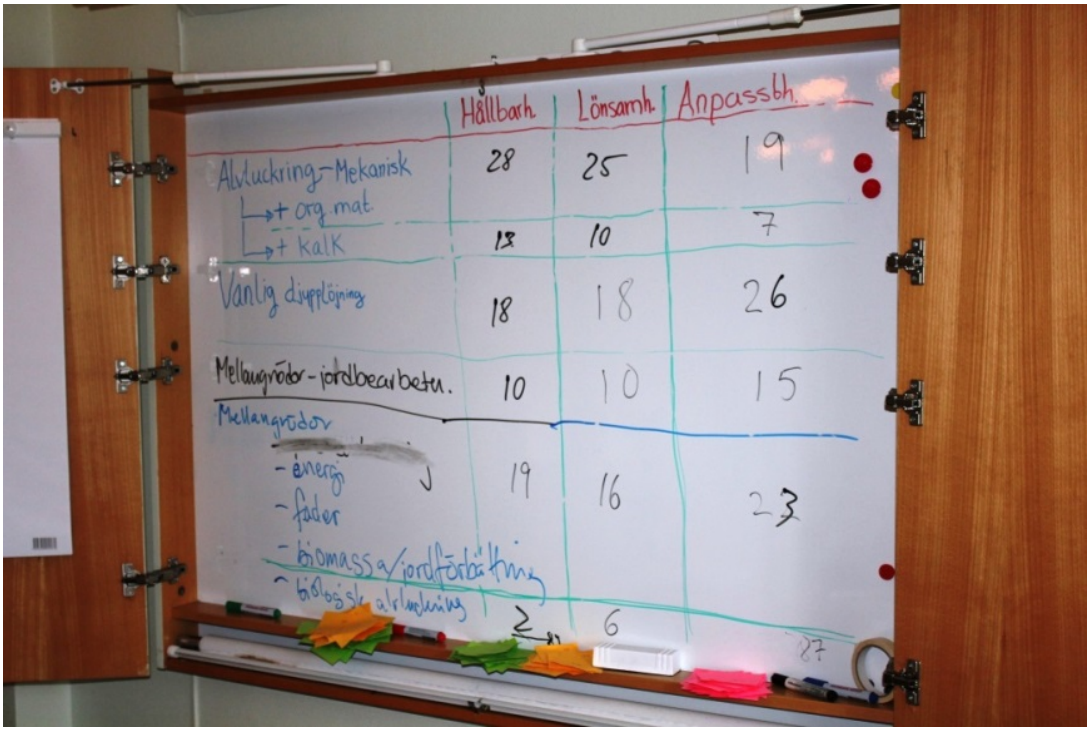

Figure 2: Counts of sticky dots allocated to each of six cropping system options, based on three criteria in Sweden

3. Results

The number of participants in the cropping system selection workshop varied considerably (from 9 in France to 18 in Germany), based on the range of different interests in cropping systems in each study site. These interests and the representation of stakeholders required was assessed via the stakeholder analysis (see Deliverable 3.1 for the range of stakeholders invited to workshops in each study site). The criteria for shortlisting cropping systems for trial varied between sites, to accommodate local stakeholder preferences, but it was made sure that all included criteria linked to the sustainability of the soil and farming system and profitability.

Table 2 shows the soil-improving cropping systems selected for trial in each study site, with comments explaining for example reasons for selection and challenges encountered. These are discussed further in the next section.

Table 2: Selection of soil-improving cropping systems for each study site

Site	Shortlisted soil-improving cropping systems	Comments
Belgium	1. Application of different types of organic fertilizers: wood chips, cut and carry fertilizers, bokashi, compared to compost and solid manure. 2. Maize: undersown with grass, strip-till in existing grassland, ordinary strip till compared to conventional tillage.	Scientific trials (with layout of treatments and replications, execution of measurements and observations)
	3. Precision farming: site-specific application of compost and or wood chips; field scan (pH, OM content) before and after the trial, yield mapping. 4. Controlled traffic: implemented in at least one field, measurements of soil characteristics, crop growth and yield in and outside the roadways. 5. Novel crops: perennial cereals (if seeds are available) and soya, in at least one field, measurement of soil and crop characteristics and yield potential (in comparison with traditional crops).	Demonstration trials (with execution of measurements and observations)
Norway	1. Precision agriculture	
	2. Biological compaction release	
	3. Cover crops	
Hungary	1. Leguminous crops	
	2. Farmyard manure	
	3. Crop rotation	
Switzerland	No single system chosen (see discussion), but likely to be controlled traffic (comparison of a plot where limiting compression by weight is applied, with plot without limiting compression), green manure or the Controlled Uptake Long Term Ammonium Nutrition system	Measures will need to be looked at in suitable combinations and will depend on location of field trials chosen, experimental set up and monitoring
Denmark	1.Ploughing contra no ploughing systems	Less ploughing is also demonstrated in the row cropping experiment at Samsø (with Gunnar Mikkelsen),

		where strips of green manure clover grass is not ploughed
	2.Row (Alley) cropping systems	Tested/demonstrated at the farm of Anders Lund where the cereals are sown in rows, and at Samsø (with Gunnar Mikkelsen), where strips of green manure clover grass is not ploughed. Moreover we have row cropping experiments at the AU Field Station in Foulum.
	3.Crop rotations with and without grass / Clover (with grass varying amounts of grass and other crops); technologies for row/alley cropping "micro-rotations"	
	4.Liming experiments (long term effects of dose)	As at the long term experiments at St. Jyndevad
	5.Long term effects of manure and fertilizer practices	As in the long term experiments at Askov. Moreover the fields with Gunnar Mikkelsen/ Samsø is fertilized with compost recycled from urban areas)
	6. Lap and trial	The whole island of Samsø as a full scale demonstration lap and trial, via scenarios and impacts assessments of possible soilcaring transitions of the farming in the island
UK	1. Amendments	There was very little difference in the scores between ranks 1 and 5. We have already done a lot of research on reduced tillage, and have also done a lot of research on cover crops, the results of which have not yet been disseminated so local farmers do not know about these yet. We also have some new cover crop and reduced tillage research starting under a different project. Given that we want SoilCare to provide additionality to the work we are doing with farmers, rather than just using the funds to pay for work that we are already doing, we have decided to focus on the other three high ranking issues - amendments, compaction and grass leys as these all represent new research topics for us, and each incorporates innovative practices.
	2. Compaction	
	3. Grass leys	
Germany	1. Cover crops	The group showed a clear preference for the first two options, but were undecided on the ranking of the third and fourth options. These final two options will be further discussed by the multi-stakeholder advisory panel and field
	2. Conservation tillage	
	3. Either undersown cover crops or Glyphosate-free conservation agriculture	

		trial farmers to reach a decision later in the year
Romania	1. Narrow rotation + legumes; balanced mineral fertilization; sprinkler irrigation; deep ploughing; weeds and pests control	These were based on four critieria, which were weighted in order of stakeholder priority: farm profitability (weighted 0.5), soil suitability to SICS (0.2), contrinbution to soil quality (0.2) and contribution to crop production (0.1)
	2. Narrow rotation + legumes; balanced mineral fertilization; amendments; minimum tillage; weeds and pests control	
	3. Narrow rotation + root crops; balanced mineral fertilization; sprinkler irrigation; deep ploughing; weeds and pests control	
	4. Narrow rotation + root crops; balanced mineral fertilization; organic fertilization; deep ploughing; weeds and pests control	
Italy	1. Crop rotation	Improves crop productivity, soil biodiversity and system sustainability; decreases need for pesticides and risk of erosion
	2. Green manures, cover crops, catch crops	Improves SOM content, soil structure, soil biodiversity, nutrient use efficiency; decreases nutrient leaching, run-off, erosion
	3. Integrated nutrient management	Improves crop productivity, soil nutrient status and resource use efficiency
Poland	1. Soil improving crops: cover crops - legumes: lupines + serradella + phacelia (130+30+4 kg/ha) 2. Amendments: A: Manure 30 t/ha, oat, wheat, triticale 3. Amendments: B: Liming CaCO3 5.6 t/ha S/R, oat, wheat, triticale.	These options were proposed by the research team. Although stakeholders added other options, they did not rank their own suggestions high enough for them to be shortlisted.
Portugal	1. New rotation systems - Rice/lucerne 4 year rotation - Maize rotation with 3 crop types over 4 years	Comparison of soil behaviour in established rice/lucerne rotation with conventional monoculture paddy nearby. Project will monitor soil quality over 3 rotations and compare with conventional mono culture maize
	2. Organic fertilization using urban sludge	
	3. Reduced soil mobilization (vertical tillage, multi-task planting, controlled traffic)	
Greece	1. Terracing	Benefits: soil stabilization, better water/nutrient retention, easier access
	2. Contour ridging	Soil stabilization, better water/nutrient retention
	3. No tillage or minimum tillage	Excellent erosion control depending on soil type. Soil moisture conservation. Reduced fuel costs associated with tillage. Builds soil structure
Sweden	1.Sub-soil loosening plus straw incorporation compared to loosening with liming	There was significantly more interest in sub-soil loosening, so cover crops

	2. Introduction of cover crops (such as bluebell (Sw. honungsört = *Phacelia* spp.), melilot (*Melilotus officinalis* = Sw. sötväppling) or a mixture of cover crop species)	will only be pursued if there are resources available
Spain	1. Cover crops	
	2. Increasing organic matter by chopping pruning wood	
	3. Implementation of deficit irrigation strategies on stone fruit trees and olive	
France	1. Grassland management including: aération, Vibrosem or grassland fissuring and grass seed mixtures	Grassland is seen as the basis to improve / maintain soil fertility in rotations
	2. Reduced cultivation	To understand better the impact of several cultivation tools (mechanical weeding tools more particularly) on soil quality, fertility, as water flows, microorganisms, texture and structure
	3.Nitrate-trap crops - Early crops sowing, in order to generate a bigger tillering and to profit of a maximum of nitrogen, with frost-susceptible cover crops (e.g. buckwheat, Egyptian clover) to limit weeds and diseases - Cover-crop sowed under rapeseed	Improving Nitrogen availability and use, and nitrate leaching limitation
Czech Republic	1. Application of limy materials	Increasing of soil buffering capacity (experimental results of long-term experiments)
	2. Applications of manures, composts, crop residues, and the other sources of organic matter	Increasing of acid-neutralizing capacity of the soil and improving of SOM content (long-term field experiments with application of different kind and application doses of organic fertilisers)
	3. Reduced/non-reduced soil cultivation	Study of impacts of different cultivation technologies (with/without ploughing, minimum tillage) on soil quality, fertility, as water flows, microorganisms, texture and structure

4. Discussion and conclusion

Study site teams reported strong participation from all stakeholders in workshops, facilitated by the structured activities. Although more confident participants spoke more during some of the discussion exercises, the design of the workshops enabled every participant to have a voice and be equally represented in the final choice of cropping systems. Examples of quotes from workshop participants include:

> *"Farming systems should be evaluated considering the entire rotation and long-term effects on soil fertility, not only yield and economic benefit."*
>
> (German stakeholder)

> *"A good quality soil doesn't mean a productive soil or a soil that provides good incomes for farmers. We have to separate those aspects."*
>
> (French stakeholder)

A number of challenges were encountered during the selection of cropping systems. For example:

- In Switzerland, it was not possible to reach consensus on a short-list of cropping systems to trial, because the location of the field trial and the interests of the farmer(s) volunteering their land were not yet known. In this case, based on detailed discussion recorded during the workshop, bi-lateral discussions will take place with farmers willing to volunteer land for trials to trial options that workshop participants agreed had significant potential
- In Germany, participants showed a clear preference for two options, but were undecided on the ranking of two others. These final two options will be further discussed by the multi-stakeholder advisory panel and field trial farmers to reach a decision later in the year
- In Greece, there were tensions between the long-term nature of field trials proposed by the project and the shorter-term goals of farming stakeholders. As a result, the SICS selected for this site were all designed to provide initial benefits the following season. Despite keeping workshops to under half a day, this was too long for some participants, and future workshops will be planned accordingly
- In France, farming stakeholders were split between arable and livestock producers, with interest from livestock farmers in trialling additional options. Given the focus of SoilCare on cropping systems, discussions are ongoing about whether or not it is possible to expand the remit of the work in France to meet the needs and interests of these stakeholders

Despite challenges such as these, all study sites successfully evaluated a range of soil-improving cropping systems, and reached a short-list of interventions for field trials. The decision-making process was designed and facilitated to ensure transparent and fair access to all interested stakeholders, ensuring strong support for and interest in the SICS that are to be trialed in the project.

Appendix 1: Agenda for workshop 1 (first multi-stakeholder panel meeting)

09.45 Tea/coffee

10.00 Introduction

- Introduction
- Introductory presentation
- Discussion

11.00 Identifying goals and cropping systems

- Optional: Problem tree analysis
- Identifying soil-improving cropping systems: discussion and metaplan

11.45 Discussion

- Small group work to discuss the benefits and drawbacks of clusters of cropping systems (these discussions will be sent to WP2 for further analysis)
- Consider other goals for your work together on SoilCare (e.g. including solutions that emerged from the problem tree analysis if you did this): would the group like this project to consider any of these? Where this is clearly out of scope and not possible, are there ways that the research team might be able to help them self-organise or fund their own ideas? Where the ideas may be feasible to include in the research, consider these and let them know what you can do at the next meeting

12.45 Next steps

- Next workshop
- Constituting the stakeholder panel

13.00 Close

Appendix 2: Agenda for workshop 3 (selection of soil-improving cropping systems for trial)

09.45 Tea/coffee

10.00 Introduction

10.15 Structured discussion of trial options

11.00 Break

11.30 Ranking of trial options

12.15 Discussion and shortlisting of top ranked options

13.00 Exit questionnaire and lunch