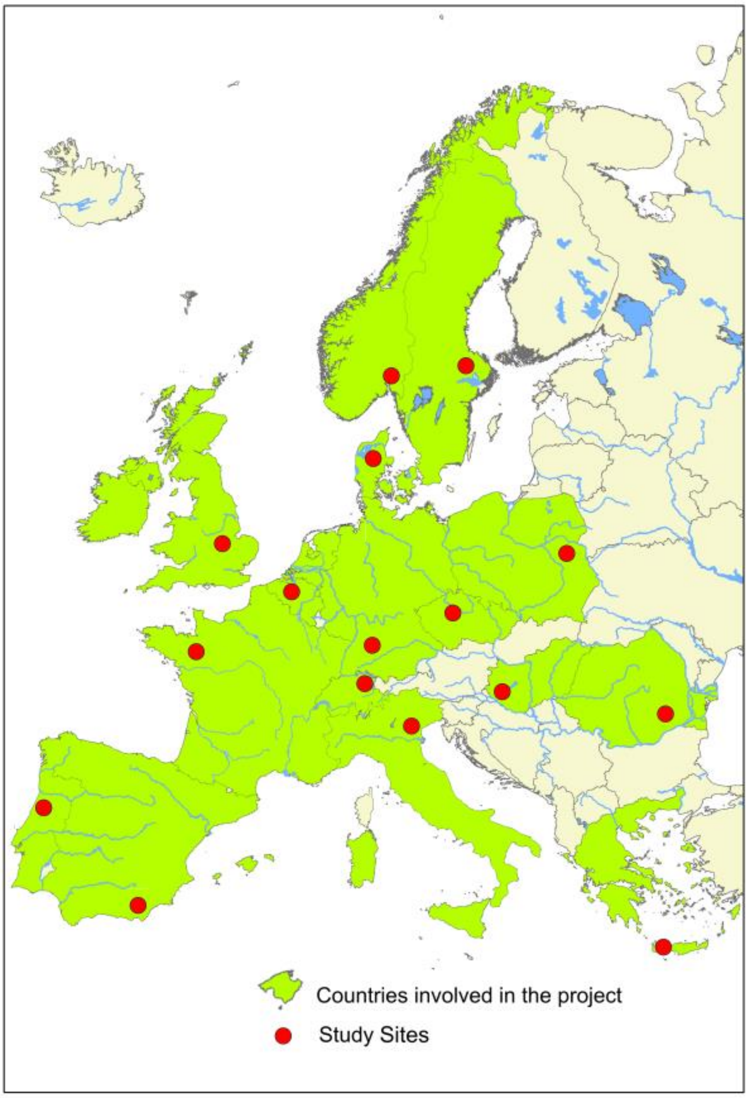
Soil Care for profitable and sustainable crop production in Europe

SOILCARE



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Name of coordinating person: Dr. R. Hessel

List of participants

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4	University of Gloucestershire (UoG)	University	UK
5	University Hohenheim (UH)	University	DE
6	Research Institute for Knowledge Systems (RIKS)	SME	NL
7	Technical University of Crete (TUC)	University	GR
8	Joint Research Centre (JRC)	Research Institute	IT
9	University of Bern (UNIBE)	University	CH
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11	Bioforsk (Bioforsk)	Research Institute	NO
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1. Excellence

1.1 Objectives

European crop production is facing the challenge to remain competitive, while at the same time reducing negative environmental impacts. Currently, production levels in some cropping systems are maintained by increased input (e.g. nutrients and pesticides) and technology, which masks losses in productivity due to reduced soil quality (Reeves 1997; Jones et al. 2012). Such increased use of agricultural inputs may reduce profitability due to their costs, while also negatively affecting the environment, both due to unsustainable use of energy and resources in producing inputs (Rockström et al., 2009) and as a consequence of their application. The quality of agricultural land is also threatened by human action, leading to, often subtle and gradual, physical, chemical and biological degradation of the soil (Attard et al. 2011; Cassman 1999; Gasso et al 2013; Sapkota et al. 2012). This includes soil threats such as erosion, compaction, salinization, soil pollution, loss of organic matter and loss of soil biodiversity. Soil improvement is necessary to break the negative spiral of degradation, increased inputs, increased costs and damage to the environment (Sørensen et al. 2014).

The choice of **cropping systems** and agronomic techniques is influenced by external factors such as pedo-climatic conditions, market and policies, and has important consequences as it influences soil quality and environment. The term cropping system (CS)[1] refers to crop type, crop rotation, and the agronomic management techniques used on a particular field over a period of years (Nafziger, 2012). Such systems **can be considered soil-improving if they result in a durable increased ability of the soil to fulfil its functions**, including food and biomass production, buffering and filtering capacity, and provision of other ecosystem services. In other words, soil improvement is necessary to make farming systems more sustainable. Competitiveness is partly influenced by the choice of cropping system and its management, and partly by factors that farmers in Europe cannot control, such as global markets and policies (Stoate et al. 2009). Different CS require different types and levels of inputs (e.g. Lechenet et al. 2014), which have different costs. In addition, the choice of CS also influences the price of the product, which is for example often higher for organic farming than for conventional farming. For competitiveness, the first and foremost requirement is that revenues are higher than costs, i.e. that crop production is profitable. A key aspect for profitability is production costs, as farmers have more control over this aspect than over e.g. price they get for their products.

Crop choice, crop rotation, tillage practice, irrigation, and nutrient and pest management are all part of the cropping system. Choices made on these factors can **influence profitability as well as sustainability of crop production systems** (Deike et al. 2008; De Vita et al. 2007; Jensen et al. 2012). Maintaining or improving soil quality and soil health is crucial for crop production, and can especially contribute to remediating subtle forms of soil degradation such as gradual loss of organic matter and nutrients. However, in practice, there often is a trade-off between productivity goals and ensuring long-term continuation and provision of ecosystem services (Foley et al. 2011). Attempts have been made in Europe to achieve soil improvement through e.g. precision farming and conservation agriculture (e.g. Anken et al. 2004), but these are not adopted to their full potential, and are in some case even abandoned (Lahmar 2010), e.g. because conservation agriculture may have negative effects on crop yield (Pittelkow et al. 2014). To understand the reasons for this, and to **promote adoption and better soil care,** the full range of soil-improving CS needs to be studied and assessed in terms of advantages, drawbacks and opportunities and barriers for adoption. To do this, a multidisciplinary approach is needed, which includes soil science (physics, chemistry and biology), agronomy, hydrology, ecology, climatology, and economy. Social and political factors such as trust, acceptability and incentives also influence adoption and should therefore not be overlooked (Jensen et al. 2012). These can only be addressed through a **multi-actor approach** in which there is true involvement of actors representing end-users on the consortium and stakeholders in all phases of the project.

The overall aim of SOILCARE is to assess the potential of soil-improving CS and to identify and test site-specific soil-improving CS that have positive impacts on profitability and sustainability in Europe**.**

[1] This definition of cropping systems shows that agronomic techniques are part of the cropping system. Therefore, when the abbreviation 'CS' is used in this proposal it refers to cropping systems including agronomic techniques

To achieve this aim the following specific objectives are distinguished:

- To review which CS can be considered soil-improving, to identify current benefits and drawbacks, and to assess current and potential impact on soil quality and environment,
- To select and trial soil-improving CS in 16 Study Sites across Europe, representing various pedo-climatic zones and socio-economic conditions following a multi-actor approach,
- To develop and apply an integrated and comprehensive **methodology to assess benefits, drawbacks and limitations, profitability and sustainability of soil-improving CS** in the Study Sites, taking into account pedo-climatic, socio-economic and legislative conditions,
- To study barriers for adoption and to analyse how farmers can be encouraged through appropriate incentives to adopt suitable soil-improving CS,
- To develop and apply a method to upscale Study Site results to European level, taking into account different pedo-climatic and socio-economic conditions in different parts of Europe, to come up with Europe-wide information on which soil-improving CS would be most beneficial where in Europe,
- To develop an **interactive tool for selection of soil-improving CS throughout Europe**,
- To analyse the effect of agricultural and environmental policies on adoption of CS, and to support these policies in order to improve adoption,
- To disseminate key-information about soil-improving CS including agronomic techniques to all stakeholders.

For this purpose, a balanced multi-disciplinary EU-wide research consortium was established covering relevant complementary scientific and practice domains and backgrounds, including universities, research institutes, SMEs, farmer federation and industry.

1.2 Relation to the work programme

This proposal addresses SFS-2-2014/215 (Sustainable crop production), and in particular topic B. [2015]: Assessing soil-improving cropping systems. The proposal responds to the specific challenge for sustainable crop production, and the scope of assessing soil-improving cropping systems, as shown in the table below.

Key requirements of the Call	**How SOILCARE addresses key requirements of the Call**
Specific challenge SFS-2	
European crop production is facing more and more difficulties in remaining competitive in the global market for many reasons. Some of these reasons are the loss of soil fertility and the consequent massive use of expensive external nutrient inputs, notably Nitrogen and Phosphorous, for which European agriculture is almost totally dependent on imported products, or on fertilizers produced with expensive industrial processes, which generates greenhouse gases (GHGs).	SOILCARE addresses this by assessing and selecting various soil-improving CS, and by determining the inputs of these systems and assessing the profitability of the systems in different parts of Europe. An assessment of conventional cropping systems versus soil-improving CS will be performed for costs, agronomic aspects and environmental impacts. In this assessment, the need for external inputs is explicitly taken into account.
Therefore, more sustainable crop management strategies are needed to maintain or increase soil fertility. Inappropriate soil and water management and the overuse of external inputs in intensive crop production systems, represent an economic loss for the farmer and a significant burden for the environment and subsequent impact on human health, as they contribute significantly to ground water and surface water pollution, GHGs emissions, the build-up in soil contaminants, such as heavy metals and organic pollutants.	Soil-improving CS address the environmental threats of conventional farming by using more sustainable CS, including management strategies, which have fewer adverse impacts. SOILCARE will assess such strategies, including growth of cover crops, reduced top soil disturbance, rotational and intercropping systems, revitalization of the subsoil, enhanced species diversity, timing of and site-specific nutrient and pesticide application and balanced nutrient withdrawal and replenishment. These strategies support the water, biomass, soil carbon and soil nutrient cycles, minimize soil and water pollution and thus enhance or maintain soil productivity and human health.
Better soil management and optimisation of	SOILCARE focusses on better soil and crop management, but

fertilisers and water are of paramount importance for conciliating the necessary competitiveness and the long-term sustainability of the entire intensive crop production sector in Europe.	as different soil-improving CS have different requirements regarding fertilisers and pesticides, it contributes to optimisation of their application too. By enhancing the provision of soil functions and ecosystem services through more conscious soil and water care, the need for external inputs is reduced while maintaining or increasing crop yields. This reduces costs and improves profitability and long-term sustainability.
Scope SFS-2B	
Proposals should assess real benefits that soil-improving cropping systems and agronomic techniques, e.g. precision farming, crop rotations, Conservation agriculture, can bring to European agriculture, as well as to identify and minimise limitations and drawbacks. Benefits may include a more rational use of natural resources, reduced energy needs, decreased GHG and other toxic gas emissions, soil fertility conservation, above and below ground biodiversity conservation and increased productivity. Limitations and drawbacks may include increased weeds, soil pathogens and problems with certain types of crops in relation to climatic conditions.	SOILCARE uses a large number of Study Sites (16) spread throughout Europe, that cover all main pedo-climatic zones and various CS. Data from these case studies will be supplemented by existing long term experiments to assess both benefits and drawbacks of soil-improving CS, and to assess how drawbacks can be minimised. By assessment of bio-physical (e.g. soil biology, chemistry and physics, environment, climate), socio-economic (e.g. use of resources, energy and machinery) and political issues, and by involving stakeholders, it is ensured that the evaluation methodology encompasses all relevant factors. Monitoring will be used to collect the necessary data for evaluation in all Study Sites, and results will be upscaled to the European scale. Exploratory scenarios will be used, a.o. for impacts that climate change might have.
Scientifically supported and field tested evidences of the mentioned beneficial effects of minimally disturbed soil, and no till or low tillage strategies, as well as of drawbacks and methods to minimise them, are needed to promote the adoption of soil-improving systems and techniques by European farmers.	An extensive monitoring programme will be set up in all Study Sites, to evaluate effects of different techniques, including different tillage strategies. Existing long term trials and data sets of farming systems will supplement the data of these monitoring programmes. Besides an assessment of bio-physical, socio-economic and political aspects, an understanding will be obtained as to how drawbacks can be minimised and the adoption of soil-improving CS enhanced.
Considering the different pedo-climatic conditions and the varieties of cropping systems in Europe, the development of tailor-made soil-improving strategies, techniques and machinery suitable to different farming areas and adapted to different crops and crop systems, should help to overcome the current barriers that prevent their adoption by European farmers.	The Study Sites of SOILCARE are distributed throughout all major pedo-climatic zones in Europe, and cover various CS. This allows the project to develop, with stakeholders, tailor made soil-improving CS for the Study Sites. The Study Sites also form the basis for upscaling of these strategies to European level. Lessons about adoption learned in the Study Sites will also be extrapolated to European scale by looking not only at pedo-climatic zones, but also as socio-economic conditions and geo-political situation.
Proposals should fall under the concept of 'multi-actor approach	Actors from a number of different organisations will contribute to the consortium (there are several SMEs and one large industrial company, as well as researchers and a farmer organisation). They have been active in the proposal development and will be involved in the planning of work and experimentation through to dissemination, demonstration, and possible exploitation of results. They bring a range of complementary knowledge types (e.g. science policy interface, agricultural engineering expertise, media, knowledge exchange, advisory skills) which will enable the projects objectives to be met. They will be assigned appropriate roles (eg WP leader and Study Site participant). In addition a range of stakeholders will take part in the project activities throughout the project to ensure that strategies that are developed are really suitable for their specific situation. All

	relevant types of stakeholders will be included, such as farmers, farmer organisations, agricultural extension services, NGOs, inhabitants, traders of fertilizer, manures, pesticides, and agricultural machinery, manufacturers, environmentalists and multi-level policy makers. A specific work package will guide the process of working with stakeholder groups.

1.3 Concept and approach

1.3.1 Overall concept

The basic concept of SOILCARE is that profitability and sustainability of crop production in Europe should be combined and enhanced. Both are influenced by choices made in farm management, which are in turn influenced by external drivers and factors (Fig. 1.1). External drivers and factors include, EU policies, supply chain and market effects (suppliers, industry, processing, retail and consumers), macro-economic conditions, society (public opinion), and pedo-climatic conditions. These external drivers and factors are dynamic and change due to socio-economic developments, geo-politics and climate change. As the focus of SOILCARE is on cropping systems, grazing systems and other farm enterprises are not considered in Figure 1.1.

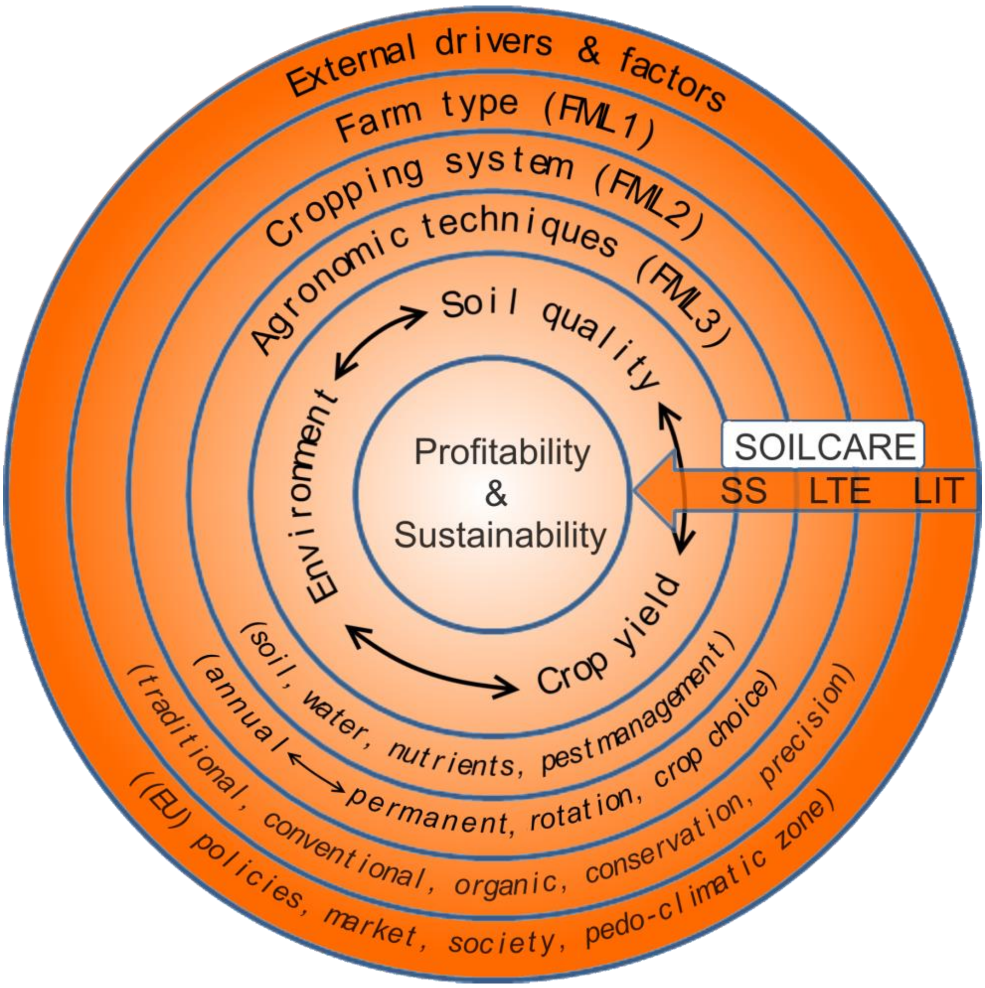


Figure 1.1. Influence of farm management level (FML) on soil quality, environment, crop yield, profitability and sustainability. LIT refers to literature and other published data, LTE to long term experiments, and SS to work in the Study Sites.

At the highest Farm Management Level (FML1) a choice is made between different types of farming; cropping systems are decided on at FML2, while choices regarding the agronomic techniques that are used for management of soil, water, nutrients and pests are made at FML3. In SOILCARE traditional, conventional, precision, conservation and organic farming systems are considered at FML1. Which farm type is chosen depends on the external factors, but also on the farm's internal decision environment, such as education, age and preferences of the farmer, ownership, and resources. Choices made at this level influence FML2 and FML3 too. For example, a choice for organic farming is made at FML1, and implies crop rotation at FML2 and biological pest management at FML3. Choices made at all 3 FMLs have an impact on soil quality, on the environment (GHG emission, water quality, and occurrence of soil threats such as contamination and erosion) and on crop yield. Through crop yield, they also influence farm economy as different choices have different costs and different revenues. Soil quality, environment and crop yield also influence each other. For example, the occurrence of a soil threat like erosion influences soil quality as well as crop yield. Crop yield can also influence soil quality, for example through nutrient mining. When impacts on soil quality and environment are positive, and the balance between production costs and revenues is also positive, the dual targets of farm profitability and environmental sustainability are reached.

1.3.2 Positioning

On the range 'lab to market', SOILCARE is mainly positioned in Technology Readiness Levels (TRL) 1-4. Industries and SMEs are involved in the project to assess for example which machinery, soil and crop sensors and analysis techniques are needed to implement the different soil-improving cropping systems, what fertilisation and weed/pest management will be needed (TRL1,2) and which test methods are most appropriate for practical use. This information is relevant for the project, but will also help companies to adapt existing products, or develop new ones (TRL3,4). Kongskilde (partner 24) will work on the development, testing and demonstration of an intelligent mouldboard plough and a power harrow to minimise fuel use and negative effects on soil structure (TRL5-7), and would mature and market both types of equipment (TRL8,9). SoilCares Research (partner 16) will develop a method to quantify soil biodiversity, which is planned to be marketed (TRL3-8). By its design, the range 'idea to application' is the focus of the SOILCARE project, as the project is mainly working on non-marketable goods and services like the development of soil-improving CS. Within this range, SOILCARE includes application for testing (TRL7), but cannot apply cropping systems at large scale. Nevertheless, the project results are expected to stimulate adoption within the Study Sites and beyond (TRL9).

1.3.3 Links

SOILCARE will build on completed projects, and will collaborate with on-going ones. Of special relevance in this regard will be the projects that have been funded as a result of the H2020 SFS4 and SFS2A calls. SOILCARE plans to collaborate closely with these projects in relation to: 1) Methodologies that can be used to assess soil quality (SFS4), potentially including testing and use of the soil quality app developed in iSQAPER, 2) External nutrient input necessary for the different soil-improving CS (SFS2A), and 3) Policies in relation to soil functions (SFS4) as studied by LANDMARK. Such collaboration has already been assured for the SFS4 funded projects iSQAPER and LANDMARK, as the institutes coordinating these projects are both included in the SOILCARE consortium. SOILCARE will also make full use of other project results and networks, such as from DESIRE, Legume Futures, PURE, RECARE, CASCADE, Catch-C, CANtoGether, Fertiplus, Ramsoil, EcoFINDERS, ENVASSO, NWRM, OSCAR, SmartSOIL, SOILSERVICE, SoilTrEC, Valerie, GSBI, GYGA, and GSP. Furthermore, SOILCARE specifically includes companies (Kongskilde, several SMEs) as partners, and will involve farmers and farmer organisations, and industry (e.g. producers of fertiliser, pesticides, biocontrol agents) to ensure that recent developments in the agricultural sector are also taken into account.

In line with the aspirations of the European Innovation Partnership (EIP) AGRI, SOILCARE aims to bridge science and practice by fostering experimentation with, and uptake of, innovative soil improving solutions. It follows an interactive innovation model, drawing on the expertise of researchers and end users in a multi actor approach. In this respect the project will develop links with the AGRISPIN and VALERIE projects which are enabling innovation and science-practice links.

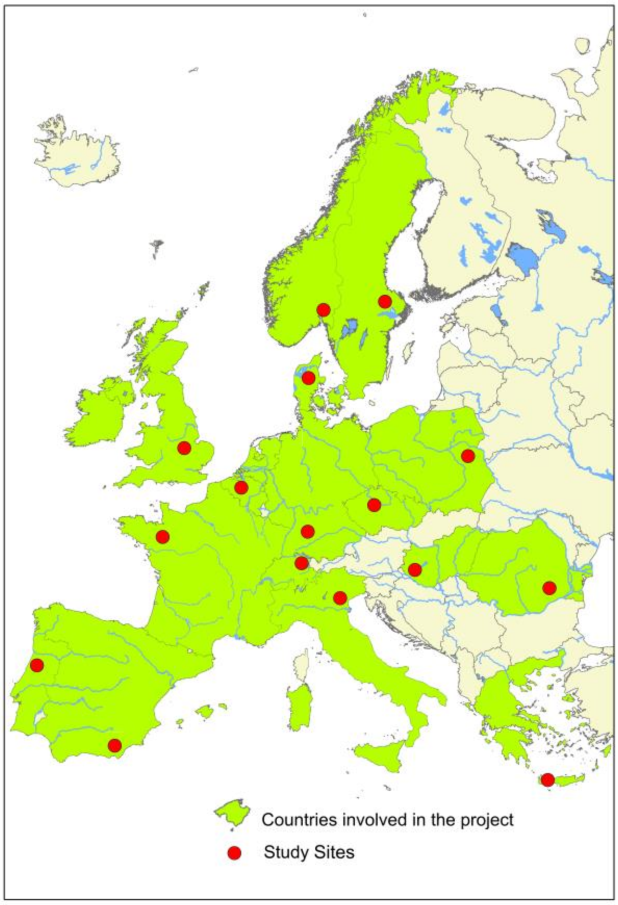


Figure 1.2. The 16 SOILCARE Study Sites

1.3.4 Overall approach

Within SOILCARE, the aim is to identify, select and assess different soil-improving CS in Europe to determine their effects on soil quality, environment, crop yield, profitability and sustainability using a range of advanced methodologies and assessment procedures, core elements being a soil quality evaluation and analysis at the farm level (costs and benefits) and surrounding environments (ecosystem services). This is done by an in-depth analysis of the benefits and drawbacks of soil-improving cropping systems as reported in literature and other published sources, through investigating data from existing **long term experiments** (LTE), and through **16 Study Sites located in different parts of Europe** (Figure 1.2), **covering different pedo-climatic, socio-economic and political conditions**. As can be seen in Figure 1.1, literature and other published data (including on policies) are mainly used to assess external drivers and factors, while LTE are mainly used to investigate the effects of decisions taken at FML1 and FML2, as such strategic choices are made infrequently in farming systems, and as effects of such changes may only become apparent in the long term. Nevertheless, literature as well as LTE will also provide information on other levels of Figure 1. The focus of the Study Sites is more on FML3, since soil, water, nutrient and pest management can be adapted in the course of the year, and as these choices generally have more immediate effects than choices made at FML1 and FML2. Hence, the combination of literature and other published information, together with LTE and Study Site data, covers all factors that determine profitability and sustainability of soil-improving CS and related agronomic techniques. Within the Study Sites, different soil-improving CS will be selected, tested and evaluated in collaboration with stakeholders, after which Study Site results will be upscaled to European level. Three scales are covered by the SOILCARE approach: **farm scale, Study Site scale, and European scale.** Table 1.1 gives an overview of the Study Sites and a more extensive description is included in Annex 1. The basic assumption behind this approach is that different conditions require the use of different CS, and that the applicability, profitability and environmental impacts of the different systems and techniques will therefore vary across Europe.

Table 1.1. Overview of SOILCARE Study Sites

Study Site	Type of crop	Intensity cropping *	Soil improving cropping systems and techniques currently used	Pedo-climatic zone[&]	Problem that causes yield loss or increased cost	Availability of long-term data
1. Flanders, BE	Food crops (winter wheat, sugar beet, potato), vegetables, forage, orchards	C, CO, O	Minimised input & tillage, rotation, cover crops, organic amendments	Atlantic Central, soil depends on site	N and P leaching, erosion, compaction, SOC[#]	From 1997: 14 compost treatments, 2002: Reduced tillage
2. Akershus, NO	Cereals	T, CO	Reduced tillage, sludge & biochar, increase C, precision fertilization	Nemoral/Boreal, marine clay soils	Erosion, nutrient loss, pests, disease, SOC, compaction	1991: tillage methods, 1977: Reduced tillage
3. Keszthely, HU	Annual: cereals, maize	C, CO	Rotations, intercropping, green-manure, mulching, minimum tillage	Pannonian, brown forest soils	Soil compaction, humus degradation, nitrate leaching, acidity, weeds	1964, 1969, 1972, 1984: 2 factorial field experiments
4. Frauenfeld, CH	Grass, cereals, maize, rape, potato, sugar beet, vegetables	C, CO	Mouldboard ploughing, no-tillage, burial crop residues, large tyres	Continental/Alpine South, Fluvisol	Soil structure, subsoil compaction, pounding risk	Mechanization level : 12 years; fuel consumption: 3 years
5. Viborg, DK	Winter cereals (wheat, 25%) and forage crops	C, O, P	Fertilizer norms, rotations, minimum tillage, incorporation straw, cover crops	Atlantic North, sandy-loamy soils.	SOC, Compaction, erosion, nutrient losses (N and P)	Askov: Rotation, fertilisation, > 120 years St. Jyndevad (1942): 16 combis of lime, P
6. Loddington, GB	Cereals, oilseeds, pulses, grass/clover leys	CO, P	Rotation, minimum tillage, cover crops, bio-compost, residues returned.	Atlantic Central/ North, clay soils	Compaction, SOC	20 years soil nutrient status. Access to Rothamsted data (since 1843)
7. Tachenhausen, DE	Maize, wheat, barley, rape, soya	C	No tillage, cover crops, measure to increase C in soils	Atlantic Central, karst, silty loam	Soil structure, compaction, reduced infiltration	Crop management, organic agriculture, soil tillage, soil cover
8. Draganesti Vlasca, RO	Annual food crops – cereals, sunflower	C, CO	Rotation, minimised tillage	Panonnian, Phaeozem	Soil compaction	10 years: different tillage systems
9. Legnaro, IT	Annual crops (maize, wheat, sugar beet, soybean, alfalfa)	C	Rotation, organic fertilisers (different types and amounts)	Mediterranean North, Cambisol	SOC, compaction, climate variations	96 different combinations of rotation,fertilisation (1962).
10. Szaniawy, PL	Barley, rye, wheat, oats, potatoes, maize, grassland.	T, C	Minimised input agricultural chemicals, legume crops, lime	Continental, Sandy, loamy soils	Water deficit, SOC, acidity, compaction, weeds.	Crop yield, soil water and soil temperature since 2001
11. Caldeirão, PT	Cereals (maize and rice), vineyards	C, O	Rotation, optimisation of irrigation	Lusitanean, silty-clayey soils	Water availability	Surveys since early 1990's
12. Chania, Crete, GR	Permanent: olive, citrus vineyards	T, C	Minimum input & tillage, manuring, precision irrigation, green strips	Mediterranean South, Calcisol	Erosion, compaction, water availability	Inputs, costs and yield for over 10 years in various fields

Study Site	Type of crop	Intensity cropping *	Soil improving cropping systems and techniques currently used	Pedo-climatic zone&	Problem that causes yield loss or increased cost	Availability of long-term data
13. Orup, SE	Annual crops: winter wheat, spring barley, spring oilseed rape, peas	C	Loosening of upper subsoil and incorporation of organic material and lime	Nemoral, sandy loams	Compaction	Lanna: Yield data from 1982, 6 treatments Orup: Yields since 1957,32 treatments
14. Prague-Ruzyně, CZ	Barley, rye, wheat, oats, potatoes, maize, grassland	C, T, O	Minimum tillage, rotation, soil improving crops, erosion measures	Continental, Luvisol	Erosion, compaction, SOC, acidification, reduced water retention	Fertilisation (since 1956; 1056 plots), rotations (since 1971), tillage (since 1988)
15. Almeria, ES	Olive, grape, subtropical fruit crops, stone fruits	T, O	No-tillage, minimised tillage Cover crops	Mediterranean South, Regosol, Leptosol	Erosion, salinization	Literature data for olives
16. Brittany, FR	Wheat, maize, grassland	O	Biological pest management, green manure, organic fertilisers	Lusitanian/ Atlantic Central, Cambisol	Compaction, weeds	Management and yield data

#:SOC= Soil Organic Carbon decline; * C=Conventional, T=traditional, O=organic, CO=conservation, P=precision; & Climatic zones based on Metzger et al (2005)

Table 1.2. Summary of multi-actor and stakeholder involvement activities in SOILCARE (SH = stakeholder; SSR = Study Site Researchers)

Activity (months)	Partners	Actors	Aims	Outputs
Consortium building	All	Universities, Research Institutes, SMEs, Industry, Agricultural Federation	• Create a diverse consortium with multiple actors • Link with other actors through network consortium • Scientific innovation and technology innovation	• Multi-actor consortium • Links with other actors
Initiation of SH involvement (1-6)	WP3[a], SSR	Land users, advisory services, civil society organisations (CSO), local authorities, developers, private sector, policy makers	• SOILCARE information event in all Study Sites • Motivate SHs to participate in SOILCARE (through personal contacts, opening event and / or project information sheets)	• Project awareness among SHs • List of relevant SHs, their roles and responsibilities concerning soil threats and sustainable land management
SH analysis, initiation of **SH platforms** (3-9)	WPs 3, 7, 8, SSR	Land user associations, private sector, CSOs, local – subnational – national and EU administration	• Assess formal and informal land use arrangements, institutional practices and existing incentives • Identify key SHs and institutions for involvement	• Analysis of land use arrangements • Contact information of key SHs for involvement throughout SOILCARE

Activity (months)	Partners	Actors	Aims	Outputs
SH Workshop 1 (9-16)	WPs 3, 6, 7, 8, SSR	Land users, CSOs, advisory services, local authorities, developers, private sector, government representatives and policy makers	• Initiate a mutual learning process by jointly reflecting on soil problems and solutions • Strengthen trust and collaboration among SHs • Identify current and new CS • Discuss bottlenecks and opportunities to facilitate adoption of measures • Select CS, techniques for testing/implementation	• Identified causes and impacts of soil threats for SHs. • Local indicators for degradation • Current and potential prevention and mitigation measures • Bottlenecks and opportunities to facilitate adoption of measures
Stakeholder interviews	WP3, SSR	Land users, land owners	• Investigate social factor relevant for adoption	• Insight in social factors influencing adoption
Development of methodology	WP4, SSR	Land users, CSOs, advisory services, local authorities, developers, private sector, government and policy makers	• Develop an assessment methodology that is supported by SHs	• Methodology and monitoring plan
Monitoring and evaluation of CS (12-20)	WPs 5, 4, SSR	Land users, land owners, developers, private sector	Monitor and evaluate existing and potential CS (as identified in SH workshop 1), using methodology from WP4	Information on impacts, benefits, disadvantages, sustainability and profitability CS
Demonstration	WPs 5, 3, 8	Land users, land owners, developers, industry	• Show CS to various SHs • Demonstrate new technologies	Feedback from SHs, to be used as input for innovation and dissemination
Workshops at EU level (4 workshops)	WP6, 3, 7	EU institutions, advisory services, private sector, NGOs.	• Develop and refine model in iterative way • Develop scenarios to improve the understanding of future uncertainties • Define and assess impact of (combinations of) policy options	• Model enhanced and supported by policy makers • Scenarios with qualitative and quantitative components • Understand impact of policy options under different scenarios
SH Workshop 2 (36**)**	WP7, SSR	National, sub-national, local authorities, private sector	• Discuss measures and incentives • Scenario development & refinement	• Scoring of preferences of SH • Stakeholder-support scenarios
SH Workshop 3 (56)	WPs 3, 5-8, SSR	As in workshop 1	• Present and discuss project results • Present policy messages • Present and discuss dissemination plans	• SH-validated results • Input for policy messages • Input for dissemination plans
Final EU level workshop (58)	WPs 8, 7	EU and national policy makers, international bodies (FAO, UNCCD), interest groups, CSOs	• Present results from SOILCARE • Develop and validate policy recommendations (at EU and national level)	Refined and validated policy recommendations

[a] WPs are described in section 3.1

The adoption of soil improving techniques can only be increased if these differences between different parts of Europe are considered, and if views and perceptions of stakeholders are taken into account through a multi-actor approach. Table 1.2 summarises the multi-actor approach that is taken in SOILCARE. Furthermore, SOILCARE participants have already informed and mobilized stakeholders at the Study Site level and the respective national and international level, to ensure full commitment and support of related communities, organizations, institutions, authorities, and policy makers during the course of the proposed initiative. SOILCARE has to date received 18 letters of support for the project; these letters can be found in Annex 2.

1.3.5 Gender

In putting together the SOILCARE consortium, a gender-sensitive approach was followed. Among the WPs, 3 out of 8 will be led by female researchers, and the teams of several other participating institutes are also led by female scientists. SOILCARE will analyse the gender aspects with regard to the organizational structure of the envisioned project as well as project contextual issues, e.g. in relation to soil-improving CS, and the adoption of these.

Traditionally, men and women have held clearly different roles in agricultural production. In most parts of Europe, the task division between men and women appears to become less stringent over the years. However, there are differences in this regard between farms of different size, and between different parts of Europe. For SOILCARE we need to know if the changes in management that are foreseen would have an impact on the actual role of the farmer men and women, and if so, how they could be prepared for these changing roles. We can compare the situation in the different study sites and countries involved in SOILCARE. This especially will lead to improvement of the scientific knowledge and societal relevance of the produced knowledge, technology and/or innovation, as stated in the gender equality objectives in Horizon 2020. Therefore gender aspects will be included in SOILCARE. For example, in the participatory work it will be ensured that the voices of both men and women will be heard, and if necessary, a gender-sensitive approach will also be taken in dissemination, and to promote adoption. Intrinsic male and female related aspects, perceptions and views will be considered.

With regard to the project consortium, gender equality across participating staff, including PhD students and post-docs, will be monitored and stimulated in three subsequent steps:

1. *Inventory partners and stakeholders;* The first step will be an inventory of gender equality among the project partner teams and the study site stakeholders. It will be about organizational aspects like the numbers of women and men involved in the project, how they are involved and what work life balance arrangements exist. The Case Studies will take care of a gender friendly communication among stakeholders and researchers, and gather the gender disaggregated data of the stakeholder men and women on their positions, roles, ownership and opinions on the soil improving techniques and the chances they foresee with the changes. This information will be asked to the partners through a questionnaire and it will be asked to case study site leaders who will be supplied with evaluation questionnaires to be filled by the stakeholders at the study site meetings or workshops.
2. *Deploying gender equality activities and tools;* The second step is about the implementation of gender equality activities across the project partner teams as well as relevant stakeholders within each of the Study Sites. The activities include gender training on economic empowerment, and the development of tools and locally adapted gender friendly communication materials.
3. *Monitoring and evaluating gender equality;* The third step deals with measuring the influence of female land users compared with male in selecting and prioritizing soil-improving cropping systems and agronomic techniques and how and why views and perceptions might differ between male and female land users. A dedicated questionnaire will be developed and used in each of the Study Sites.

The output of the gender equality analysis will be released in phases during the course of the project and will consist of three reports presenting methodologies applied, data gathered, analysis and results, and recommendations, all directed to enhance gender equality both within the SOILCARE consortium as a whole as well as in relation to specific tasks within each of the Study Sites.

1.4 Ambition

1.4.1 Beyond state-of-the-art

Crop production in Europe is facing several challenges, one of which is to remain competitive. Average wheat yields in several EU countries are significantly less than what is locally attainable (Van Ittersum et al. 2013; Boogaard et al. 2013), likely due to suboptimal management and/or impairment of soil quality. It has been suggested that subtle forms of soil degradation are looming (Cassman 1999), due to for example the use of heavy machinery (leading to soil compaction and impaired root growth; Nosalewicz and Lipiec 2014), increased soil cultivation and climate change (leading to soil organic matter decline; Bellamy et al. 2005), and narrow rotations (leading to biodiversity decline and increased incidence of soil-borne diseases; Schneider et al. 2014). These forms of soil degradation are too often neglected, due to low awareness, low visibility during initial stages of degradation, and lack of appropriate tools, benchmark values and policies. Soil-improving cropping systems can remediate such subtle forms of soil degradation, and thereby increase crop productivity and resource use efficiency, and decrease soil, water and air pollution. SOILCARE will test advanced soil analytical tools and techniques and will develop benchmark values to allow a better assessment and implementation of soil-improving CS in practice. For example, modern methods in soil ecology to study abundance, diversity and function of soil microbial communities will be used to determine important ecosystem services (e.g. mineralization potential of soils, resilience and resistance against disturbance, degradation of pesticides) and biological soil health. Biological soil health is, on the one hand influenced by the choice of CS, and on the other hand influences occurrence of plant diseases, crop yield and crop quality. Hence, these data on soil ecology can be used to optimize CS.

Attention on soil quality and soil health is increasing, as it is being recognised that soil quality also impacts the functions that the soil can perform, and the ecosystem services it can provide. Improved soil quality might also enable CS to better cope with climate change and increased climate variability. In the USA, soil health has become a key topic in agriculture. For example, various cropping systems, including no tillage, cover crops, and organic farming have been studied since at least the early 1990's (Teasdale et al. 2007). Karlen et al. (1997) defined the concept of soil quality, Cassman (1999) looked at ecological intensification of cereal production, and Liebman & Davis (2000) studied low-external-input farming systems. Recently, several studies compared yields of conventional agriculture with other systems, such as organic farming (Seufert et al. 2012) and conservation agriculture (Pittelkow et al. 2014). Finally, more than 40 US National Organisations delivered a joint vision statement on cover crops and soil health (SSSA, 2014). In Europe, various recent projects have worked, or are working on, soil threats, prevention of soil degradation, Sustainable Land Management (SLM) and soil quality. SOILCARE will build further on results of e.g. ENVASSO, OSCAR, SmartSOIL, Biodiversity-Expoloratories, DESIRE, DESURVEY, Catch-C, SOILSERVICE, SoilTrEC, RECARE, LANDMARK and iSQAPER by adding a focus on agronomic practices, which have only been considered as one aspect to be considered in SLM in these previous projects, alongside vegetative, management and structural measures (WOCAT 2008). In Europe, there is now also increasing attention on e.g. nature-based solutions, ecology-intensive agriculture and Green Infrastructure (EC 2013). It is increasingly being recognised that flexibility, multi-functionality and a landscape perspective are needed for sustainability of agro-ecosystems and agricultural landscapes, and that production should be enhanced without compromising the environment (Tittonell 2014). Such multi-functionality requires a transdisciplinary approach involving multi-actors and stakeholders, and to make such multi-functionality work more sustainable CS are needed.

In Europe, more sustainable farming systems such as organic farming have taken a foothold. Bioland, an association for organic farmers in Germany, for example, has more than 5800 members (Bioland, 2014). However, for the most part business in Europe has continued as usual. Lack of widespread adoption of more sustainable farming systems so far might be due to perceived drawbacks such as lower yields, increased need for pesticides and herbicides in minimum-tillage systems, and the occurrence of pests and diseases. Lahmar (2010) reported that in some parts of Europe conservation agriculture was abandoned due to problems with weed and residue management. Also, cultural and political issues should not be overlooked (Stoate et al. 2009). Cassman (1999) mentioned that barriers to adoption often involve issues around land tenure, access to credit and inputs, and other socio-economic factors, while) lack of knowledge, credible scientific evidence and good quality technical advice are also highlighted (Ingram et al., 2013). The following paragraphs describe how SOILCARE will contribute to understanding adoption by its integrated trans-disciplinary approach, and by looking at sociological and political aspects of adoption too.

Integrated approach
A systematic and thorough investigation of benefits, limitations and drawbacks of soil-improving cropping systems is necessary to determine under which circumstances which CS may be used to best effect. Such a systematic approach is also needed to determine to what degree perceived drawbacks are real, and to provide advice regarding adoption to policy makers, extension services and farmers. SOILCARE will develop such an approach and will apply it in its Study Sites. Various factors, which all vary across Europe, influence which soil-improving CS are suitable in a certain location, what the balance is between benefits and drawbacks for the different systems, and in what ways drawbacks can be minimised. These factors include pedo-climatic zone, type of problem that threatens soil quality and crop production, bio-physical conditions and socio-economic and political conditions. Therefore, **environmental assessment needs to be combined with economic, social and policy assessments, while also taking into account future trends in land use and climate change**. This necessitates the involvement of scientists and practitioners from multiple disciplines, as well as the true involvement of stakeholders.

Various building blocks exist to develop an all-encompassing methodology, such as existing crop suitability assessments and maps (e.g. S-info, JRC 2014), methodologies to develop sustainable land management, micro and macro-economic models and tools for soil quality assessment that are being developed in ongoing EU projects such as iSQAPER and LANDMARK. These building blocks will be integrated in the SOILCARE approach, resulting in the overall assessment methodology needed in SOILCARE which is much broader than its constituents, and which represents a significant advance beyond the state of the art. Based on upscaling the results of this methodology, an interactive tool will be developed that can help land users and decision makers to select suitable soil-improving CS throughout Europe through a multi-actor approach.

Social and political aspects
The thorough and innovative investigation of soil-improving systems described above will be accompanied by an analysis of how **policies and socio-economic factors affect adoption,** to identify major barriers to adoption as well as possible ways to overcome these.

SOILCARE will derive important new insights about the adoption of soil-improving innovations, by exploring how the dynamics of trust (across space, time, social groups and culture) can explain how innovations are adopted through social learning and collaborative learning processes. SOILCARE views the adoption of soil-improving technologies as a fundamentally social process that occurs through social interaction, influence and learning, building on various social science theories including Rogers’ (1995) Diffusion of Innovations, social learning, the social acceptability of new technologies and the nature of public attitudes towards their implementation (Wolsink 2008; Wolsink and Breukers 2007). It will test the hypothesis that the speed and spatial scale at which trust can develop depends on the extent to which it is possible to find or develop shared values, converge towards compatible epistemologies and find common interests that can transcend socio-cultural, political and economic differences. It will also critically assess the social acceptability of proposed technological changes and the social change that such innovations might bring with them. The temporal and spatial components of this work are particularly innovative, considering for the first time how trust develops over time in a wide range of case study contexts. To do this, we will take an applied anthropological approach to assess levels of trust among different stakeholder groups and between stakeholders and members of the research, practitioner and policy communities in each Study Site for the duration of the research project. This will be set in the context of a wider analysis of social learning, assessing the extent to which stakeholders and researchers share what they learn from the project with others in their social networks. In these ways, the research will use the dynamics of trust and social acceptability of innovations to improve our theoretical understanding of the adoption of agricultural innovations and the generation of social innovations more generally.

In addition, we will assess the performance of financial, regulatory and voluntary incentives, as well as the influence that policies have on adoption. This information will be used at farm scale, Study Site scale and European scale, and will be combined with the assessment of CS carried out within SOILCARE. Analyses will include scenarios of socio-economic developments, such as changing public awareness on the importance of sustainable production, and the consequences this has for the price people are willing to pay for sustainably produced food. In combination, the analyses carried out in SOILCARE will provide **increased insight in bio-physical, economic, social and political barriers for adoption, and in ways that can help to overcome such barriers**.

1.4.2 Innovation potential

SOILCARE provides innovation in science, as described in the beyond the state-of-the-art section (1.4.1). Scientific innovation can be summarised as follows:

- Development of an integrated and comprehensive methodology to quantitatively and qualitatively assess benefits, drawbacks and limitations of soil-improving cropping systems and agronomic techniques, looking at soil quality, environmental impacts, crop yield and effects on profitability and sustainability,
- Development of a harmonized method to upscale Study Site results to European level, taking into account different pedo-climatic and socio-economic conditions in different parts of Europe,
- Application of a novel approach to investigate soil bacteria, soil fungi and soil biological health. This approach will investigate how CS affect soil biological health, and how soil biological health influences the chance of plant disease and the ability of the soil to perform its functions. This has direct consequences for crop yield and crop quality,
- Development of an interactive tool for selection of soil-improving CS throughout Europe,
- Increased insight in bio-physical, economic, social and political barriers for adoption, including ways to overcome such barriers.

Apart from innovation in science, which will stimulate the adoption of suitable soil-improving CS, there is potential for innovation in technology too. Compared to conventional agriculture, soil-improving CS are more specialised, and might require precision application of those external inputs that remain necessary. Some systems might also need specific types of machinery. Hence, the results of the proposed project would enable manufacturers of e.g. fertiliser or machinery to innovate by developing products specifically needed for soil-improving cropping systems. By involving such manufacturers as partner in the project, such innovation is part of SOILCARE too. For example, Kongskilde Industries (partner 24) is planning to work on:

- Development, testing and demonstration of an intelligent moldboard plough, able to reduce fuel consumption by including knowledge of soil structure and texture, topography, weed density and residue mapping
- Development, testing and demonstration of an intelligent power harrow for seed bed preparation, designed to minimise risk of destruction of soil aggregate structure by including on-line sensor measurement and knowledge of soil texture and topography

Both types of self-adjustable machinery are currently not on the market, and represent a significant innovation in the field of precision agriculture as operation of the machinery is adapted to actual working conditions.

SCR (partner 16) will apply and further validate and test the novel approach to investigate biological soil health using DNA sequencing that was mentioned above. This approach is both an innovation in science, and an innovation in technology. Once tested it will be marketable too as a science-based commercial service.

2. Impact

2.1 Expected impacts

2.1.1 Expected impacts set out in the work programme

The main impacts of SOILCARE will be that i) scientifically proven soil-improving CS, techniques and machinery have been identified across Study Sites, representing the different pedo-climatic zones and different socio-economic conditions in Europe, ii) that insight is obtained on how barriers to adopt these techniques can be minimized and overcome, and iii) that opportunities for and effects of upscaling of adoption at European level are assessed. Adoption of these techniques by farmers will improve soil quality with reduced external inputs and with decreased soil degradation and emissions of pollutants to the environment, while at the same time improving profitability and thus competitiveness of European farmers. This will be achieved by conducting detailed studies in 16 Study Sites spread throughout Europe within a Europe-wide transdisciplinary approach. This approach allows the upscaling of results from the different Study Sites, and the integration of these results with factors operating at EU-scale, such as policy development, macro-economy, societal developments and climate change. As a result of this approach, SOILCARE will have an impact both in the respective Study Sites and at European level. Figure 2.1 shows how choice of agronomic techniques (FML3, see Figure 1.1) affect soils, environment and farm economy, and therefore provides insight into which impacts can be achieved by SOILCARE at that level.

Within SOILCARE, the effects that the choice of CS have on profitability and on the environment (with a focus on soil quality) will be assessed across agricultural regions in Europe, using published data, long term experiments and work in the Study Sites, to generate impacts at all three levels of FML identified in figure 1.1. Our focus on profitability is important in the context of promoting sustainable land management under the Common Agriculture Policy, and significantly increases the likelihood that innovations emerging from this research will be adopted by European farmers. By aiming for sustainability as well as profitability, through the use of soil-improving CS, SOILCARE contributes to reducing negative environmental impacts of cropping in Europe.

For each of the expected impacts set out in the work programme under the call topic addressed by this particular initiative, main impact results are summarized and categorized into scientific (**Sc**), technological (**T**), environmental (**Env**), social (**S**), economic (**Ec**) and policy (**P**) related ones.

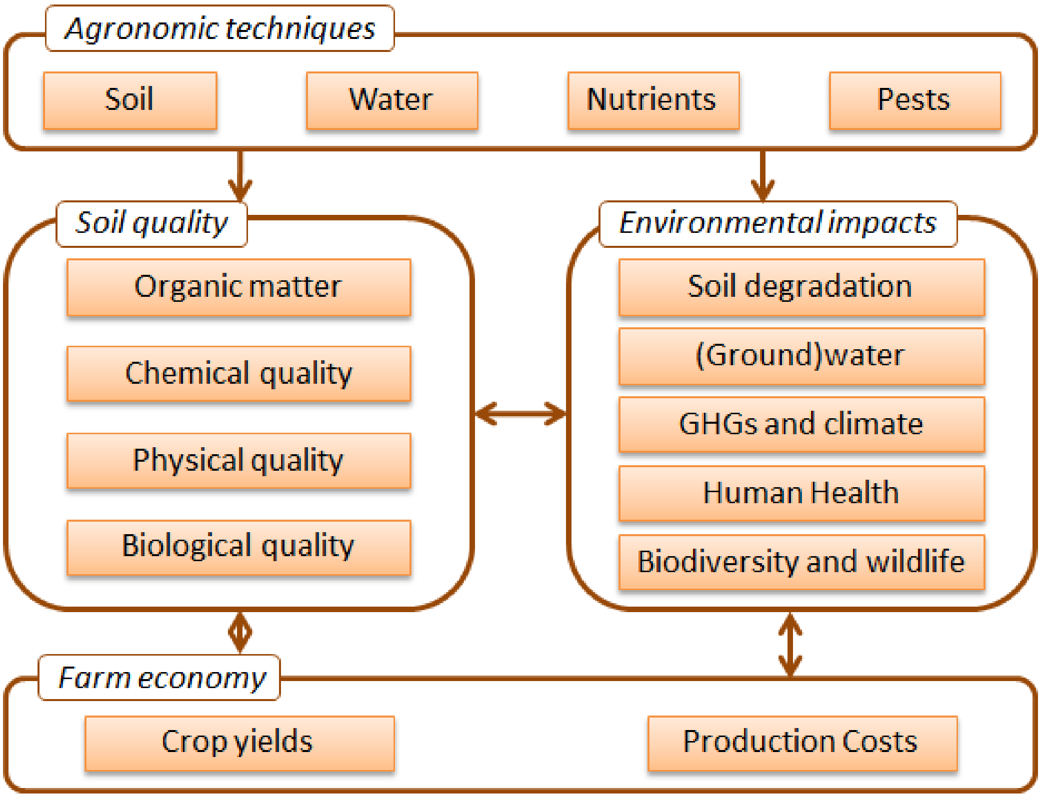


Figure 2.1. Impacts of agronomic techniques for managing soil, water, nutrients and pests. Note that agronomic techniques are part of CS, and correspond to Farm Management Level (FML) 3 in Figure 1.1

Soil and water quality

Addressing impacts: Improvement of ground and surface water quality, Reduction of soil contaminations with toxic compounds and heavy metals, Reduction of soil erosion and improvement of soil quality and structure, Reduction of the negative environmental impact of crop production through less soil disturbance, better exploitation of soil biodiversity and functions and more rational use of external inputs, water and natural resource base.

Within SOILCARE, the effects that the choice of CS have on soil quality and on the environment will be assessed across agricultural regions in Europe, using published data, long term experiments and work in the Study Sites. By aiming for sustainability as well as profitability, through the use of soil-improving CS, SOILCARE contributes to reducing negative environmental impacts of cropping in Europe (**Env**). The use of soil-improving CS results in improved soil quality and has direct as well as indirect benefits for the environment (Figure 2.1). Direct benefits include e.g. reduced emission of GHGs and reduced soil degradation (e.g. less contamination), while improvement of soil quality can also benefit the environment, e.g. by making soils more resilient to degradation processes such as soil erosion and soil compaction (**Env**). Soil quality, soil structure, and soil erosion are all part of the proposed monitoring programme, so that field proof for soil improvement will be obtained from 16 Study Sites spread across EU. The effect of soil-improving CS on soil properties and soil quality will be evaluated in collaboration with the funded SFS4 projects iSQAPER and LANDMARK using the latest methodologies (**Sc, T**). Attention will also be given to recycling of organic materials and where soil compaction is a problem also to rooting depth. The functions of soil organic matter have a basic importance not only from an agricultural point of view but also for soil quality, the ecosystem and the environment. Quality of soil and water are intrinsically linked. Healthier soils have better hydrological properties and are better able to filtrate and store water, so that preserving soil quality is actually also a natural water retention measure (NWRM, www.nwrm.eu) that contributes to flood protection as well (**Env**). Increased rooting depths improve efficient use of water and nutrients. Furthermore, by applying no more fertilisers and pesticides than is needed, contamination of soil decreases, which also positively impacts the quality of ground and surface waters. The requirements of the different CS regarding external inputs will be taken into account, in collaboration with the funded SFS2A project(s). By ensuring that the right amount and type of external inputs is used, and that this external input is applied in the right place at the right moment, contamination will be reduced. The use of soil-improving CS will reduce negative environmental impacts, e.g. because of better soil quality, better soil structure, better regulation functions (e.g. hydrology), increased rooting depth, increased soil biodiversity, and decreased use of external inputs (**Env, Ec**). The assessment of environmental impacts is an integral part of the methodology that is used for assessment of CS in SOILCARE, and will provide guidance about which CS will result in enhanced environmental performance. This assessment also underlies the tool that will be developed to select appropriate soil-improving CS in Europe (WP6, **Sc**). In this way, better care is taken of our soils, which allows the soil to continue to service our needs – now and in the future.

Environmental quality

Addressing impacts: Conservation of biodiversity and wildlife, Improved human health, through the reduced release of pollutants and GHGs.

SOILCARE contributes to healthier soils by reducing negative environmental impacts and by improving soil quality (Figure 2.1). SOILCARE will explicitly study physical and biological soil health through the work of partners 5 and 16 (**Sc, T**). Healthier soils are better able to sustain a rich soil biodiversity. This also makes these soils better able to perform their functions, which is conducive to crop production too. Furthermore, it also results in a smaller risk that soil degradation occurs, and improves for example soil hydrological properties (e.g., infiltration capacity) and water quality. A reduced use of external inputs results in less contamination, and, depending on the pedo-climatic zone and CS, also in less emission of GHGs (**Env**). There is also evidence that emissions of pollutants resulting from application and storage of manure can result in the formation of micro-particles that are harmful to human health. Thus, reducing emissions has a positive effect on human health. SOILCARE also takes into account the energy and water requirements of the different soil-improving CS to avoid unnecessary emission of GHGs, to reduce air pollution (**Env**) and to minimize economic loss (**Ec**). This is beneficial for biodiversity, wildlife, and human health. Release of pollutants and GHGs will be studied and quantified in the Study Sites where applicable. Finally, CS also have above ground impacts, for example on vegetation (use of hedges, buffer strips, trees etc) and on landscape elements (e.g. dikes, ditches). Such impacts may also directly contribute to conservation of biodiversity and wildlife, and may, in turn, also have a positive influence on soil health (**Env**). Gaining such knowledge on environmental quality is a prerequisite to meet the challenges of sustainable development and growing demand of energy with regard to future land use and climate changes.

Policies

Addressing impacts: Scientific support to relevant EU and national policies.

SOILCARE will provide scientific evidence on the potential of soil-improving cropping systems in 16 study sites and also EU-wide. SOILCARE is expected to contribute to EU and national policy by facilitating more profitable, sustainable and competitive farming in Europe (**Ec, Env, P**). In addition to providing scientific evidence on the impact, cost and effectiveness of the cropping systems, SOILCARE will also deliver on how to adopt the cropping systems researched in SOILCARE, by individual farmers (WP3), European institutions (WP6-WP7), Member State authorities (WP7) and agricultural advisory services (WP8) (**S**). A multi-actor and multi-level approach is hereby followed, with an engagement of the actors from the inception phase, throughout the project. In particular, SOILCARE will provide scientific support to the following EU and national policies (**Sc, P**).

Agricultural policy

The reformed Common Agricultural Policy (CAP) promotes high levels of production of safe and quality food and the enhanced competitiveness of EU agriculture, while also becoming more equitable and sustainable. For example, through greening of the CAP permanent grasslands, crop diversification, and ecological focus areas in arable land (i.e. field margins, hedges, trees, fallow land, landscape features, biotopes, buffer strips, afforested areas) are now promoted. Strengthening rural development remains an important component of CAP, addressed via Member States' Rural Development Programmes (RDPs). Under the reformed CAP, the system of direct payments has changed, giving Member States the flexibility to offer direct payments to green and redistributive schemes and also for small farmers.

SOILCARE's assessment of soil-improving cropping systems will provide evidence on which techniques are best used in practice to achieve more productive, greener and more competitive agriculture (**Ec, Env**). The selection of good cropping systems (**Ec, Env**), in combination with the policy alternatives (**P)** to facilitate adoption (**S**) of the cropping systems, will be based on the priorities stated in the RDPs covering the geographic areas of the study sites. The priorities for the RDPs highlighted by the European Commission, that are addressed by SOILCARE, are fostering knowledge transfer, enhancing farm viability and competitiveness, restoring, preserving and enhancing ecosystems related to agriculture, promoting resource efficiency and the shift towards a low carbon and climate resilient economy in agriculture (**Env**).

SOILCARE will also contribute to achieving the aims of the European Innovation Partnership on Agricultural Productivity (EIP-AGRI), by helping to foster a competitive and sustainable agriculture through identification and dissemination of soil improving practices (**Ec, Env**). Using a multi-actor approach and involving potential end users (stakeholders) throughout will help to close the innovation gap between research and practice in the soil management context (**S**).

Environmental & Nature policy
SOILCARE will aim to reduce pollution to surface waters and groundwater, in addition to reducing erosion and land degradation. SOILCARE will in particular fill knowledge gaps for the implementation of the Nitrates Directive, Water Framework Directive, Birds and Habitats Directive and the Soil Thematic Strategy, in particular on the cost and effectiveness of measures to reduce nitrates, phosphorus, erosion and land degradation (**Env**). The cropping systems of concern will be selected by study site stakeholders to reflect local priorities (**S, Ec, Env**); this step will be informed by the priorities set out in existing Action programmes in Nitrates Vulnerable Zones, River Basin Management Plans and Flood Risk Management Plans, in addition to the Rural Development Plans (see CAP) and the communication on land as a resource (foreseen in 2015, EC 2015).

In SOILCARE, it will also be assessed to which extent the researched cropping systems count as Green Infrastructure, as Natural Water Retention Measure (NWRM), or have benefits for biodiversity. The SOILCARE results could hence contribute to the respective EU strategies, i.e. Strategy on Green Infrastructure, the EU policy document on Natural Water Retention Measures and the EU Biodiversity Strategy (**P**).

Europe 2020 Strategy: Resource efficiency and Competitiveness
Europe 2020 is the EU's growth strategy for the coming decade. SOILCARE will assess the researched cropping systems in terms of their results regarding resource efficiency and competitiveness (**Ec, Env**), two key objectives of the strategy (**P**). A set of indicators will be used and quantified (by means of modelling and stakeholder engagement) to assess the impact of the cropping systems. Our approach to support the Europe 2020 Strategy is elaborated under the header "Increased European farmers' competitiveness through the reduction of production costs" (**P, Ec**).

Climate Policy
In accordance with the EU Adaptation Strategy, all Member States have to adopt comprehensive adaptation strategies. In addition, the Adaptation Strategy calls for the climate-proofing of the CAP. SOILCARE will address existing knowledge gaps, including in terms of the benefits of soil-improving cropping techniques in terms of climate change adaptation and vulnerability assessment. The impact of the researched cropping systems on GHG emissions will also be assessed and thus will contribute to EU climate policy (**P**).

Evaluation of soil-improving CS
Addressing impacts: Sound scientific evaluation of benefits and drawbacks of soil-improving cropping systems and techniques.
SOILCARE takes a trans-disciplinary approach to evaluate benefits and drawbacks of soil-improving CS based on field evidence, stakeholder involvement and monitoring, which incorporates all relevant factors (bio-physical,

socio-economic and political, **Sc**). Experts on these different fields of science are included in the consortium, and will collaborate to develop an evaluation methodology that considers all aspects. Field evidence from the 16 Study Sites (FML level 3, figure 1) will be supplemented with data on benefits and drawbacks that can be derived from long term experiments and literature (FML levels 1,2). The all-encompassing methodology that will be used allows not only to determine benefits and drawbacks, but also to provide recommendations to reduce drawbacks, and to up-scale results from the study site level to EU-level using modelling (**Sc**). Views and priorities of stakeholders, SMEs and industry are also taken into account in the scientific evaluation of soil-improving cropping systems, thus guaranteeing that results are not only scientifically sound but also relevant to society (**S, Ec**).

Competitiveness
Addressing impacts: Increased European farmers' competitiveness through the reduction of production costs.
Conventional farming is expected to become increasingly costly due to rising costs for external inputs and/or for mitigation measures against soil degradation. The economic crises furthermore disrupted farmer's profitability and introduced significant volatility (European Communities, 2011). The price fluctuations of agricultural products are expected to persist and continue to challenge the ability of consumers, producers and authorities to cope with the consequences (FAO, 2012). In this context of rapid change and long-term challenges, it is important to enhance the competitiveness of European farmers' in comparison to non-European farmers. In line with the Europe 2020 Strategy on achieving smart, sustainable and inclusive growth, boosting competitiveness is not only about reducing production costs or more broadly increasing productivity, but also about more sustainable and smart agriculture and the consequent marketing of an image of green and high-quality products.

SOILCARE will contribute to a smarter and more sustainable agriculture, through the development and testing of soil-improving cropping systems which have the potential to reduce the costs by reducing the need for external, costly inputs e.g. fertiliser, pesticides and energy to operate machinery (**Ec**). While some soil-improving techniques proposed in SOILCARE, may lead to reduced productivity (yield/ha), they may be more efficient and profitable, i.e. when input costs are compared to the outputs. On the long-term, when soil quality has improved, efficiency is expected to increase further as a consequence of a further reduced need for external inputs and higher production (**Env, Ec**). In addition, on long-term, the lesser impact of land degradation, reduced level of GHG emissions and reduced risk to damages from natural disasters such as storms, droughts or floods results in smaller expenditures (**Env, Ec**).

A smarter and greener agriculture, to which SOILCARE will contribute, also has the potential to increase the value of agricultural products and the willingness to buy European agricultural products, both in and outside of the EU. This can be achieved by providing higher quality products or providing assurance of a particular production method or process along the supply chain through certification schemes. An important condition to boost value and more broadly competitiveness is the prevailing support from authorities and private actors involved in the supply chain of agricultural products are essential. The latter can range from a legal framework, incentives, certification, advertising and marketing and facilitation of the purchasing of European agricultural products.

In SOILCARE, the contribution to enhanced competitiveness will be assessed by means of a set of indicators, for which values are generated in various Work Packages or are derived from existing reports (**Ec**). The set of indicators will be developed in WP6, as part of the Integrated Assessment Model, starting from the various methods and indicators existing. The indicator set on competitiveness are quantified based on values from the economic analysis carried out at both micro and macro level. SOILCARE will also provide information about short-term as well as long-term profitability and resource efficiency (**Ec**). The required policy framework will be assessed in WP7, based on an analysis of current practices, organizational capacity (bottlenecks and opportunities) of the public and private sector and the selection of scenarios (including options and incentives) most preferred by stakeholders (**P**). The adoption of measures by individual farmers' is assessed in WP3 (**S**).

It is expected that the soil-improving techniques developed and tested in SOILCARE will lead to a more sustainable and competitive agriculture.

2.1.2 Improving innovation capacity
As SOILCARE is working on important societal issues in an integrated way, any innovation developed in SOILCARE will meet a societal need, and will therefore be relevant for European and global markets. SOILCARE

adopts the philosophy that a common focus on harmonisation of approaches building on previously acquired knowledge and competencies, supported by appropriate project organisational structure, strategy, culture and leadership, contributes to an environment that enables and/or is favourable to innovation and the integration of new knowledge. As a result (see section 1.4.2), SOILCARE has innovation potential regarding both science and technology. Scientific innovations will be made available to the companies involved in SOILCARE, and will help them to develop new technological innovations. For example, the self-adjustable machinery that is due to be developed by Kongskilde Industries (partner 24) represent a significant innovation in the field of precision agriculture as operation of the machinery is adapted to actual working conditions. Such innovations are necessary to make farm operations as efficient as possible, while also minimizing any adverse environmental effects that such operations might have. The development of this technology can benefit from knowledge that is made accessible to partner 24 within SOILCARE, such as access to the long experience gained from the TASC (Tyres/tracks And Soil Compaction) tool (Diserens and Battiato, 2014).

Similarly, the knowledge and experience generated in SOILCARE will also enable the SMEs that are involved in SOILCARE to further develop existing expertise and products, and to develop new ones where market opportunities exist. For example, SCR (partner 16) develops a commercially available tool for assessment of biological soil quality based directly on DNA sequencing.

Due to its process-driven nature, innovation capacity must be assessed and improved during the course of the project to sustain, and accelerate innovative initiatives. This requirement for assessment and constant improvement directly translates to the concept of innovation capacity maturity models, which will be used for boosting innovation in SOILCARE.

The innovation capacity maturity model describes a set of structured levels defining how well the activities, practices and processes deployed in a project can reliably and sustainably produce the required outcomes. In SOILCARE, innovation management will institutionalise innovation to go beyond the *ad hoc and limited* level, where innovation-related practices and procedures are impromptu and limited in their ability to fulfil the requirements for consistent innovation, and the *formalisation and predictability* level, where innovation-related best practices and procedures have been identified and deployed, enabling the consistent fulfilment of the requirements for innovation, to achieve *integration, synergy and autonomy*: Once formalisation has been attained, institutionalisation of practices emerges. In other words, activities become natural behaviour that concentrate on achieving alignment and synergy within an innovation initiative and with project operational activities. As innovation necessitates the execution of a process, this process may be represented as a life cycle of phases, ranging from invention to feasibility, demonstration and implementation, linking to the identified Technology Readiness Levels (TRL) as mentioned in section 1.3.2.

Additionally, SOILCARE will contribute to strengthening the competitiveness of a range of companies and organizations active in the agro-environmental domain and bio-based economy in Europe, by creating opportunities for growth for farmers (higher productivity with less resources), extension services (introducing the soil quality assessment tool across European farmers), suppliers and service providers to farmers (targeted soil sample assessments, seeds, fertilizers and irrigation systems), food retail industry (more and better quality food products), and other end users and players of the biomass supply chain, as well as construction, landscaping and consultancy firms (farm development, extension, and innovation). SOILCARE will thus offer concrete opportunities to increase resource efficiency and maintenance of natural capital, by stimulating innovations and by strengthening competitiveness of European companies and organisations.

2.1.3 Environmental and social impacts

Soils are at the intersection of a broad range of agricultural and land use challenges, and are themselves impacted by a variety of policies. They are critical for economic and environmental well-being because they form the basis for agricultural production and because of the range of ecosystem services they provide. In addition to the scientific and practical benefits described elsewhere in this proposal, additional environmental and social related benefits and impacts of the work can be expected. These will include:

- Greater understanding of the links between cropping systems, agronomic techniques and soil quality with its related key ecosystem services, particularly production.

- Additional *climate mitigation* and *competitiveness* benefits. A better understanding of climate mitigation opportunities offered by soils and agricultural production will lead to earlier identification and uptake of relatively low-cost climate mitigation opportunities. This potentially reduces the pressure on other sectors of the EU economy to lower their carbon footprint. It also has wider implications for international mitigation opportunities (and for global food security), because of the range of soil types considered across the EU, and potential for replicating positive results in other agricultural economies.
- Extra-EU deployment of techniques developed will also enhance *international development* objectives, in line with the post-2015 sustainable development targets currently being negotiated.
- Improved understanding of *consumers and general public* of the environmental impacts of different approaches to agricultural production, enabling more informed choice in relation to the environmental impact of agricultural products.
- Through the use of practices of *social innovation* in SOILCARE, improved understanding on the part of both scientific partners and land users of the factors leading to land use and cropping systems decisions and the environmental impacts of different approaches to agricultural production. This will enable *land users* to make realistic, relevant and informed choices in relation to the environmental impact of agricultural products in particular.
- Better understanding of the role of gender in soil quality and ES management by conducting gender specific actions and surveys. This will allow developing strategies for more efficiently involving female land users and other female stakeholders in improved management of agricultural soils.

2.1.4 Barriers and obstacles

Envisioned impacts of the project are closely linked with and are expected to result from the respective research tasks. Foreseen impacts as described in Section 2.1.1 are sufficiently specific, measurable, realistic and also timely achievable. No substantial barriers, obstacles or framework conditions are expected opposing, hindering or delaying the achievement of the SOILCARE impacts.

However, an important challenge is to also achieve impacts beyond the project study sites, and beyond the project lifetime. The challenges addressed by SOILCARE are of large importance for agriculture, but are currently neglected and form a largely technical domain predominantly occupied by a relatively small group of scientists, policy makers and practitioners. In response to this reality, the SOILCARE consortium seeks to facilitate the engagement of a large group of farmers and other practitioners and policy makers in both the assessment of CS, and in the development of CS that are both profitable and sustainable. Secondly, SOILCARE will actively liaise with a large number of corporate, civil society, (local) government networks and specialised agencies, both as sounding boards and to enable a broad sharing of results among their respective constituencies.

As described in section 1.3.1, the choice of CS is influenced by many external factors and drivers, including (changes in) pedo-climatic zone, policies, markets and society (e.g. public opinion). By their nature, these factors cannot be controlled by farmers and can therefore act as barriers for adoption of more sustainable CS. Furthermore, whether or not CS are adopted depends on a range of bio-physical, legislative, economic and social conditions, as studied in detail in SOILCARE. All these factors do not pose a risk for execution of the proposed SOILCARE project, but they could influence the impact of SOILCARE outside the immediate study sites, particularly as adoption is crucial to achieve wider and longer lasting impact. SOILCARE cannot overcome these issues, but studies them in detail, and can maximise impact by addressing them as described in the next section.

2.2 Measures to maximise impact

2.2.1 Dissemination and exploitation of results

Plan for dissemination and exploitation

To achieve true and lasting impact, dissemination is crucial. The information needs of different stakeholder groups and multi-actors will be investigated early in the project, and dissemination of results will be integrated into the plans of all WPs in SOILCARE, to ensure that the project outputs are communicated in a targeted, efficient, appealing, and effective manner to a wide-ranging audience. SME/industry actors will also be involved in development of the dissemination strategy, drawing on their extensive expertise. Furthermore, Study Site stakeholders will assist in the development of individual Study Site dissemination plans that are tailored to each local agronomic, political and cultural situation. This will be coordinated by WP8, which will ensure that the communication and dissemination products will be suited to target audiences, and that a wide range of communication methods will be used to maximise knowledge exchange (an active process) and diffusion (more passive) to end users (see Table 2.1). WP8 will provide the "packaging" for the dissemination products, reorganising scientific material and interpreting it for use by various audiences with different information needs. All WPs will be encouraged to prepare all their results and reports with thought to how the material can be presented to both scientific and non-scientific audiences. WP8 will provide guidelines for doing this, plus templates for products, and a website to provide a central repository for sharing all products. Writing and production of products will require joint work between WPs 2-7 and WP8. The plan for the dissemination and exploitation of project results will be fully described in the Communication and Dissemination Strategy (one of the WP8 deliverables). The strategy will be drafted at the beginning of the project, and will be updated throughout the project as research results become available and as potential users and their requirements become more defined. Further information of what the Strategy will include is given below.

A dedicated plan regarding any potential for exploitation, commercial or otherwise, will also be developed and implemented within the Dissemination and Communication Strategy. The main areas of exploitation envisaged concern the uptake of the effective CS identified by the project by all those listed as potential target audiences. The strategy will include a systematic analysis of the stakeholders likely to benefit from (or be able to influence the success of) the research, considering the outcomes they are most likely to be interested in, the modes of communication they are most likely to respond to, and any other information that may enable effective engagement. The strategy will identify clear knowledge exchange (KE) and impact objectives and intended outcomes (including deliverables and milestones) through discussion with key stakeholders. A programme of work will be identified to reach each objective and outcome, identifying potential risks, and how these will be mitigated, and indicators that can help monitor progress. Impacts arising from the research will be captured systematically as they occur by project staff using a shared online platform such as KOLOLA (https://www.kolola.net) or similar, for regular reporting to the European Commission. As part of the KE Strategy, a social media strategy will also be developed, considering the use of Twitter, LinkedIn, Facebook, Google+, You Tube and other platforms.

As mentioned earlier, companies involved in SOILCARE will use SOILCARE results to develop innovative products and expertise that can be marketed. The marketing, however, is not part of the SOILCARE project, but will be done by the companies outside of the project. Hence, if project results give rise to marketable innovative products, SMEs and Industry involved in SOILCARE will develop their own plans for bringing these products to the market. Therefore, this section will focus on the dissemination of project results. However, WP8 will produce an Exploitation and Sustainability plan, which will identify which products could potentially be marketed, and which markets exist for these products (see task 8.5 description in section 3.1.3)

Messages

SOILCARE will identify with actors engaged in project which key messages emerging from project results should be disseminated. This will not only be determined at WP level, but also at the overall project level, so that messages can also be identified that supersede individual WPs, and need input from different WPs to formulate. SOILCARE will in this process not only identify information that the project can provide, but will also identify the information needs of the different stakeholders, based on WP3 work. These needs will be taken into account in the formulation of messages.

Audiences

Due to the multiple uses of, and threats to, soil, the audience for the project's outputs is diverse and will include specialists as well as a more general audience. The audiences of SOILCARE will initially be assessed by the consortium at the national and European levels, and then enhanced by the stakeholders and the stakeholder analysis in WP3 at the national and regional levels. As the project progresses, different layers of target audiences will emerge. The main target groups are described below and are summarised in table 2.1.

i) Local level

The most important group of end-users is formed by the people who actually manage the land, i.e. the farmers and/or the landowners. Hence, an important part of the dissemination effort will focus on these groups, through the targeted use of participatory learning and demonstration (WP5). These activities will be crucial to the development of innovative agricultural management practices. A second important group to target concerns farm advisors (including advisors of companies that deliver farm inputs, independent advisors, and extensionists). Focus of the project dissemination will partly be on teaching the teachers, again through participatory learning and demonstration (WP5). Links will also be made, with the help of organisations, such as the European Forum for Agricultural and Rural Advisory Services (EUFRAS), to professional development programmes for advisors and agronomists like BASIS in UK.

ii) National and Regional level

Project and Study Site partners at national and regional levels will identify stakeholders (WP3 stakeholder analysis) who will be invited to events at the Study Site level and be targeted with relevant project outputs and information. These will include amongst others the following:

- Policy makers, authorities, environment agencies and regulatory bodies
- National level relevant institutions and networks concerned with agricultural crops
- Professionals (like engineers) and practitioners (land managers, users, and consultants) and their respective representative bodies (e.g. farmers unions / agricultural chambers, home builders federations, professional bodies for spatial planners, engineers)
- Industries, especially those focussing on agricultural inputs such as fertiliser, pesticides, and equipment
- Intermediary, advisory, brokerage organizations, and NGOs

iii) European level

European level policy makers - European policy makers concerned with agriculture, soil management and ecosystems services will be kept informed and invited to take part in selected meetings and workshops, specifically: DG for Agriculture and Rural Development, DG Research, DG Environment, DG Climate Action. Those involved in the Soil Thematic Strategy (Members of Working Groups) will be specially targeted.

European level institutions, networks and representative bodies – Key European farming networks, such as the European Initiative for Sustainable Development in Agriculture (EISA), European Conservation Agriculture Federation (ECAF), European Arable Farmers (EAF), European Forum for Agricultural and Rural Advisory Services (EUFRAS), EIP-AGRI, European Council of Young Farmers (CEJA) and soil networks, such as the European Soil Bureau Network (ESBN) (soil research and data holders), the European Network on Soil Awareness (ENSA), as well as the Eionet (member state representatives) will be important targets for project networking and dissemination. Members of Europe-wide representative bodies for farming (Copa-Cogeca, IFOAM), water management (European Water Association, and the European Water Resources Association), and soils (European Confederation of Soil Science Societies) will be targeted with outputs concerning relevant soil-improving cropping systems and agronomic techniques. The European Environment Agency will also be invited to take part in selected meetings, workshops and conferences, to network with the project and interact with the Dissemination and Communication Hub.

iv) Global levels

Scientific community - various disciplines within the scientific community will be kept informed of developments.
General public – not a key target group in SOILCARE, but various dissemination materials developed for other target groups are suitable for this group and will be disseminated.
International bodies and global networks- FAO, UNCCD, UNFCCC, OECD and others will be informed of SOILCARE developments and outputs. The World Overview of Conservation Approaches and Technologies (WOCAT) network will directly benefit from the enhanced knowledge of agronomic practices in Europe.

Scheduling

The Dissemination and Communication strategy will explicitly set out the schedule of dissemination activities in the project. The scheduling of dissemination activities is of course dependent on the delivery of project results, but it will also take into account existing networks, newsletter, and planned meetings. There will be extensive use of formal/informal meetings, farming events, trade fairs, workshops and scientific conferences, either arranged as part of SOILCARE's work programme or taking advantage of other suitably-timed events.

Table 2.1. Target audiences and suggested dissemination outputs for the SOILCARE Project

	Target audiences	Purpose	Formats and mechanism
Local level	Farmers and land-owners	Diffuse knowledge and data on soil-improving CS (outputs from WP5,6), influence social acceptance (WP3)	Flyers and bulletins in local languages, stakeholder workshops and field days, fact sheets, Real Life Case Studies, technical/practical guidance manual, social media (Twitter, Facebook), blog
	Farm advisors	Diffuse knowledge and data on soil-improving CS (outputs from WP5,6)	Flyers and bulletins in local languages, fact sheets, Real Life Case Studies, technical/practical guidance manual, social media (Twitter, Facebook), blog
National and regional level	Policy makers, authorities and regulatory bodies	Provide policy recommendations to policy makers and decision-makers on innovative soil-improving CS (outputs from WP7)	Policy briefs, stakeholder workshops, videos, fact sheets, newsletters, final conference
	National level relevant institutions and networks	Diffuse knowledge and data on soil-improving CS (outputs from WP5,6)	Policy briefs, flyers, bulletins stakeholder workshops, fact sheets technical/practical guidance manual, social media (Twitter, Facebook)
	Professionals, practitioners, and their representative bodies and intermediary, organizations	Diffuse knowledge and data on soil-improving CS (outputs from WP5,6)	Flyers and bulletins in local languages, stakeholder workshops and field days, fact sheets, Real Life Case Studies, technical/practical guidance manual, social media (Twitter, Facebook), blog
EU level	Policy makers, DG for Agriculture and Rural Development, DG Research, DG Environment, DG Climate Action	Present principal recommendations for promoting soil-improving CS and streamlining EU policies (outputs from WP7)	Policy briefs, stakeholder workshops videos, newsletters, final conference
	Institutions, networks (e.g. EISA, ECAF, EAF, ESBN, EUFRAS, CEJA and representative bodies, e.g. COPA-COGECA, IFOAM. EEA	To inform on scientific advancements, data and innovative soil-improving CS (outputs from WP6)	Policy briefs, stakeholder workshops, videos, fact sheets, newsletters, final conference
Global levels	Scientific community from various disciplines	Disseminate scientific outcomes of the project (outputs from all WPs)	Scientific publications and oral and poster presentations at conferences, relevant society meetings, dedicated section of the Hub
	General public	Raise awareness and disseminate knowledge on how choice of CS affects life of everybody (outputs from all WPs)	Videos, press releases, fact sheets, newspapers, facebook, blogs, twitter feeds.
	International - FAO, UNCCD, OECD	Present principal results and recommendations on adopting soil-improving CS and techniques (outputs from WP5,6,7)	Policy briefs, videos, newsletters, final conference, international meetings

It will be important to establish communication networks, using media such as email lists, social media (e.g. Twitter, LinkedIn and Facebook) and links to existing networks and coordinate these through SOILCARE's Dissemination and Communication Hub. Full use will be made of CORDIS, the EU portal for 'Community Research and Development Information Service'. Links will also be made with key European networks, and the IISD reporting services to ensure that newsletters, bulletins and alerts are available to their members. At an international level, the project will link to the Global Soil Partnership, WOCAT and other international networks. SOILCARE will exchange information with scientists working on similar issues through establishing content-driven networks of collaboration. The results of SOILCARE will be widely disseminated using the partner networks. There are 29 partners from a variety of institutes and organizations across Europe, and several of these partners are involved in national, pan-European and international networks, so that they can use possibilities for dissemination as and when they occur within these networks. Articles from SOILCARE will be prepared for Science for Environment Policy (DG Environment News Alert Service). SOILCARE will use events such as Global Soil Week, World Soil Day, exhibitions and scientific conferences (e.g. EGU) to publicise its activities and outputs. Links will be made to scientific societies (e.g. International Society of Soil Science, European Society for Soil Conservation) and their respective events and conferences. At the national level, partners will be encouraged to make links with national dissemination programmes in all sectors.

Activities within WP8 and the development of the dissemination and communication strategy will ensure that SOILCARE dissemination activities complement and are integrated into existing soil dissemination activities such as soil management advice connected to cross compliance under the CAP and within the EU Water Framework and Nitrates Directives. Efforts will be made to complement and extend the awareness raising activities with regard to the Soil Thematic Strategy. The project will also ensure it links to the Commission's activities and soil publications and leaflets and brochures.

Formats

The SOILCARE Dissemination and Communication Hub will be the central collection point and communication portal for dissemination material developed within the project, it will ensure outputs are accessible to all the target audiences. The Hub will be a powerful web-based application at the core of the dissemination and communication strategy, based on the web site of the project; it will develop and grow throughout the project and remain in place after the project has ended. It will provide information in a range of formats and at different levels of complexity using a hierarchical structure. Stakeholders will be encouraged to contribute and link to their own activities, networks and websites in their own languages.

The project's integrated approach and stakeholder involvement (WP3) will ensure that dissemination is based on a good understanding of the different information needs of these groups, and their preferred formats and mechanisms for communication. In recognition that there is need to raise awareness amongst the agricultural community about the need for soil-improving CS, this project will use a number of innovative methods and media to reach this audience (see also table 2.1): videos, press releases, television, fact sheets, Real Life Case Studies, newspapers, via Facebook, Twitter and other social media platforms, and films. The efficacy of SOILCARE's dissemination and communication strategy will be evaluated during the course of the project using standardized indicators and improvements and/or addition will be made to activities planned if considered necessary.

Dissemination activities materials that are foreseen include (see also Table 2.1):

- Research publications in peer-reviewed journals will be used to target the research community. Publications will be made publicly available as quickly as possible, and Open Access publications will be used where possible via dedicated section of the Dissemination and Communication Hub.
- Fact sheets and Real Life Case Studies will be developed with input from stakeholders for each soil-improving CS and agronomic technique to explain impacts on profitability and sustainability and potential barriers to adoption based on results from the Study Sites. They will be used to inform the public, decision makers, practitioners, land managers and consultants.
- Guidance on practical application of selected soil-improving CS for practitioners, land managers, users and consultants will be prepared with input from stakeholders in a number of formats (eg, technical sheets, manuals, videos) including demonstrations.
- Policy guidelines will be prepared for all levels of policy requirements as briefs, videos, and newsletters, which will also be presented and discussed in policy workshops and at appropriate conferences.
- As described above a range of multi-media will be used to reach a wider audience.

- Film. Informative multi-lingual videos will be prepared highlighting project aims, results and promising measures, as visual impact is often the most successful medium for conveying scientific information to the general public. Film will also be one of the means to disseminate results to large audiences across Europe that explain the scientific issues and highlight the innovations achieved by SOILCARE. For this reason, a professional film maker is part of the consortium (Scienceview, partner 29). The films will be made available on YouTube, and other media, all of these accessible through the SOILCARE Dissemination and Communication Hub.
- Stakeholder workshops will be used to engage policy makers (EU and national) practitioners, land managers, users and consultants in Study Sites and these will be a fora for dissemination as well.
- A final conference (session) will be used to set out project outputs to a wide audience of policy makers and interested parties. Scientific conferences and meetings will be used to reach specific scientific disciplines.

To be effective in dissemination and exploitation requires some preliminary organisation including:

- Design of document and presentation templates for project-wide use in all types of dissemination including newsletters and factsheets, posters, press-releases and presentations. This will establish the identity and branding of SOILCARE products. All products will carry EU logos, and appropriate disclaimers, and acknowledgement of the funding source.
- Design of all SOILCARE databases according to specifications and protocols in the Data Management Plan (DMP).
- Management of knowledge and intellectual property rights according to EC guidelines.
- Detailed guidance on selecting the right kind of dissemination formats for the audience in question, and on methods of preparing/rewriting/reorganising project deliverables reports and results for dissemination to different target audiences or for different purposes. For example, a press release requires a different focus from a fact sheet aimed at farmers, but both may be conveying a similar message.

Maximisation of impact

SOILCARE works on maximisation of impacts in two main ways.

First of all, it uses an integrated trans-disciplinary approach to its research, which enables it to obtain a full understanding of the factors that control impact. One crucial aspect in this regard is adoption of CS. Many previous projects have assumed that farmers will automatically adopt measures if it is demonstrated that these are economically beneficial to them. However, adoption is much more complex than that, and various other factors play a role too. Impacts can only be maximised if all factors that could limit impacts are duly considered, and this is precisely what SOILCARE sets out to do. It also allows tailor made soil improving strategies to be identified.

Secondly, maximisation of impacts also depends to a large extend on communication and dissemination. By including stakeholders from the inception of the project through a multi-actor approach, it is ensured that messages are produced that are relevant to them, in formats that are relevant to them, and at times that are suitable for them. This increases the chances that the project results actually find their way into the daily practise of the stakeholders.

Management of research data generated and/or collected

SOILCARE will take part in the Commission's Pilot on Open Research Data. The DMP will be developed early in the project (month 6) to set out mechanisms and procedures for: quality checking, ensuring consistency of message, ensuring consistency of the use of templates and brand images (project logo) for all outputs and all languages, and for decision making when questions, conflict or disagreement arises. Drafting the protocol will be a priority task within the Dissemination and Communication Strategy and the protocol will be agreed at the combined Project Management Board and Scientific Board level. The main aim of setting up the protocol will be to ensure that the project has unified, high quality and cohesive messages and that their delivery is well coordinated. The DMP will also specify protocols for data sharing, ownership and use and publishing.

The following types of data will be collected: Data on the classification of soil, climate and land use (including soil property, quality and productivity data) will be collected to characterise CS across Europe (WP 2). Data derived from existing soil quality indicator systems and field trials will be compiled in a database to identify the most cost-effective indicators of soil threats, soil functions and land potential (WP2). The development of a database with monitoring results from the Study Sites is included in WP5, and spatial data used and generated in the project, especially in WP6, will be safeguarded to ensure that they remain available after the end of the proposed project, e.g. trough partner 8 (JRC).

The DMP will describe the data management life cycle for all data sets that will be collected, processed or generated by SOILCARE. It will outline: how research data will be handled; what data will be collected, processed or generated; what methodology and standards are to be followed; whether and how this data will be shared and/or made open access; and how it will be curated and preserved. The DMP will evolve and gain more precision and substance during the lifespan of the project. The first version of the DMP will be delivered by month 6 (Deliverable 1.2), in compliance with the template provided by the Commission. It will be updated at opportune intervals, whenever important changes to the project occur due to inclusion of new data sets, changes in consortium policies or external factors. For each database the DMP will address the points below on a dataset by dataset basis, to reflect its current status:

• Data set reference and name
• Data set description
• Standards and metadata
• Data sharing
• Archiving and preservation (including storage and backup)

The Consortium agreement, drawn up according to Horizon 2020 guidance, is the appropriate instrument to balance all the various legitimate interests of the different participants in the project, including the guidelines and protocols for sharing pre-existing know-how and resulting knowledge. The advice of the Commission in the Open Research Data Pilot on the maintenance of intellectual property rights, the protection of pre-existing know-how, the access rights to knowledge or software, data sharing policy, and regulations for the publication of project results will be adhered to. As regards the results, the Contract and Consortium Agreement will set out provisions concerning the ownership of results, their protection, publication, use and dissemination as well as access rights to them.

Strategy for knowledge management and protection

A dedicated plan regarding the management of knowledge and intellectual property will be developed and implemented in accordance with the principles of the Open Research Data Pilot. Due to the 5 year duration of SOILCARE, the large number of people involved (consortium partners, Study Site partners and stakeholders) and the ambition and extent of planned dissemination activities and the potential for these activities to become fragmented, there is clear need to establish protocols both with respect to management of knowledge and Intellectual Property Rights (IPR).

The IPR protocol will be drafted within the Dissemination and Communication Strategy and agreed at Scientific Board level and all partners will be asked to abide by its terms and conditions. The project aim will be to make as many outputs as possible freely available and accessible. However, SOILCARE appreciates that data, knowledge and other intellectual property which come from participants who are in the non-governmental or university sectors cannot be revealed too early in their development without risking original ideas being exploited by outsiders. Disclosure of knowledge can therefore be a sensitive issue. It will be essential to understand current legislation and protocol, and to be able to adapt procedures to safeguard those whose knowledge needs protection, including local stakeholders whose knowledge and experience of soil quality and its management might be tapped during the various research activities. In accordance with the Open Research data Pilot, partners in the SOILCARE consortium will share their research results within the project and/or publicly with minimum delay. The details of the most appropriate open access mechanisms will be discussed and agreed at the first plenary meeting of the project. When selecting media (including scientific journals) to publish their research, the public access mechanisms of that media will be a prime consideration. For peer-reviewed scientific papers, (gold) open access publishing will be promoted by budgeting some publication costs for Study Site partners and WP leaders. Where this budget is not sufficient, or gold open access not possible, green open access principles will be used. The majority of results and communication or dissemination products will also be made publicly available, and stored on the project's own website and online information system as soon as is practical. It is envisaged that SOILCARE will provide a repository for all deliverables and outputs acquired during the course of the project.

Communication activities
Communication is very closely linked to dissemination. Indeed, all dissemination measures described in section 2.2.1. are also communication measures. Communication will occur throughout the project, both raising awareness of the project and disseminating its results and given the variety of target groups, will be achieved at different levels (depending on the scientific literacy of the target group), using appropriate formats to reach the different target groups. Central to the communication activities will be the project website which will also host the Dissemination and Communication Hub and will display the latest news items, project newsletters and contain links to the project Facebook group and Twitter feeds.

One subject that requires specific attention in relation to communication is branding. We will, from the start of the project, work on the establishment of SOILCARE as a brand. This involves development of logo and templates at the very start of the project, and using these in all our communication and dissemination efforts.

3. Implementation

3.1 Work plan — Work packages, deliverables and milestones

3.1.1 Overall structure of the work plan
SOILCARE consists of eight interrelated work packages, as shown in figure 3.1. SOILCARE will start (WP2) by taking full stock of existing data, as can be found in literature, in databases with field-tested evidence resulting from (on-going) experiments on soil-improving CS and in results of related EU-projects. A meta-analysis is made of these data and a conceptual framework is developed that defines which CS can be considered soil-improving based on an assessment of how CS impact physical, chemical and biological soil properties and soil quality indicators. Within this framework a SWOT (Strengths, Weaknesses, Opportunities and Threats) analysis will be developed and applied to make assessments of soil-improving CS in terms of crop yields, resource efficiency, costs, environmental impact indicators, soil threats and soil quality. These data will also be used to make a pre-selection of soil-improving CS, based on conditions (pedo-climatic, bio-physical, socio-economic, political), requirements of different CS, and benefits and drawbacks as evident from existing literature and LTE data. This information provides input to the development of a monitoring plan and an evaluation methodology that will be used to assess CS in 16 Study Sites located in different pedo-climatic zones of Europe (WP4). SOILCARE will take a trans-disciplinary multi-actor approach (see Table 1.2) by involving a range of actors in the consortium who have been active in proposal development and will be involved in the planning of work and experimentation through to dissemination, demonstration, and possible exploitation of results. They bring a range of complementary knowledge (see section 3.3.3), which will enable the projects objectives to be met. In addition the project will closely involve stakeholders from the start of the project (WP3), for example in the selection of CS to implement for testing, as well as in implementation, monitoring, evaluation and assessment of adoption dynamics and incentives.

Evaluation of soil-improving strategies will be done using the developed evaluation methodology at Study Site level taking into account relevant environmental, economic, social and political aspects (WP5). This will provide information about the performance of tested CS with respect to potential to improve soil quality, sustainability and profitability in the Study Sites. Assessments of ways in which drawbacks can be minimised are part of the Study Site evaluation. The Study Site results will be upscaled to European level (WP6) using a spatially-explicit criteria-based model assessment, to provide information on 1) which CS could be applied where in Europe, 2) which CS would be most applicable/profitable in specific locations, 3) which limitations to adoption currently exist, and 4) ways to overcome these limitations. Exploratory scenarios will be used at European scale to test the robustness of selected cropping systems and agronomic techniques under changed socio-economic and climate conditions. These results will be used in policy analysis (WP7) and dissemination (WP8), with a view to improving adoption. Existing policies (e.g., Common Agricultural Policy, Rural Development Program, Water Framework Directive, Nitrates Directive, Fertiliser Regulation) will be analysed for their impacts on (adoption) of CS, both in the early stages of the project and in the final stages to identify ways in which policies could be supported to improve adoption of promising CS. Finally, to encourage wider adoption of soil-improving CS, project results will be disseminated to all relevant stakeholders using appropriate and up-to-date communication channels and formats.

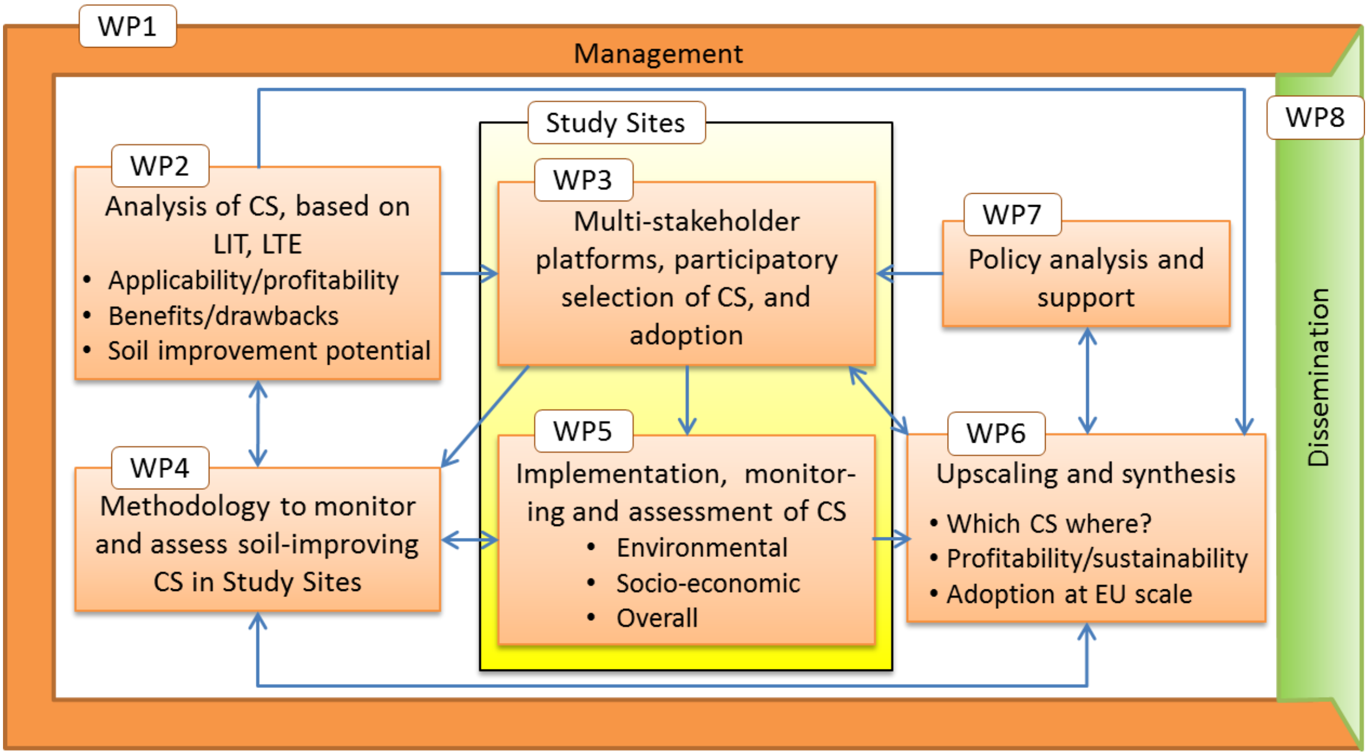


Figure 3.1. SOILCARE approach. LIT refers to literature and other published data, LTE to long term experiments, and CS to cropping systems including agronomic techniques.

3.1.2 Timing of work packages and their components

Timing of work packages and their components is given in table 3.1a.

3.1.3 Detailed work description

The work packages foreseen in SOILCARE (see also Figure 3) are summarised below, and are discussed in detail in table 3.1b.

WP1 (lead: Alterra-DLO – partner 1) will deal with project management, focusing on i) activity management, ii) financial and legal management, iii) communication among partners and with the European Commission, iv) implementation of the gender action plan, and v) organisation of meetings. WP1 will deliver the SOILCARE project website, the DMP, and the contractual reports to the EC.

WP2 (lead: Alterra-DLO – partner 1) will review available literature, databases, and existing long term experimental data from ongoing (EU) projects) to provide an overview and analysis of soil-improving CS that could be used for the different pedo-climatic conditions in Europe. Published meta-analyses about effects of CS on soil quality aspects (e.g. Van den Putte et al., 2010) will be supplemented with data on soil quality aspects that are not yet covered, to develop a conceptual framework. A decision tool for the pre-selection of soil-cropping systems will be developed and will be provided as input for WP3. It is based on 1) Suitability of soil-improving CS for Europe, as function of pedo-climatic zones, and socio-economic conditions, 2) Suitability and effectivity of soil-improving CS to address impairments resulting from different soil degradation processes, 3) Potential benefits, drawbacks and limitations of CS, which is the basis of the development of the methodology in WP4, and 4) Requirements for use of CS, including knowledge, use of exogenous energy, fertilisers, pesticides, water, and machinery. The decision tool will provide input for the integrated assessment that will be performed in WP6. The main WP2 results will be: 1) Framework for analysis of existing soil-improving CS, 2) Report on assessment of the benefits and drawbacks of existing soil-improving CS used in Europe, and their impact on soil quality, environment, crop yield, profitability and sustainability, to be used in WP4, and 3) List of pre-selected CS to be explored in WP3 and WP6.

Table 3.1a Timing of work packages and their components (dark tone indicates intense activity, light tone less intense activity. D refers to deliverables, and M to milestones.

Year	Y1	Y2	Y3	Y4	Y5
Month	2 4 6 8 10 12	14 16 18 20 22 24	26 28 30 32 34 36	38 40 42 44 46 48	50 52 54 56 58 60
WP1 Project management[1]					
T 1.1 Activity management	D1.2				
T 1.2 Financial and legal management					
T 1.3 Gender equality					
T 1.4 Communication	D1.1				
T 1.5 Organisation of meetings					
WP2 Review of soil-improving CS					
T 2.1 Review of soil-improving CS		D2.1			
T 2.2 Development of an analytical framework	M1			D2.2	
T 2.3 Pre-selection of key soil-improving CS	M2				
WP3 Participatory selection of CS					
T 3.1 Stakeholder analyis, and involvement	M3 M4, D3.1				
T 3.2 Selection of CS for testing		D3.2			
T 3.3 Social factors influencing adoption			D3.3		
T 3.4 Workshop to seek stakeholder feedback					D3.4
WP4 Methodology to monitor and assess CS					
T 4.1 Development of methodology		M5			D4.1
T 4.2 Elaboration of monitoring plan		D4.2			
WP5 Monitoring and assessment of CS					
T 5.1 Implementation of CS			M6		
T 5.2 Monitoring, cloud-storage data-base			M7		D5.1
T 5.3 Demonstration to stakeholders					D5.2
T 5.4 Analysis of monitoring					D5.3
WP6 Upscaling and synthesis					
T 6.1 Synthesize and integrate results					D6.1
T 6.2 Upscale Study Site results				M8	D6.2
T 6.3 Explore uncertainties					M9
T 6.4 Development interactive mapping tool					D6.3
WP7 Policy analysis and policy support					
T 7.1 Review of relevant policies		D7.1			
T 7.2 Incentivies and success factors				D7.2	
T 7.3 Policy briefings and recommendations					D7.3
WP8 Dissemination and communication					
T 8.1 SOILCARE information hub	M10				D8.1
T 8.2 Soil related advice landscape					
T 8.3 Dissemination, communication strategy	D8.2				
T 8.4 Operationalising the strategy					D8.3
T 8.5 Exploitation and sustainability planning					D8.4

[1] Some titles of WPs and Tasks have been abbreviated for this table; full titles can be found in section 3.1.3

WP3 (lead: BCU – partner 2) will form the cornerstone of the multi-stakeholder approach and will select cropping systems and agronomic techniques to be implemented for testing in the Study Sites. Following a stakeholder analysis, three cropping systems and agronomic techniques per Site will be selected in stakeholder workshops from a list of options identified in WP2. Multi-stakeholder advisory panels will be established in each study site, and stakeholder involvement in other WPs will also be supported through expert inputs and internal training from the WP3 team. In addition to facilitating stakeholder participation across the project, WP3 will provide evidence about social factors influencing the adoption of soil-improving innovations, which will inform the development of scenarios and models in WP6. In selected sites, qualitative data will be collected to consider how the dynamics of trust (across space, time, social groups and culture) may explain how innovations are adopted through social learning processes that occur at different levels, and empirically and theoretically investigate the social acceptability of new technologies such as new CS. This will include an analysis of interactions between personal preferences, and values and beliefs of different social groups (including members of the research, policy and practitioner communities), as these social factors influence adoption of the soil-improving innovations. WP3 will work with WP8 to identify the most suitable ways and formats to disseminate project results within the Study Sites. The main WP3 results will be: 1) Report on stakeholder analysis, 2) Multi-stakeholder advisory panels in Study Sites, 3) Report on the role of trust in adoption of CS, and 4) Selection of cropping systems to be tested in WP5.

WP4 (lead: UNIBE – partner 9) will develop a comprehensive methodology for assessing both benefits and drawbacks of different CS, which will serve for monitoring as well as evaluation purposes. The methodology will be developed in collaboration with WP2 and with ongoing projects for soil quality assessment, and building on existing concepts, such as crop suitability maps. Additional components will be added, including economic assessments at farm level (resource input and cost, energy, yield, cost-benefit and competitiveness), environmental assessments (water quality, infiltration capacity, soil quality, contamination, GHG, ammonia, compaction, erosion and other degradation processes, soil biodiversity and wildlife, ecosystem services, sustainability, and human health) and socio-cultural assessments (traditions, gender, workload, and diets). The methodology will be developed in collaboration with stakeholders to perform an overall assessment of CS, by taking into account the above mentioned sustainability aspects. The methodology will be formalised in guidelines for comprehensive and standardised assessment of land management to be used beyond the project lifetime. This will entail a number of innovative, but also already established tools for assessment and monitoring (WOCAT (Schwilch et al 2011), TASC (Tyres/tracks And Soil Compaction) tool (Diserens and Battiato, 2014)). Based on this, a monitoring plan will be elaborated for each study site in collaboration with WP5, and will specify what will be monitored, with which methods, indicators and sensors, how often, at which scale and by whom. This plan will ensure that monitoring in all sites will be done in comparable fashion, and that the data that are needed for evaluation of CS are included, but also that study site specific conditions such as the pedo-climatic zones and the socio-economic context are taken into account.

WP5 (lead: KUL – partner 3) will implement the soil-improving CS that were selected in WP3 for testing in collaboration with stakeholders. Where possible, already implemented CS will also be monitored to be able to assess longer-term effects. Monitoring will continue for 2-3 years to be able to assess performance under different weather conditions. The assessment methodology developed in WP4 will be applied to determine which soil-improving CS would be most suitable for each site. The analysis will also show which are the most important factors that determine profitability and sustainability, which are the most important drawbacks, as well as the reasons for that. These insights will allow us to provide recommendations on how drawbacks can be minimised. Demonstrations will be given in collaboration with WPs 3 and 8 to share and discuss monitoring and assessment results with stakeholders. Data from the Study Sites will be stored in formats that facilitate comparison between Study Sites in WP6, according to the monitoring plan developed in WP4. In cooperation with partners, especially WP4, a common database structure will be designed and the database will be safeguarded in cloud storage, and can be consulted by the project members. Data-extraction and elementary exploration procedures will be prepared for the partners. The main WP5 results will be: 1) Common database structure, 2) Report on monitoring results in the Study Sites, and 3) Report on assessment of soil-improving CS at Study Site level.

WP6 (lead: RIKS – partner 6) will synthesize and integrate the results from the different Study Sites, and from existing data sources, to draw lessons about application CS on the European scale. Assessment results will be extrapolated to European scale using the zonation and tools specified in WP2. Socio-economic conditions will be taken into account too to assess barriers for adoption, and methods that might be applied to promote adoption (in close collaboration with WP3 and WP7). Exploratory scenarios will be used to enhance the understanding of future uncertainties resulting from climate change and socio-economic developments, in order to test the robustness of

CS. These scenarios will include qualitative and quantitative aspects and will be developed using a combination of methods including participatory workshops, quantitative analysis and forecast modelling. Scenarios will also include projected changes in climate and their effect on agricultural productivity. WP6 will develop interactive maps that show which CS can be applied where in Europe, supplemented by relevant additional information for their uptake, such as required inputs and machinery and information on how profitability of each technique is likely to vary across Europe. To communicate the EU-level findings, WP6 will develop a spatially explicit and interactive tool that enables users to select soil-improving CS for different locations in Europe. This WP will also arrange that European scale project results will remain available and accessible after the end of the project. The main WP6 results will be: 1) Report on barriers for adoption and possible ways to overcome these, 2) Report on potential of soil-improving CS in Europe, and 3) Interactive tool for selection of soil-improving CS in Europe.

WP7 (Lead: Milieu – partner 10) will analyse existing relevant policies and practices at EU level and in Member States with relevance to soil quality and land degradation. In particular, attention is given to policies, instruments and practices that can facilitate the adoption of soil-improving techniques. Starting from this assessment good policy alternatives to facilitate adoption will be selected. The performance of the alternatives and consequent selection of good policy alternatives will be done at EU-level and at site level. At EU level, the selection will be done based on scenarios using the integrated modelling and upscaling efforts in WP6. At Study Site level, a dedicated workshop, and further in-depth interviews, will be organised focusing on firstly the short-listing of good alternatives and secondly, the impact assessment of shortlisted scenarios. The performance of good policy alternatives will be assessed according to various criteria. In addition, the advantages and disadvantages are described. A synthesis will be developed for each Study Site and consequently discussed with the engaged stakeholders. In addition, as an input to the upscaling in WP6, results at study site level will also be compared to assess e.g. to which extent good practices can be transferred to other Study Sites and how outcomes at study site level compare to the results at EU level. Finally, succinct and appealing policy briefings are developed on the main outcomes of all WP's. The policy briefings are aimed at effectively promoting the adoption of soil-improving CS in the study site country and region and more broadly in the EU. Main WP7 results will be: 1) Report on how current policies influence adoption of soil-improving CS, 2) Report on the selection of good policy alternatives, and 3) Policy briefings.

WP8 (lead: UoG – partner 4) will develop a targeted SOILCARE Dissemination and Communication strategy to ensure wider adoption of the soil-improving CS. An effective dissemination and communication on the project and its results is of crucial importance. The strategy will identify target audiences, and ways to provide messages at different levels of complexity and in the right format. Also efforts will be focussed on building a social media presence (Twitter, Facebook) throughout the life of the project; on building and maintaining a dissemination website; and on developing links with existing organisations promoting soil-improving CS and techniques, such as European Conservation Agriculture Federation (ECAF). In this way, the project results can be disseminated widely to all relevant stakeholders, in formats that are appropriate for the different audiences, such as farmers, farmer organisations, agriculture lobbies (e.g. COPA-COGECA, IFOAM), environmentalists, NGOs, policy makers and the general public. Examples of different dissemination formats will include: factsheets, technical leaflets, policy briefs, workshops/field days, tweets, film, facebook messages, scientific articles and presentations at congresses. Local language will be used to inform local to regional stakeholders. Care will be taken to reach not only stakeholders that are already involved in the project, but also stakeholders outside the project Study Sites. The main WP8 results will be: 1) Dissemination and communication strategy, 2) Dissemination website, and 3) Targeted dissemination materials for different audiences.

Table 3.1b: Work package descriptions

Work package number	1	**Start Date or Starting Event**			1		
Work package title	Project management						
Participant number	1	2	3	4	6	9	10
Short name of participant	Alterra-DLO	BCU	KUL	UoG	RIKS	UNIBE	Milieu
Person/months per participant:	35	1	1	1	1	1	1

Objectives

The overall objective of WP1 is two-fold: 1) to ensure proper activity management of the project, 2) to streamline administrative, financial, legal and IP (Intellectual Property) issues in order to enable RTD partners to focus on their research activities. Specific sub-objectives are:

- Activity management to facilitate smooth operation of the project objectives by supporting the coordinator, WP leaders and other partners, and compiling the periodic activity reports
- To handle all the financial, administrative and legal matters of the consortium
- Address gender equality issues in the project
- To ensure good communication within the project, and to parties outside the consortium
- To organize plenary project meetings and to facilitate the organization of Scientific Board meetings

Description of work and role of participants

Task 1.1: Activity management (Lead partner 1, partners: WPs)

- Activity management is aimed at tracking the progress of the activities of the project and includes: i) maintenance of the project work plan and monitoring of its implementation, ii) identification of required corrective actions and contingency plans, iii) implementation of decisions of the project managerial bodies
- Coordination of reporting procedures aimed at preparing periodic and final activity reports that comply with the EC rules
- Give overall direction to the project and provide follow-up on decisions of the plenary project meetings and the Scientific Board meetings
- Preparation of the Data Management Plan (DMP)
- The Project Advisory Board will be recruited and consulted regularly

Task 1.2: Financial and legal management (Lead partner 1)

- Preparation of Consortium Agreement (CA) with the aim of regulating the managerial bodies, the decision making process, and the management of IP and prior-existing knowledge
- Financial administration will take care of: i) timely distribution of funding to the partners via a dedicated Euro account, ii) budget management, utilization and monitoring and, iii) preparation of annual consortium consolidated financial statements
- Coordination of reporting procedures is aimed at preparing periodic and final management reports that comply with the EC rules. Preparation of periodic management reports, including justification of costs and Form C of all beneficiaries. Online reporting tools will be used to ensure efficient communication between project management and project partners.

Task 1.3: Gender equality (Lead partner 1)

SOILCARE will actively promote gender equality within the consortium, and will also pay due attention to gender related aspects in executing the project, especially in relation to activities in each of the Study Sites. Questionnaires and reports required by the European Commission concerning gender issues will be submitted. These activities will be coordinated by a subcontractor of partner 1.

Task 1.4: Communication (Lead partner 1, partners: 4)

- To establish and maintain a project website, including a Dissemination and Communication Hub in collaboration with WP8
- To prepare a project dissemination, communication and visibility plan in collaboration with WP8
- To initiate and develop project working papers and project communication series for, respectively, internal and external communication of project results; also in collaboration with WP8

Task 1.5: Organisation of meetings (Lead partner 1, partners: WPs)

- Smooth organization and facilitation of activities of the project will be achieved by plenary meetings planned well in advance, which ideally will be hosted by partner organisations with Study Sites. The goal of the meetings is to evaluate project progress, to outline work plans, to have scientific discussions, targeted training sessions for project partners, and to receive updates regarding the financial and IP status and interactions with the EC
- Organisation and facilitation of Scientific Board meetings, which will be either physical meetings or electronic

meetings, whatever is most appropriate at the time. Partner 1 (Alterra-DLO) will facilitate the organization of Scientific Board meetings which will be planned ahead of time

Links with other WPs
WP1 will work with all WPs and partners. It will in particular collaborate with WP8 on dissemination and communication issues, including management of the information Hub, and for preparation of the DMP.

Deliverables
1.1 SOILCARE website (Month 3)
1.2 Data Management Plan (Month 6)

Work package number	2	**Start Date or Starting Event**		1		
Work package title	Review soil-improving CS						
Participant number	1	3	5	6	7	9	10
Short name of participant	Alterra-DLO	KUL	UH	RIKS	TUC	UNIBE	Milieu
Person/months per participant:	25	4	3	2	2	4	1
Participant number	11	12	13	14	17	18	19
Short name of participant	Bioforsk	BDB	AU	GWCT	ESAC	ICPA	UNIPD
Person/months per participant:	2	2	3	2	3	3	1
Participant number	20	21	22	23	26	27	28
Short name of participant	IA	WU	UP	SLU	VURV	UAL	FRAB
Person/months per participant:	2	2	3	1	3	2	2

Objectives
The main purpose of WP2 is to review and assess currently used soil-improving cropping systems and agronomic techniques in EU. Specific objectives are:
- To review soil-improving CS and their key driving forces, in Europe,
- To analyse the strong and weak points (SWOT analysis) of the identified soil-improving CS, using agronomic, environmental, and social-economic criteria,
- To develop and test a framework for classifying soil improving CS,
- To derive threshold values for soil quality, and to identify the need for soil-improving CS as function of pedo-climatic zones in Europe, and
- To develop and test a decision tool to be used for the pre-selection of key soil-improving CS.

Description of work and role of participants

Task 2.1: Review of soil-improving cropping systems (Lead partner 1, partners: WPs, Study Sites)
The work proposed here builds on insights, results and data gathered in a number of recent EU-wide projects, surveys and databases, as well as in long-term field experiments and farmers' networks across representative land use and pedo-climatic zones in EU-28. We will review available literature, databases (e.g. Survey on Agricultural Production Methods (SAPM), Farm Structure Survey (FSS), Farm Accountancy Data Network (FADN), and existing long term experimental data from ongoing (EU) projects) to provide an overview and analysis of soil-improving CS that could be used for the different pedo-climatic conditions in Europe. Results of the FSS and SAPM databases in Eurostat will be used to provide a general overview of cropping systems in Europe, including tillage methods, soil conservation methods, landscape features, and forage systems. The WOCAT database will also be consulted for sustainable cropping practices in Europe and their documented evaluation. Effects of soil improving cropping systems and best management practices on soil quality and functions will be derived from literature reviews, on-going field experiments and farmers' networks. Information from farmer's networks will be obtained through interviews. A SWOT analysis will be carried out for soil-improving strategies based on: i)

Agronomic aspects, i.e. crop yields, crop quality and occurrence of soil pathogens, crop diseases, and weeds, ii) Soil quality aspects and soil improvement potential, iii) Economic aspects, i.e., cost of production, iv) Resource use efficiency, including land, water, nutrients, pesticides, energy and soil biodiversity, v) Human health and environmental impacts, including effects on ground and surface water quality (eutrophication by N and P, contamination with heavy metals and pesticides), and air quality (emissions of greenhouse gases (CO_2, N_2O, CH_4), nitrogen gases (NH_3, NOx) and volatile organic compounds to the atmosphere), and wildlife, and vi) Any other drawbacks and limitations, including uncertainties. These analyses will provide information not only on the CS, but will also indicate what key factors to assess in evaluation of CS, which is relevant for development of methodology in WP4. Results will be summarized in a report and scientific publication. Results will be summarized in a report and scientific publication.

Task 2.2: Development of an analytical framework (Lead partner 1, partners: WPs, partner 21)

Based on results from Task 2.1, an analytical framework will be developed, tested and used to identify the cropping systems that can be considered 'soil-improving', following an assessment of how these systems impact soil quality and functions. The framework will be used (i) to assess the specific needs for soil-improving cropping strategies as function of pedo-climatic zones in Europe, and (ii) to identify the most crucial soil-environmental factors and indicators that can be used to determine which CS could be used where in Europe, to improve soil quality and functioning. Next, threshold values will be derived, using amongst others work done in the iSQAPER project, and these threshold values will be used, in cooperation with WP 6, to evaluate the status of soil quality in Europe and to determine whether soil quality is sufficient for CS (above threshold) or not (below threshold). Proto-types of the framework will be discussed in workshops, and tests will be made in farmers networks in a range of pedo-climatic zones. Results will be summarized in a scientific publication. The data and information obtained from the application of the framework will feed into the methodology to be developed in WP4.

Task 2.3: Pre-selection of key soil-improving cropping systems (Lead partner 1, partners: WP3, 4)

Results of the SWOT-analyses in Task 2.1 and of the soil quality assessment in Task 2.2 will be used to develop and test a decision tool for the pre-selection of soil-cropping systems, as input for WP3. The following criteria will be used likely for the pre-selection: 1) Suitability of soil-improving CS for Europe, as function of pedo-climatic zones, and socio-economic conditions, 2) Suitability and effectivity of soil-improving CS to address impairments resulting from different soil degradation processes, 3) Potential benefits, drawbacks and limitations, which will inform the development of the methodology in WP4, and 4) Requirements for use of CS, including e.g., knowledge, use of exogenous energy, fertilisers, pesticides, and machinery. The main results if this task is a list of pre-selected soil-improving cropping systems, to be explored in WP3.

Links with other WPs

WP2 provides information on CS that is relevant to all WPs. In particular, WP2 provides WP3 with a pre-selection of CS, WP4 with information relevant to develop the evaluation methodology, and WP6 with information on CS applicability relevant for upscaling.

Deliverables
2.1 Review report of soil-improving cropping systems (Month 18)
2.2 Scientific publications, based on the work done in Task 2.1-2.3 (Month 48)

Work package number	3	**Start Date or Starting Event**		1		
Work package title	Multi-stakeholder involvement, participatory selection of CS, and adoption					
Participant number	1	2	3	4	5	6	7
Short name of participant	Alterra-DLO	BCU	KUL	UoG	UH	RIKS	TUC
Person/months per participant:	2	28	3	2	3	1	1
Participant number	9	10	11	12	13	14	17

Short name of participant	UNIBE	Milieu	Bioforsk	BDB	AU	GWCT	ESAC
Person/months per participant:	3	3	3	2	3	3	3
Participant number	18	19	20	22	23	25	26
Short name of participant	ICPA	UNIPD	IA	UP	SLU	PM	VURV
Person/months per participant:	4	3	4	5	2	3	3
Participant number	27	28					
Short name of participant	UAL	FRAB					
Person/months per participant:	3	3					

Objectives:

- Create multi-stakeholder advisory panels to guide and co-produce research in each study site
- In collaboration with advisory panels, identify the most suitable ways and formats to disseminate project results within the study sites (in collaboration with WP8)
- Using deliberative multi-criteria techniques, work with local consortium partners to facilitate local stakeholders in each study site to select cropping systems and agronomic techniques
- Collect evidence about social factors influencing the adoption of soil-improving innovations (identified initially by case study partners in WP2, and to inform the development of scenarios in WP6)
- In selected sites, collect and analyse qualitative data to consider how the dynamics of trust and other factors may explain the social acceptability and adoption of soil-improving innovations such as new cropping systems

Description of work and role of participants

Task 3.1: Stakeholder analysis, advisory panels and involvement (Lead partner 2, partners: Study Sites, WPs, partner 25)

WP3 will form the cornerstone of the multi-stakeholder approach, and will start by establishing multi-stakeholder advisory panels in each Study Site in collaboration with study site teams. With training and guidance from the WP3 team, a stakeholder analysis will be conducted in close collaboration with these stakeholder advisory panels, to identify relevant workshop participants, including those who may typically be marginalised from decision-making processes (and in selected sites, interviewees). These advisory panels will also provide information on the information needs that different stakeholder groups have. Stakeholder involvement in other WPs (e.g. participatory development of scenarios in WP6) will also be supported through guidance and internal training from the WP3 team.

Task 3.2: Selection of CS for testing (Lead partner 2, partners: Study Sites, WP4,5)

Three cropping systems and agronomic techniques will be selected in stakeholder workshops from a list of options identified in WP2. The list of selected measures will be provided to other WPs, in particular WP4 and 5. Workshops will be facilitated in local languages and run by study site teams with local facilitators, with training and guidance provided by the WP3 team.

Task 3.3: Social factors influencing adoption (Lead partner 2, partners: Study Sites, WP6,7,8)

In addition to building capacity among consortium members for stakeholder participation across the project, WP3 will provide evidence about social factors influencing the adoption of soil-improving innovations, which will inform the development of scenarios and agent-based modelling in WP6. In selected sites, mixed-methods data collection will be adopted. Survey instruments will be co-designed with the WP6 team to ensure data can efficiently inform the development of scenarios and models in subsequent work. Qualitative semi-structured interviews together with survey data will be collected to consider how the dynamics of trust (across space, time, social groups and culture) may explain how innovations are adopted through social learning processes that occur at different levels, and empirically and theoretically investigate the social acceptability of new technologies such as new CS. To do this, the WP will draw on applied anthropology and quantitative sociology, using qualitative analysis of interview transcripts and quantitative Social Network Analysis to analyse interactions between personal preferences, values and beliefs of different social groups (including members of the research, policy and practitioner communities), as these social factors influence adoption of the soil-improving innovations. WP3 will also from the beginning work with WP8 to identify the most suitable ways and formats to disseminate project results within the Study Sites.

Task 3.4: Workshop to seek stakeholder feedback on preliminary findings (Lead partner 2, partners: Study Sites, WPs)

Finally, WP3 will organise workshops in collaboration with study site teams to provide feedback on research findings to stakeholders, and seek feedback and discuss their interpretation of the results. These workshops will be organised and facilitated in local languages by study site teams, with workshop design and training provided by the WP3 team, and WP3 will collate feedback in a deliverable report.

Links with other WPs

WP3 will work on stakeholder involvement in all WPs. It will collaborate with WP6, 7 on adoption, and with WP8 on dissemination. WP3 participatory activities will also be central to preparing the dissemination strategy and to understanding stakeholder requirements in WP8.

Deliverables

3.1 Stakeholder analysis report providing results from each study site (Month 12)

3.2 List of CS selected for testing in WP5 (Month 18)

3.3 Report on the role of trust and other factors in the adoption and social acceptability of soil-improving innovations (Month 36)

3.4 Report describing final stakeholder workshops held in study sites, detailing stakeholder feedback on preliminary findings (Month 56)

Work package number	4	**Start Date or Starting Event**		5		
Work package title	Methodology to monitor and assess soil-improving CS in Study Sites						
Participant number	1	2	3	5	6	7	9
Short name of participant	Alterra-DLO	BCU	KUL	UH	RIKS	TUC	UNIBE
Person/months per participant:	5	1	8	4	1	3	14
Participant number	10	11	12	13	14	16	17
Short name of participant	Milieu	Bioforsk	BDB	AU	GWCT	SCR	ESAC
Person/months per participant:	1	1	1	1	3	6	3
Participant number	18	19	20	21	22	23	24
Short name of participant	ICPA	UNIPD	IA	WU	UP	SLU	Kongskilde
Person/months per participant:	3	1	2	4	2	3	1
Participant number	26	27	28				
Short name of participant	VURV	UAL	FRAB				
Person/months per participant:	2	2	1				

Objectives

The main objective of WP4 is to develop a comprehensive methodology for assessing both benefits and drawbacks of different CS, which will serve for monitoring as well as evaluation purposes.

Specific objectives are:

- To develop and test a comprehensive assessment methodology for Study Sites
- To elaborate a monitoring plan for each Study Site in collaboration with WP5

Description of work and role of participants

Task 4.1: Development of comprehensive methodology for evaluating CS (Lead partner 9, partners: Study Sites, WPs, partners 16, 21, 24)

The methodology will be developed in collaboration with WP2 and with ongoing projects for the assessment of CS and soil quality. It will thus build on existing concepts, such as the concept of Sustainable Land Management practices (SLM technologies questionnaire and database) from WOCAT, the TASC tool and crop suitability maps. Additional components will be added and detailed methods and tools will be included with regard to the economic assessments at farm level (resource input and cost, energy, yield, cost-benefit and competitiveness), environmental assessments (water quality, infiltration capacity, soil quality, contamination, GHG, compaction, erosion and other degradation processes (see for instance, Alaoui et al., 2011), soil biodiversity and wildlife) and socio-cultural assessments (traditions, gender, workload, human health and diets). The methodology will be developed in collaboration with stakeholders to perform an overall assessment of CS, by taking into account all the above mentioned sustainability aspects. The methodology will be formalised in guidelines for comprehensive and standardised assessment of land management to be used beyond the project lifetime. This will entail not only the already established tools for assessment and monitoring but also innovative ones. The methodology will thus be reviewed during the project and be finalized only after the field testing of WP5.

In selected Study Sites, this collection of methods will be tested together with stakeholders in order to evaluate its practical usefulness, applicability as well as its outcome (i.e. information strengths of resulting data). Improvements consider the selection of methods, but will also aim at reducing the number of indicators and assessment methods to the minimum needed without compromising the comprehensiveness and scientific strengths. The guidelines will mainly help to check for comprehensiveness rather than entail detailed manuals for all kind of assessment methods. The latter will be included through links to appropriate existing methods as identified in Task 1. The methodology will be applied in WP5. Some of the indicators will also serve for the upscaling and scenario modelling work in WP6.

Task 4.2: Elaboration of monitoring plan (Lead partner 9, partners: Study Sites, WP5,6, partners 16, 21, 24)

From the methodology developed in Task 2, a detailed monitoring plan for each study site will be elaborated by the study sites partners. With this procedure it can not only be assured that each monitoring plan is based on the pedo-climatic zone and the socio-economic context of the specific case study site, but that is also corresponds with specific needs and possibilities of the study site partner. The plan will specify what will be monitored, with which methods, indicators and sensors, how often, at which scale and by whom. The leaders of WP4 and WP5 will jointly review these plans and propose improvements. Possible improvement will not only concern comprehensiveness, but also include harmonization needs across the study sites. The role and involvement of stakeholders in the monitoring of the CS implementations shall be taken duly recognition during all important steps of the field study. This plan will ensure that monitoring in all sites will be done in comparable fashion using needed data for evaluation with respect to study-site specific conditions such as the pedo-climatic zones or the socio-economic context.

Links with other WPs

WP4 will closely collaborate with WP5, as it develops the monitoring and evaluation methodology that is used in WP5. It will also collaborate with WP2 to review existing methodologies, with WP3 to develop and test the methodology with stakeholders and with WP6 on indicator development.

Deliverables

4.1 Final version of Assessment methodology for Study Sites (Month 52)
4.2 Monitoring plan for Study Sites (Month 24)

Work package number	5	**Start Date or Starting Event**			21		
Work package title	Implementation, monitoring and assessment of CS						
Participant number	1	2	3	5	6	7	8
Short name of participant	Alterra-DLO	BCU	KUL	UH	RIKS	TUC	JRC
Person/months per participant:	2	1	32	11	1	9	2
Participant number	9	11	12	13	14	16	17
Short name of participant	UNIBE	Bioforsk	BDB	AU	GWCT	SCR	ESAC
Person/months per participant:	13	10	12	10	13	17	13
Participant number	18	19	20	21	22	23	25
Short name of participant	ICPA	UNIPD	IA	WU	UP	SLU	PM
Person/months per participant:	18	10	12	6	11	9	2
Participant number	26	27	28				
Short name of participant	VURV	UAL	FRAB				
Person/months per participant:	10	10	9				

Objectives

- Implement the soil-improving CS that were selected in WP3 for testing in collaboration with stakeholders
- Monitoring these CS for 2-3 years to be able to assess performance under different weather conditions
- Determine which soil-improving CS would be most suitable for each site
- Give demonstrations of CS to stakeholder to share and discuss monitoring and assessment results
- Building a common database which enables the comparison of the implementation, monitoring and assessment of the CS at the study sites

Description of work and role of participants

Task 5.1: Implementation of the soil-improving CS (Lead partner 3, partners: Study Sites, WP4,6, partners 16, 21, 24)

The CS that were selected in WP3 will be implemented according to the monitoring plan developed in WP4. Implementation (and monitoring in task 5.2) will be done in collaboration with stakeholders. Since the monitoring plan from WP4 was developed in collaboration with stakeholders and study site partners, it is ensured that the field experiments will be implemented in such a way that specific local circumstances are taken into account, but that implementation is also sufficiently similar across sites to allow comparison where needed (e.g. for sites with the same or similar CS). Forms will be drafted to ensure that the measurements specified in the monitoring plan can be conducted smoothly and completely.

Task 5.2: Monitoring of the field experiments and cloud-storage of the data-base (Lead partner 3, partners: Study Sites, WP4,6, partners 8, 16, 21, 24)

Monitoring will continue for 2-3 years to allow us to investigate developments over time, and in dependence of weather conditions. To store the data obtained in the field experiments in a standardised and accessible format,

a database structure and a "cloud" storage approach will be worked out with input from partner 8 (JRC). Timing will be agreed for data-entry by all the partners. The data-entry should be done as quickly as possible after collection, even as much as possible if technically feasible already in the field, e.g. using the iSQAPER app. Data-validation and quality control will also take place shortly after the data-entry, so that possible errors can be corrected, shortly after data-collection and entry. Thus, a good quality control of the monitoring across the field experiments in the different countries will achieved, so that the data analysis is straightforward without missing data across the experiments.

The structure should not only accommodate the data from the study sites but also allow queries across sites in different countries according to different criteria like climate, soil, tillage. All partners should have access to the data-base and be able to extract information. Hereto exploratory and more profound analysis methods need to be worked out. Important will be to agree a protocol between the different partners for the use of these data

Task 5.3: Demonstration to stakeholders (Lead partner 3, partners: Study Sites, WP8)

Field days will be organised during which stakeholders can visit the experiments, and during which these experiments and their results are discussed. To allow comparison between Study Sites, the on-site discussions will be semi-structured and reports will be made. Therefore every partner will use a similar checklist and reporting format. Results from different sites will be compared to draw general conclusions based on feedback received from stakeholders.

Task 5.4: Analysis of monitoring results (Lead partner 3, partners: Study Sites, WPs, partners 16, 21, 24)

The data collected at the field experiments will be analysed using the methodology developed by WP4 to assess the performance of soil-improving CS at Study Site level, which will allow to draw conclusions on which CS are most suitable in each particular Study Site. The analysis will also show which are the most important factors that determine profitability and sustainability, which are the most important drawbacks, as well as the reasons for that. These insights will allow us to provide recommendations on how drawbacks can be minimised. Study Site results will be shared with stakeholders through Task 3.4. The Study Site level analyses done in this task will also be provided to WP6 to synthesise and integrate results from the different sites. This is facilitated by using the database developed in Task 5.2, in which all the monitoring data are stored in a consistent and uniform way, so that comparisons can be made between the different Study Sites.

Links with other WPs

WP5 will work with WP4 to develop the evaluation methodology and monitoring plan. WP5 will evaluate CS at Study Site, and will provide these to WP6 for upscaling. It will work with WP8 on demonstration of CS. It also provides the database, which is used in particular in WP6.

Deliverables

5.1 Database with monitoring data (Month 50)

5.2 Report on demonstration activities in Study Sites (Month 50)

5.3 Report on monitoring results and analysis (Month 56)

Work package number	6	**Start Date or Starting Event**		9		
Work package title	Upscaling and synthesis						
Participant number	1	2	3	4	5	6	7
Short name of participant	Alterra-DLO	BCU	KUL	UoG	UH	RIKS	TUC
Person/months per participant:	9	4	5	1	5	23	2
Participant number	8	9	10	11	12	13	14
Short name of participant	JRC	UNIBE	Milieu	Bioforsk	BDB	AU	GWCT
Person/months per participant:	8	2	5	1	1	1	2
Participant number	16	17	18	19	20	21	22
Short name of participant	SCR	ESAC	ICPA	UNIPD	IA	WU	UP
Person/months per participant:	1	3	4	4	4	6	4
Participant number	23	26	27	28			
Short name of participant	SLU	VURV	UAL	FRAB			
Person/months per participant:	2	2	2	2			

Objectives

The main objectives of WP6 are to:

- Synthesize and integrate the results obtained by WPs 3-5 in the different Study Sites in order to draw general conclusions for the application of soil-improving CS
- Develop and apply a quantitative, spatially explicit model to assess the impact of soil-improving CS at the European level under a set of future scenarios

- Develop an interactive tool to assess the potential for application of soil-improving CS throughout Europe.

Description of work and role of participants

Task 6.1: Synthesize and integrate the results from the different Study Sites and existing data sources (Lead partner 6, partners Study Sites, WPs, partners 8, 16, 21)
Based on the results from the various Study Sites and using the outputs of WP2 as a starting point, n assessment will be made of the extent to which Study Site results: i) are transferable to other regions in Europe and under what circumstances, and ii) can be up-scaled to provide pan-European information for each CS and agronomic technique. Besides the pedo-climatic zones identified in WP2 and the bio-physical analysis from WP5, we will look at the socio-economic and political context (WP3, WP5 and European wide data sources such as Eurostat and FADN) to pursue the potential for integration and upscaling. As part of this we will look at (integrated) indicators for productivity, profitability, adoption, competitiveness and sustainability. We aim to understand limitations and barriers for adoption by addressing social, economic, political and environmental aspects, building on results obtained by WP3 at Study Site level. Synthesised results from this assessment will be extrapolated to European scale in Task 6.2.

Task 6.2: Upscale study site results to European level using modelling (Lead partner 6, partners Study Sites, WPs2,3,7,8)
A spatially-explicit integrated assessment model (IAM) will be developed to assess the impact of CS and agronomic measures throughout Europe. The approach will build on EU-wide integrated assessment modelling approaches developed in previous European research projects (MedAction, LUMOCAP, DeSurvey, CASCADE, RECARE), which have over the years resulted in a flexible and modular modelling framework. The SOILCARE IAM will include models and model components from this framework operating at appropriate scales, with feedbacks where relevant. More in particular an agricultural economic model which considers macro-economic factors and local and global foodmarkets (LUMOCAP PSS), farm level behaviour (RECARE IAM), land use and management (Metronamica), bio-physical and dynamic suitability (PESERA and RECARE IAM) and components for socio-economic and environmental impact assessment (Miterra Europe and indicator algorithms from previous projects). Main enhancements to existing models and modelling framework will be the strengthening of the biophysical modelling to allow simulating impacts of management options on productivity, profitability and competitiveness, as well as additional ecosystem services and sustainability indicators (based on knowledge obtained from WP2 and WP5) by using the zonation and tools specified in WP2 and by complementing the framework with Miterra Europe, improved interaction between macro and micro-economic processes and the enhancement of the agent-based farmer decisions model for simulating crop choice and applied management practices by including behavioural rules related to the adoption of management practices based on results from WP3 and EU-wide data sources such as Eurostat, FADN, LUCAS and Corine Land Cover.

The IAM will operate at different scales (EU, national, regional, local) and have a spatial resolution of 100-500 m at local level. We will likely apply a monthly temporal resolution to capture the bio-physical changes throughout the year. The foreseen time horizon is 2050. Indicators to be incorporated will be agreed in collaboration with WP4 and calculated based on model results and where necessary and relevant additional data.

As a European-wide database for a full historic calibration and validation of the integrated assessment model is currently not available, we will complement the structural validation and the historic calibration and validation of the model with expert judgement. Workshop sessions will be organised in which project members are asked to assess the results of the integrated assessment model using their knowledge on the different processes of CS and agronomic practices as well as the adaptation of them, especially for their Study Site areas. Experts from outside the consortium will also be invited to provide their opinion, in particular on the overall EU-wide behaviour and model results.

We will establish a reference scenario that builds on historic developments and current and agreed policies. Using the EU-wide integrated assessment model we will assess the impact of applying soil improving techniques throughout Europe and the role different environments and socio-economic conditions play in this. The modelling will support assessing which soil-improving CS could be applied where in Europe, which CS would be most applicable/profitable in specific locations, which limitations to adoption currently exist, and if there are ways to overcome these limitations.

Task 6.3 Explore future uncertainties impacting on profitability and adoption of CS and agronomic practices (Lead partner 6, partners Study Sites, WPs)
Exploratory scenarios will be used to enhance the understanding of future uncertainties resulting from climate change and socio-economic developments, in order to test the robustness of CS. These scenarios will include qualitative and quantitative aspects and will be developed using a combination of methods including participatory workshops, quantitative analysis and forecast modelling. A series of workshop will be organized with EU-level stakeholders in order to develop qualitative scenarios in the form of narratives to allow for a creative and rich exploration of how the future might unfold. These narratives will be used as input into the modelling, and the modelling will in-turn be used to bring scientific input into the scenarios and enhance the consistency and coherence of the narratives. Moreover it will contribute with a visual and spatially explicit understanding of the impact of a combination of drivers on land use, productivity, profitability, sustainability and ecosystem services indicators. The scenarios will subsequently be used to assess the impacts of various policies in collaboration with WP7. The impact of (a combination of) policies will be assessed for each scenario as well as the robustness of this (combination of) policies under the range of scenarios.

Task 6.4 Development of an interactive mapping tool (Lead partner 6, partners Study Sites, WPs)
To communicate the EU-level findings, WP6 will develop a spatially explicit and interactive tool that enables users to select soil-improving CS for different locations in Europe. This WP will also arrange that European scale project results will remain available and accessible after the end of the project.

The envisaged tool will include interactive maps that show which CS can be applied where in Europe, supplemented by relevant additional information for their uptake, such as required inputs and machinery and information on how profitability of each technique is likely to vary across Europe. It will build on the results from tasks 6.2 and 6.3 and hence also include how profitability and adoption of techniques will be impacted under different future pathways.

Links with other WPs
WP6 integrates results from Study Sites (in particular WP3,5), and also uses information from WP2 (zonation and suitability criteria of CS). It works together with WP7 on policy-related issues, and investigates barriers to adoption with WP3, 7 and 8. WP6 collaborates with WP4 on indicator development.

Deliverables

6.1 Report on the integration and synthesis of Study Site results and their potential for upscaling (Month 50)

6.2 Report on the potential for applying soil-improving CS across Europe (Month 52)

6.3 Interactive mapping tool for the application of soil-improving CS across Europe (Month 56)

Work package number	7	**Start Date or Starting Event**		1		
Work package title	Policy analysis and policy support					
Participant number	1	2	3	4	5	6	7
Short name of participant	Alterra-DLO	BCU	KUL	UoG	UH	RIKS	TUC
Person/months per participant:	2	1	2	1	3	1	2
Participant number	8	9	10	11	12	13	14
Short name of participant	JRC	UNIBE	Milieu	Bioforsk	BDB	AU	GWCT
Person/months per participant:	1	1	25	2	2	2	2
Participant number	15	17	18	19	20	22	23
Short name of participant	Teagasc	ESAC	ICPA	UNIPD	IA	UP	SLU
Person/months per participant:	6	2	4	2	2	3	2
Participant number	26	27	28				
Short name of participant	VURV	UAL	FRAB				
Person/months per participant:	2	2	2				

Objectives

To identify good policy alternatives to adopt the soil-improving techniques researched in the other WP's. More specifically, WP7 focuses on the institutional (governance) aspects of achieving smarter and more sustainable agriculture and has the following aims:

- To review current policies with relevance for soil quality, soil degradation, and adoption of CS
- To select policy alternatives to enhance soil quality and prevent land degradation in agriculture at various scales (Europe, national, sub-national and local) and following a participatory multi-actor approach.
- To promote policies that can increase adoption of soil-improving CS, by translating scientific SOILCARE results into policy briefings

Description of work and role of participants

Task 7.1: Review of relevant policies (Lead partner 10, partners: Study Sites, WPs, partner 15)

The team will analyse existing relevant policies and practices at EU level and in Member States with relevance to soil quality and land degradation. In particular, attention is given to policies, instruments and practices that can facilitate the adoption of soil-improving techniques. The analysis will comprise of following steps:

- Desk review of EU policies and practices, starting from publicly available information, in addition to the policy analysis and recommendations developed under the H2020 LANDMARK project and other studies. The targeted EU policies include the reformed Common Agricultural Policy (CAP), the Nitrates directive, the Water Framework Directive, the Flood Directive, the Roadmap for a Resource-Efficient Europe / the Europe 2020 Strategy, the EU Adaption Strategy, the Soil Thematic Strategy, the Strategy on Green Infrastructure, the Biodiversity Strategy and the European Structural and Investment Funds (ESIF).
- Desk review of national policy in the study sites, with particular focus on existing programmes plans and implementation reports, such as the Rural Development Programmes (RDP's) under the CAP, the Operational Programmes (OP's) under the Cohesion Policy, the Stability / convergence programmes and national reform programmes to monitor progress towards the national targets under the EU 2020 Strategy, the River Basin Management Plans (RBMP's), Flood Risk Management Plans (FRMP's) and the National Adaptation Strategy (NAS)
- Interviews with EU officials, from various European institutions (DG ENV, DG AGRI, DG GROW, DG ENERGY, DG REGIO, DG CLIMA and others) and EU associations (actors in the food supply chain, environmental NGO's etc...) on upcoming initiatives, potential opportunities and needs and bottlenecks to a smarter and greener agriculture. The interviews will be accompanied with a series of workshops, organised under WP6.
- Interviews with national, sub-national and local authorities competent for the study sites, in addition to actors involved in the supply chain of agricultural products. The interviews will be associated to the stakeholder workshops organised by WP3 and done in local language by the study site teams.
- In order to facilitate an effective and consistent data collection across study sites, the study site teams will be trained and supervised by the WP7 team. For this purpose, guidance will be developed, as well as a template, and a filled out example.

The outcome of Task 1 is the identification of opportunities and bottlenecks in policy to enhance soil quality and land degradation and more specifically to facilitate the adoption of soil-improving techniques. A data register will be used to this end which will also be helpful in terms of carrying gathered data and information from one task to the next and of updating those data and information as appropriate throughout the project. This inventory will be updated and further fine-tuned during the course of the project.

Task 7.2: Selection of best policy alternatives to facilitate adoption (Lead partner 10, partners: Study Sites, WPs, partner 15)

Starting from the assessment in Task 1, Task 2 will select good policy alternatives (can be more than one) to facilitate adoption. A policy alternative refers to a set of policy options of various nature including market-based instruments, regulatory instruments and voluntary schemes such as e.g. certification schemes or resource pooling. While WP3 focuses on the adoption of the soil-improving techniques themselves, WP7 focuses on the institutional aspects of adoption, answering questions like: 'which policy alternatives can be used to facilitate adoption? What are advantages and disadvantages? What would raise the interest of actors in the supply chain for products from more sustainable agriculture? Is the current institutional capacity sufficient to facilitate adoption? WP7 focuses on institutional capacity and policy alternatives for the regulatory authorities at various scales, while WP8 address the latter in particular for the agricultural advisory services.

The performance of the alternatives and consequent selection of good policy alternatives will be done at EU-level and at site level. At EU level, the selection will be done based on scenarios. The impact of scenarios is quantified by means of the integrated modelling and upscaling efforts in WP6. The scenarios are further specified together with EU level stakeholders. At study site level, a dedicated workshop, and further in-depth interviews, will be organised focusing on firstly the short-listing of good alternatives and secondly, the impact assessment of shortlisted scenarios. The choice of good alternatives will be based on the scoring of a set of criteria by stakeholders. The criteria will include: a) the effectiveness to trigger adoption; b) potential design- or implementation-related obstacles that may be negatively affecting effectiveness (incl. potential social conflicts); c) costs related to implementation (investment and maintenance); and d) fitness with the prevailing socio-economic conditions and institutional context. The criteria and the selection method are given here as indicative and will also be discussed with the stakeholders, in order to build trust in the later results. Data generated in SOILCARE e.g. on costs and effectiveness, relevant for the selection of measures, will be compiled in a synthetic document and brought to the workshops to support the discussions where needed. To enable a transparent selection and in order to identify potential conflicts, the selection is based on a set of criteria, scored with quantitative values where available and qualitative estimates where needed. To trace potentially biased or extreme opinions, it is envisaged that at least 20 persons will be involved in the workshops and the interviews.

The main output from Task 2 will be the selection of good policy alternatives at EU and study site level to facilitate the adoption of soil-improving cropping systems. The performance of good policy alternatives will be assessed according to various criteria. In addition, the advantages and disadvantages are described.

Task 7.3: Synthesis & Policy briefings (Lead partner 10, partners: Study Sites, WPs, partner 15)
This task will compose of two activities: synthesis of the findings from Tasks 1 and 2 and the development of policy briefings. Firstly, a synthesis will be developed for each study site and consequently discussed with the engaged stakeholders. In addition, as an input to the upscaling in WP6, results at Study Site level will also be compared to assess e.g. to which extent good practices can be transferred to other case studies and how outcomes at study site level compare to the results at EU level. Findings on the institutional capacity and alternatives for the agricultural advisory services (from WP8) will be integrated.

Secondly, succinct and appealing policy briefings are developed on the main outcomes of all WP's. The policy briefings are aimed at effectively promoting the adoption of soil-improving CS in the Study Site country and region and more broadly in the EU. These briefings help to "translate" the scientific evidence for policy purposes. The target group and content of the policy briefings will be discussed with relevant authorities at study site level and EU level. It is expected that the policy briefings describe the soil-improving techniques, why they are needed, what there advantages (benefits) and disadvantages (trade-offs) are and how they can be adopted and realise a real-life impact. The broad dissemination of the policy briefings is done in WP8. Policy briefings are iteratively developed throughout the project. The final version will include the final conclusions of the project.

Links with other WPs
WP7 provides information on policies to all WPs, and works together with WP3, 6 and 8 on issues that have to do with incentives, adoption and upscaling. It will work with WP8 to develop targeted policy recommendations.

Deliverables

7.1 Inventory of opportunities and bottlenecks in policy to facilitate the adoption of soil-improving techniques (Month 24)
7.2 Report on the selection of good policy alternatives at EU and study site level accompanied by an analysis of their performance on multiple criteria (Month 48)
7.3 Policy briefings translating the scientific evidence to a policy audience advertising on the potential of soil-improving cropping techniques for a smarter and more sustainable agriculture (Month 60)

Work package number	WP8	Start Date or Starting Event		1		
Work package title	Dissemination and communication					
Participant number	1	2	3	4	5	6	7
Short name of participant	Alterra-DLO	BCU	KUL	UoG	UH	RIKS	TUC
Person/months per participant:	5	3	3	25	2	2	2
Participant number	8	9	10	11	12	13	14
Short name of participant	JRC	UNIBE	Milieu	Bioforsk	BDB	AU	GWCT
Person/months per participant:	1	2	4	2	2	2	3
Participant number	15	16	17	18	19	20	21
Short name of participant	Teagasc	SCR	ESAC	ICPA	UNIPD	IA	WU
Person/months per participant:	1	1	3	4	2	2	1
Participant number	22	23	26	27	28	29	
Short name of participant	UP	SLU	VURV	UAL	FRAB	Scienceview	
Person/months per participant:	3	2	2	2	2	2	

Objectives

• Develop an advanced and easy accessible SOILCARE Information Hub
• Develop a Dissemination and Communication Strategy based on specified goals and objectives to raise the visibility of the project and to ensure project results reach the intended target audience
• Develop a suite of dissemination products from the research outputs suited to different categories of stakeholders at Study Sites, national and European levels.

Description of work and role of participants

Task 8.1: Development of the SOILCARE Information Hub (Lead partner 4, partners: WPs, Study Sites)
A web-based application, which will be the central collection point (hub) and communication portal for the dissemination of information developed within the project, will be established on the project website. It will have advanced functionality, be interactive, use a variety of multi-media methods and be accessible to all the target audiences. The site will provide a platform for disseminating learning from the Study Sites and provide a facility for knowledge exchange among all those who have an interest in soil-improving CS. The Hub will represent a space for sharing evidence and learning within the SOILCARE consortium itself, in addition to encouraging wider international sharing of experience and best practice.

Task 8.2 Review of soil related advice landscape at different scales (Lead partner 4, partners: Study Sites, WPs3,7)
Drawing on existing literature and stakeholder knowledge, a review will be undertaken of the advice landscape with respect to soil improving CS. The review will consider the current dissemination and advisory activities with respect to soil and identify how farmers currently obtain information about soil improving techniques distinguishing differences for FMLS 1,2 and 3. It will inform the development of the dissemination strategy (Task 8.3) by identifying current gaps in advice and dissemination, examples of best practice and key principles for effective knowledge exchange of soil improving CS. Critically it will ensure that SOILCARE's outputs are integrated into existing activities and translated into practice, in line with the aims of EIP-AGRI. The review will take place at the European, national level as well as local, regional study site level.

Task 8.3: Development of the Project Dissemination and Communication Strategy (Lead partner 4, partners: Study Sites, WPs)
The strategy will be developed at a project wide level and a study site level. At the project-wide level the strategy will comprise i) a set of specified goals and objectives with respect to what knowledge will be disseminated, to whom, how and when. WP leaders will be consulted to identify the planned project-wide and WP specific outputs to reveal what knowledge will be available for dissemination, the target audiences (EU, national and regional level) and their specific knowledge requirements. Effective means of communication will be identified to reach these audiences, ensuring that messages are provided at different levels of complexity, in different languages, and

using the appropriate (social) medium and means.; and ii) a central element of the strategy will also be to ensure that SOILCARE has a high level of visibility amongst interested communities.

Due to the context-specific nature of the Study Sites, individual Study Site dissemination and communications plans will be developed that are tailored to each local agronomic, political and cultural situation. Study Site stakeholders will input into plans from WP3, identifying the most suitable formats and channels to disseminate project results within the local area and beyond the Study Sites. These plans will also ensure dissemination activities link into existing local and regional networks and will incorporate best practice and key principles of knowledge exchange identified in Task 8.2. A timetable will be scheduled to enable planning of dissemination activities and engagement with target audiences throughout the lifetime of the project. A full strategy will be prepared by month 12, however, this will be continuously refined incorporating inputs from WPs 3 and 7. The efficacy of SOILCARE's dissemination and communication strategy will be evaluated during the course of the project using standardized indicators.

Task 8.4: Operationalising the strategy (Lead partner 4, partners: Study Sites, WPs, partners 15,16,29)
To operationalise the strategy the following four steps or sets of activities (each delivered in the most part through the SOILCARE Information Hub) are proposed:

1. Generic project information - dissemination to a wide audience:
- A project leaflet in English and the national language of the partner and Study Site countries
- A film about SOILCARE, to be made by partner 29 (Scienceview)
- A newsletter/bulletin will be compiled and disseminated at 9-12 month intervals.
- Multimedia (podcasts/video, Twitter, Facebook, Linked In, press releases - multi-lingual) hosted on the Information Hub.

2. Detailed practical guidance - participatory development with practitioners, land managers, consultants:
This guidance will focus on helping practitioners to assess the benefits, applicability, profitability as well as the risks in adopting the practices and to overcome barriers to uptake. In line with the multi actor approach, stakeholders will inform the development of this guidance.
- Real life case studies, including videos, detailing the experiences of land managers who have successfully implemented the SOILCARE soil-improving CS
- Technical and practical guidance for practitioners (fact sheets, manuals) to disseminate findings from WP5-6 on effective soil-improving CS (including costs and benefits).
- Dissemination/Demonstration events for stakeholders outside of the project to facilitate learning and knowledge exchange about practices being implemented at Study Sites in collaboration with WP3 and 5. These will be developed with practitioners input to ensure their usefulness.

3. Policy recommendations - dissemination to decision makers and policymakers:
- Policy briefs, policy guidance, podcast/video, and final conference will be communicated to a wide range of regional, national and European policy makers. These will be prepared in collaboration with WP7.
- Final policy conference will be organised together with WP7.

4. Scientific information – dissemination to project partners, scientific community peers:
- Project partners will share knowledge using a protected section of the SOILCARE project website.
- Research outputs will be disseminated to the scientific community through peer-reviewed and open access scientific publications.

Task 8.5: Exploitation and sustainability planning (Lead partner 4, partners: 6,10,12,14,16,24,25,29)
SOILCARE is mainly positioned in Technology Readiness Levels (TRL) 1-4, however, some partners will develop some techniques for market (i.e. beyond TRL5), such as the development, testing and demonstration of an intelligent moldboard plough and a power harrow by Partner 24, and the development and testing of a novel method for DNA sequencing by Partner 16. This task will be completed by the SME/Industrial partners, such as Partner 16 and 24, who have direct experience in identifying and realizing business opportunities and will share their knowledge on business development with other partners. The task will produce an Exploitation and

Sustainability (E&S) plan which will describe the potential commercial exploitation of products/services created within the project. It will identify what can be exploited, and what is the demand? and from which target groups? by investigating:
•Products/service potential - identification of products/services that have potential for commercial exploitation. This will be done in liaison with WP leaders throughout the project.
•Market potential - identification of potential users (target groups) of products/services. This will be done by engaging with stakeholders (potential target groups) to ascertain their needs and interests (i.e using social marketing intelligence methods).
A draft E&S plan identifying the market potential for promising products/services will be prepared by month 48 and revised with input from the consortium and target groups. The final E&S plan and recommendations will be made available as a deliverable at the end of the project

Links with other WPs
WP8 will work closely with all WPs. WP8 will, for example, liaise with WP5 to develop technical and practical guidance from the research outputs as well as demonstrations. WP6's investigation of barriers to adoption will feed into the communication and dissemination strategy. Working closely with other WPs in an integrated way will allow an iterative approach and integration of research and dissemination activities throughout the project.

Deliverables
8.1 SOILCARE Information Hub hosting a suite of dissemination products: SOILCARE Information Hub hosting a suite of dissemination products (Month 60)
8.2 Dissemination and Communication strategy (Month 12)
8.3 Final conference to disseminate the project results to a range of stakeholders (Month 58)
8.4 Exploitation and Sustainability plan (Month 60)

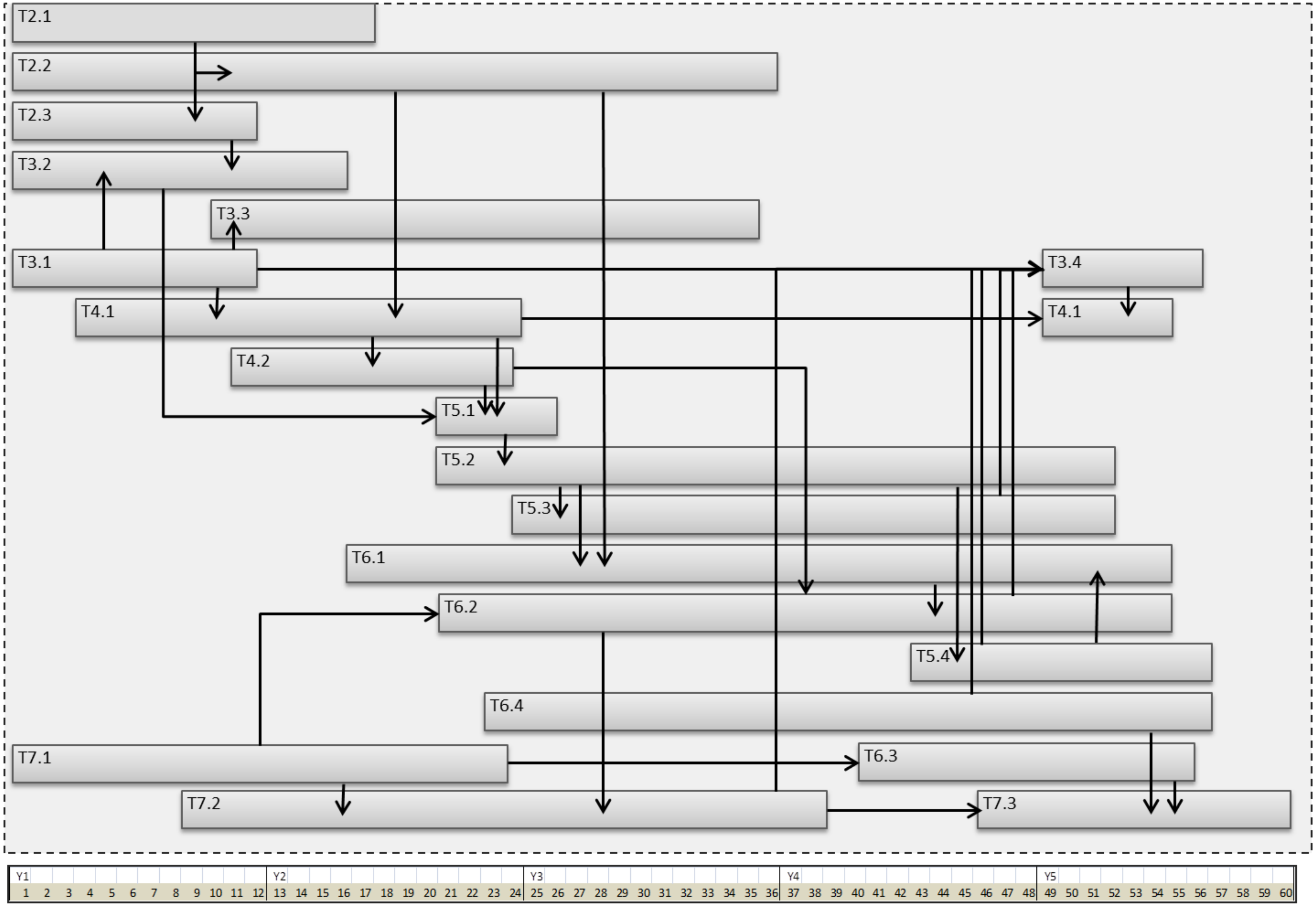
Table 3.1c: List of work packages

Work package No	Work Package Title	Lead Participant No	Lead Participant Short Name	Person-Months	Start Month	End month
1	Project management	1	Alterra-DLO	41	1	60
2	Review of soil-improving CS	1	Alterra-DLO	72	1	48
3	Multi-stakeholder involvement, participatory selection of CS, and adoption	2	BCU	90	1	60
4	Methodology to monitor and assess soil-improving CS in Study Sites	9	UNIBE	73	5	52
5	Implementation, monitoring and assessment of CS	3	KUL	243	22	56
6	Upscaling and synthesis	6	RIKS	103	9	56
7	Policy analysis and policy support	10	Milieu	74	1	60
8	Dissemination and communication	4	UoG	85	1	60
				781		

Table 3.1d: List of Deliverables

Deliverable (number)	Deliverable name	Work package number	Short name of lead participant	Type	Dissemination level	Delivery date
1.1	SOILCARE website	1	Alterra-DLO	DEC	PU	3
1.2	Data Management Plan	1	Alterra-DLO	R	CO	6
3.1	Stakeholder analysis report	3	BCU	R	PU	12
8.2	Dissemination and communication strategy	8	UoG	R	CO	12
2.1	Review report of soil-improving CS	2	Alterra-DLO	R	PU	18
3.2	List of CS selected for testing in WP5	3	BCU	R	PU	18
4.2	Monitoring plan for Study Sites	4	UNIBE	R	CO	24
7.1	Inventory of opportunities and bottlenecks in policy to facilitate the adoption of soil-improving techniques	7	Milieu	R	PU	24
3.3	Report on the role of trust and other factors in the adoption and social acceptability of soil-improving innovations	3	BCU	R	PU	36
2.2	Scientific publications	2	Alterra-DLO	R	PU	48
7.2	Report on the selection of good policy alternatives at EU and study site level accompanied by an analysis of their performance on multiple criteria	7	Milieu	R	PU	48
5.1	Database with monitoring data	5	KUL	R	CO	50
5.2	Report on demonstration activities in Study Sites	5	KUL	R	PU	50
6.1	Report on the integration and synthesis of Study Site results and their potential for upscaling	8	RIKS	R	PU	50
4.1	Final version of assessment methodology for Study Sites	4	UNIBE	R	CO	52
6.2	Report on the potential for applying soil-improving CS across Europe	8	RIKS	R	PU	52
3.4	Report describing final stakeholder workshops held in study sites, detailing	3	BCU	R	PU	56

Deliverable (number)	Deliverable name	Work package number	Short name of lead participant	Type	Dissemination level	Delivery date
	stakeholder feedback on preliminary findings					
5.3	Report on monitoring results and analysis	5	KUL	R	PU	56
6.3	Interactive mapping tool for the application of soil-improving CS across Europe	8	RIKS	R	PU	56
8.3	Final conference to disseminate the project results to a range of stakeholders	8	UoG	DEC	PU	58
7.3	Policy briefings translating the scientific evidence to a policy audience	7	Milieu	R	PU	60
8.1	SOILCARE information hub	8	UoG	DEC	PU	60
8.4	Exploitation and Sustainability plan	8	UoG	R	CO	60



PERT DIAGRAM

Notes: 1) T refers to tasks. For tasks, only the most active period is given; full duration is given in section 3.1.2. 2) WPs 1, 8 have not been included as these are in constant contact with all WPs for the whole duration of the project. Results of all tasks will be shared with WP8 for dissemination. The main relationships between all WPs are shown in Figure 3.1

3.2 Management structure and procedures

3.2.1 Organisation structure an decision making mechanisms

Contributing partners within SOILCARE are representatives from universities, research institutes, farmer federations, industry and SMEs, with expertise in all scientific areas, demonstration, knowledge transfer, dissemination, practice, policy advice and recommendations. This ensures maximum input of scientific knowledge, innovation and affinity with translating science into policy-relevant and practitioner-relevant outputs. The team is committed to deliver fully-integrated and holistic methods to assess and evaluate CS and their adoption, and to find ways to combine sustainability with profitability.

The SOILCARE Project will follow the format of previous EU projects, building on the knowledge and experiences gained in these projects. The management of the project is based on shared responsibility, joint ownership and good communication. Where possible, decisions will be taken on the basis of consensus. A clear management structure is needed to ensure that the work in a project of this size is executed smoothly. This management structure is shown in Figure 3.2, and is described in the following paragraphs. The tasks of the actors in the management structure are described in Table 3.2a.

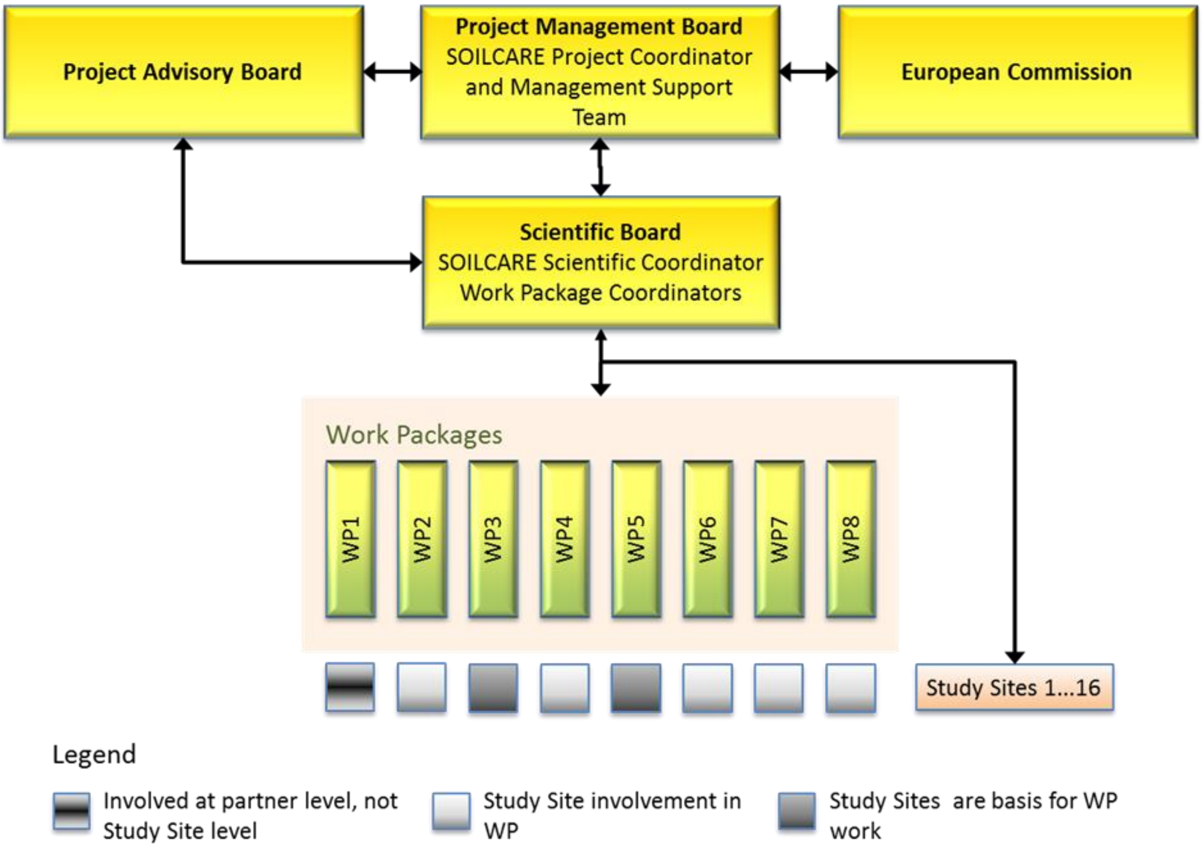


Figure 3.2 Management structure of the SOILCARE project

Project Management Board

The project Management Board consists of the proposed SOILCARE Project Coordinator supported by the project Management Support Team.

Dr R. Hessel of Alterra-DLO is the proposed Project Coordinator and chairman of the Project Management Board. The Project Coordinator will be supported by a Management Support Team responsible for day-to-day management of the project. Specific tasks of the Project Coordinator and the Management Support Team are:

- Monitor project progress and up-dating time and task-schedules,
- Decide on major changes in the planning/budgeting of the project (all in accordance with the rules of conduct as agreed with the European Commission),

- Decide on matters that concern the partner structure of the consortium,
- Decide on all matters that are tabled for decision making by the Scientific Board,
- Handle proposals of the Scientific Board for review and/or amendment of the terms of the EU-Contract,
- Facilitation of tasks for WP coordinators (providing formats for reporting, financial guidelines) and integration of WPs,
- Organization of project meetings and training activities,
- Administration and preparation of minutes, including follow-up of its decisions,
- Preparing, updating and managing the consortium agreement between the partners,
- Receiving all payments made by the Commission to the consortium and administer the Community contribution regarding its allocation between contractors and activities,
- Keeping accounts making it possible to determine at any time what portion of the Community funds have been paid to each contractor for the purposes of the project,
- Handle conflict resolution which could not be handled at a lower level,
- Implementing the gender action plan and program,
- Providing assistance to partners in administrative matters.
- The overall legal, contractual, ethical, financial and administrative management,
- Communication with EU Commission project officers, including reporting,
- Maintaining contacts with the Advisory Board

Alterra-DLO is experienced in leading large international research projects. The proposed Project Coordinator, Dr R. Hessel, has more than 10 years of experience in managing large EU-funded projects, was amongst others project manager of the FP6 DESIRE integrated project, and is currently project coordinator of the FP7 WAHARA project (ending in early 2016), and scientific coordinator of the RECARE project. Other members of the Management Support Team also have experience with coordinating activities, for example in the FP7 projects e-SOTER, COROADO and CASCADE, and are familiar with the latest project management tools.

Scientific Board

The Scientific Board will provide executive leadership necessary to run the project successfully from a scientific point of view. The Scientific Board consists of the 8 Work Package (WP) coordinators and the Scientific Project Coordinator. Members of the Scientific Board are experienced in scientific management in EU-funded projects, and are of sufficient seniority to commit their organisations to decisions made during meetings of the Board. Regulations on the agenda, distribution and acceptance of minutes and type of decisions requiring a certain/specific majority will be laid down in the Consortium Agreement (CA). The Scientific Project Coordinator is the chairman of the Scientific Board. Prof. Dr. Oene Oenema of Alterra-DLO is the proposed Scientific Project Coordinator, and chairman of the Scientific Board. To avoid conflicts of interest, the Scientific Project Coordinator is not part of the Project Management Board. The Scientific Board will:

- Achieve optimal scientific integration of the work,
- Monitor scientific progress and coordinate scientific activities,
- Decide upon the scientific roadmaps with regard to the project,
- Decide upon measures to ensure effective day-to-day coordination and monitoring of the progress of the scientific work affecting the project as a whole,
- Make proposals to the Project Management Board for decisions on, or proposals to the partners, and to serve notice on a defaulting partner and re-assign tasks to other partners,
- Decide upon the nomination and period of office of co-opted Scientific Board members,
- Handle conflict resolution within the project which could not be handled at lower level,
- Ensure that all project deliverables and milestones are achieved on time, and ensure appropriate exploitation and dissemination of knowledge,
- Implement press releases and other (joint) publications by the partners with regard to the project,
- Oversee scientific and societal issues related to the conduct of research activities within the project.

The Scientific Board will communicate mostly by e-mail or other electronic communication and make use of web-based conference facilities to limit travel. In addition, the Scientific Board will meet at least once a year, if needed twice a year, or at any other time when necessary at the request of one of the Scientific Board members. Additional electronic meetings can be held at the request of a partner representative in case of a serious issue. Meetings shall be convened by the chairman with at least 15 calendar days prior notice. Although the Scientific Board has the overall responsibility for the scientific management of the project, it will delegate day-to-day management of the project to the Scientific Project Coordinator and his management unit. The proposed Scientific Board Chairman, Prof. Dr. Oene Oenema, has significant experience in scientific project coordination. He has been coordinator of two EU projects and of three EU service contracts. He has participated in the scientific advisory boards of a number of international institutions and EU projects. Currently, he is chair of the EU Nitrogen Expert Panel and chair of the scientific committee of the nutrient management policy in The Netherlands.

Work Package Coordinators

The Work Package Coordinators, as principal scientific experts on the their areas of research, will produce the expected deliverables within the allocated time and budget. As self-steering teams, the WP teams will have to tackle scientific dilemmas and barriers as they arise and will address problems and issues that encompass their WP up to the WP coordination level. Any major diversion of the initial project plan is to be reported to the Scientific Board for further handling. Specific tasks of a WP Coordinator are:

- Transmission of any documents and information connected with the WP between the partners concerned and the Scientific Project Coordinator,
- Facilitating and supporting the WP staff in implementing the respective project activities,
- Timely transmission of the Project Deliverables to the Scientific Coordinator,
- Reporting to the Scientific Board (e.g. about scientific progress),
- Reporting to the Project Management Board (e.g. about project progress),
- Providing input/information on training and innovation related activities to the Management Board,
- Convening and chairing WP meetings.

Study Site Coordinators

The Study Site Coordinators are responsible for execution of the project work in their Study Sites, for all WPs. They lead the Study Site teams, which consist of all persons who work in the Study Site for the different WPs, and they coordinate activities in the Study Site in such a way that results for the different WPs are provided on time to the respective WP leaders. Study Site Coordinators will have regular contact to ensure that optimum collaboration between Study Sites is achieved. Study Site Coordinators report to the Scientific Project Coordinator when asked, or on their own initiative, when the continuation and/or quality of the work in the Study Sites is endangered. In that case, the scientific coordinator will solve any issues together with the corresponding Study Site Coordinator. If needed the Project Management Board will be consulted.

Project Advisory Board

The main function of the Project Advisory Board is the evaluation of project progress, and providing guidance regarding future work. The Project Advisory Board will be invited to attend the yearly plenary workshops. The Project Advisory Board will: i) evaluate progress made during the course of the project, ii) give recommendations for further actions for consideration to the project consortium, and iii) will facilitate a dialogue with fora representing the wider community. For the anticipated Project Advisory Board, members of 5 different types of actor will be invited:

- Policy makers in the fields of agriculture and management of natural resources. For this purpose, a representative of governmental authorities from one of the countries with Study Site will be approached to serve as a member on the Project Advisory Board.
- A farmer organisation, such as COPA-COGECA
- European or international organisations, active in the field of agriculture, natural resource management, soil degradation and ecosystem management, i.e. the UNEP, FAO, CBD, UNCCD, GEF, the European Environment Agency.
- The scientific/technical community, with a potential member from the World Conservation Union (IUCN), the European Society for Soil Conservation (ESSC), or the European Land and Soil Association (ELSA).
- Industrial community, in relation to the subjects addressed in the proposal, e.g. agricultural inputs, pest control, manufacturers of agricultural equipment.

Individual Project Partners

The Project Partner's staff members involved in SOILCARE will have a voice in important project matters. Project Partners, who would like to address certain issues concerning the project or project management, are able to approach Scientific Board members, or request certain issues to be addressed and put on the agenda at the yearly project meetings for discussion, and where necessary, voting. Possible issues will be reported in the periodic project reports that are sent to the European Commission.

Table 3.2a. Brief description of tasks of management entities within SOILCARE.

Management entity	Task	Participants
Project Management Board	Daily management of the project	Project Coordinator and Management Support Team
Scientific Board	Supervision of scientific project progress, decision making on scientific issues.	Scientific Project Coordinator and WP leaders
Work Package Coordinators	Coordinate project work according to plan at WP level	Senior Scientists of beneficiaries involved in WP
Study Site Coordinators	Execute project work according to plan within a Study Site	Team Leaders, working in a Study Site
Project Advisory Board	Project guidance and scientific review of output, providing input to discussion	Representatives from target groups, European and international organisations and the scientific community

Sound and transparent administration and management

The project will be managed on output, guidelines for this are the described project outputs; deliverables and milestones. The overall project objectives will only be realised through an integrative approach in which each WP performs its own work, but in which all WPs also closely work together to achieve project results that go beyond individual WPs. The work within WPs is subdivided into tasks, and each WP has clearly defined deliverables. The timing of the deliverables will be according to the project work planning. In addition to deliverables, milestones have also been defined (table 3.2b). For each milestone, means of verification are identified. Decisions on further progress (go, no-go), against the established means of verification for each milestone, will be taken by the Scientific Board. Also, the Scientific Board will make use of an online management system that enables fast and convenient reporting for scientific work done at different (partner, WP) levels. The online system includes the WP coordinators' observations on progress, risks and deviations for the Scientific Board to accommodate.

Table 3.2b. List of milestones

Milestone number	Milestone name	Related work package(s)	Estimated date	Means of verification
1	An analytical framework for assessing soil-improving cropping systems	2	6	Framework tested on sites with different CS and bio-physical, socio-economic and political conditions
2	A list of pre-selected cropping systems to be explored in WP3	2	9	WP3 leader indicates that list contains the needed data
3	Multi-actor stakeholder advisory panels established in each study site	3	6	Panels ready to play their role in SOILCARE
4	Participation training delivered to all local consortium partners	3	12	Partners able to moderate stakeholder workshops
5	Methodology and guidelines tested and ready for use	4	22	Successful application in one of the Study Sites
6	CS implemented for testing	5	26	Experiments implemented and ready for monitoring
7	Database for monitoring data tested and accessible to partners	5	28	Successful test in one of the study sites
8	Working version of IAM available	6	40	IAM model tested and delivered to coordinator
9	Integrated scenarios with qualitative and quantitative components available	6	50	Report with scenarios delivered to coordinator
10	SOILCARE information hub developed	8	12	Hub ready to store results from the project

The Project Coordinator will be responsible for the day-to-day financial and administrative management of the project. Alterra-DLO will coordinate the implementation of a project-wide online management tool to facilitate day-to-day scientific management. Using the online management tool, scientific progress can be monitored, which will assist daily management of the project. The project management will request partner audit certificates when required by the European Commission guidelines. Alterra-DLO, as the coordinating institution, has a standard in ISO 9001-2000 certification ensuring organizational quality.

Management Tools
The nature of the SOILCARE Project is trans-disciplinary, multi-institutional and multi-cultural. The selection of the partners and their role and input in the project reflects our understanding of the issues and best ways to advance from the state-of-the-art to improved soil care and natural resource management on the ground. Management tools include:

- The management structure of SOILCARE will ensure effective management and decision making,
- Regular meetings of the Scientific Board will ensure efficient coordination between WPs,
- A specific WP coordination level ensures that experts will discuss scientific issues among themselves, so as to alleviate the scientific coordination at the Scientific Board level, and
- An on-line management system will be used to track project progress scientifically. Implemented in the SOILCARE internal website, this collaborative web-based platform with restricted access will allow a dynamic follow-up of all scientific components of the project. Reports, procedural documents, templates and written communications between partners will be archived thanks to this electronic platform.

Reporting and financial administration.
Periodic reports will be produced and communicated by the project coordinator to the EC. In order to produce reports respecting the objectives laid out in terms of time and quality, the online management system will prompt project partners and WP leaders to submit regular information. Reports can be jointly edited using the online management system and subsequently submitted to the Project Coordinator, through the same system.

Conflict resolution process
In order to avoid potential conflict between partners or between the consortium and one or more partners, specific rules will be clearly defined before the start of the project through the consortium agreement, especially on the following aspects:

- the balance between the partners regarding the contribution, the interest and the budget ;
- the allocation of the payments to the partners ;
- issues concerning the protecting, publishing and utilising the knowledge generated.

In the event of a conflict, the resolution process will, in accordance with the Consortium Agreement, respect the following steps: 1) attempt to resolve the conflict at the lowest level possible, 2) negotiation/mediation between the coordinator and the partner representative, 3) consultation of the European Commission (project officer), and 4) consultation of the Plenary Meeting.

In the event of no solution and after a reasonable amount of time to resolve the conflict, the party (-ies) should be excluded from the consortium and replaced, according to the H2020 Consortium Agreement rules. This extreme decision will require a special meeting, called upon by the project coordinator.

3.2.2. critical risks
There might be risk of delay, incomplete delivery, or even failure of work planned in the Work Packages. This is especially serious if there are dependencies between WPs, so that delay in one WP would affect other WPs as well. To avoid negative consequences, risks should be made clear and contingency plans are needed. In Table 3.2c, an overview is shown of all identified potential risks at WP level, and contingency plans for these. At a more general level, the following 3 main risks can be identified:

- Stakeholders are not willing to participate. This is potentially a serious problem as SOILCARE seeks to work closely together with stakeholders. This risk can be minimised by truly involving stakeholders from the start, as this allows researchers to build trusted relationships with them and to increase their sense of ownership of SOILCARE developments and results. Such an approach can also overcome initial scepticism on the part of stakeholders, as it helps to prove that SOILCARE is there for their benefit.

- Study Site partners might not be able to do all the work on time, in particular because multiple requests from various WPs overload them. This is a real risk, and it would affect deliverables too as these require input from all Study Sites. However, the proposed management structure allows for good timing of requests as well as for making efficient combinations of requests from different WPs, and thus helps minimise this problem. The Project Management Board and Scientific Board will collaborate to provide a workable project planning in which prioritisation of tasks is included.
- Technical problems. These can potentially be serious, but in almost all cases alternatives or adaptations exist that can be used if a certain method proves not feasible.

Table 3.2c. Critical risks for implementation

Description of risk	**WP(s) involved**	**Proposed risk-mitigation measures**
Coordinator not able to work	WP1	The project is not too dependent on the project coordinator. All WP leaders are experts in their field. Furthermore, the project coordinator will do his work in close consultation with colleagues at Alterra-DLO, so that these colleagues are able to take over his work if the project coordinator is not able to continue working for whatever reason.
WP leader not able to work	WP2-8	For such an eventuality, deputy WP leaders will be appointed for all WPs (including WP1). Deputies will be kept informed of everything ongoing in the WP, so they are able to take over if needed
One or more Study Sites are not able to provide required data	WP2-7	WP leaders will provide training and assistance. If that is not sufficient, the number of Study Sites is large enough to allow for a comprehensive presentation of results even without including one or two Study Sites.
Lack of data and process knowledge to upscale and apply Study Site results to the EU-wide integrated assessment model	WP3-6	Use expert based rules instead of physically based model components for those (parts) of the model for which sufficient data or process information is lacking
Conflicting interest in monitoring indicators and insufficient expertise / resources at Study Site level to assess certain indicators	WP4/5	Allow for some flexibility in the monitoring indicators while defining a workable set of compulsory minimum indicators to allow comparison between sites
Selected CS during monitoring prove less or not effective to improve profitability and environmental sustainability	WP5	CS have been selected on basis of well-founded expectations about their efficacy, or because of known effectiveness elsewhere. Several CS are tested in each Study Site, so unlikely that none show effect.
Development of individual model components delayed, not effective or not compatible with the overall Integrated Assessment Model	WP6	Regular interaction with partners, clear submission deadlines, quality checks during model development process and feedbacks. Develop and update a strategy document throughout the model development phase to communicate objectives and decisions made
Study Site results too diverse to allow up-scaling	WP6	Study Site conditions are diverse, but this is an integral part of the research that is in fact necessary to allow useful up-scaling. Problems of comparability of results between Study Sites will be minimised by using protocols for data collection, and by close contacts between WP leaders and Study Sites, as well as between Study Sites that have the same CS
No project results useful for policy briefings	WP7	This is highly unlikely as project is specifically set up in such a way that results useful for policy briefings are obtained. Several project partners are highly experienced in policy, and in translation of research results into policy

		messages
Delayed delivery of results of other WPs	WP8	All WPs will provide their products to WP8 as soon as they are completed; thus WP8 will be active throughout the project instead of only at the end
Dissemination outputs fail to reach the intended audiences due to technical difficulties.	WP8	Produce a resilient dissemination strategy that will allow enough flexibility to use alternative dissemination channels should outputs fail to reach target audiences

3.3 Consortium as a whole

The SOILCARE consortium is composed of 29 participants from 18 countries throughout Europe. The objectives of the proposal demand an international and multidisciplinary approach and could not be carried out by just one nation. The consortium consists of different kinds of organisations (such as universities, research institutes, farmer organisation, industry and SMEs) with different levels of expertise and interests in agricultural and environmental research and practice. The international partnership forms the critical mass necessary to realise SOILCARE's successful implementation and to reach the objectives and goals as described in the previous chapters. Many of the partners have already successfully worked together on various occasions and projects, such as within the RECARE project (Grant agreement 603498), DESIRE project (GOCE-037046), SMARTSOIL project, CASCADE project (Grant agreement 283068), CLIMED (Project ref. ICA3-CT-2000-30005), EROCHINA (INCO-DC, contract number IC 18CT970158). Disciplines embedded in SOILCARE range from soil science, ecology, hydrology, agronomy, extension and communication, learning and action, land use planning, geography, to economy, sociology and political science. SOILCARE will work in a truly interdisciplinary and integrative manner with the aim of developing tools and methods for wider application by managers and decision makers in the fields of agronomy and natural resource management. This will be achieved by using a multi-actor trans-disciplinary approach which encompasses working closely with stakeholders, including policy makers at the regional, national and international levels using advanced participatory, monitoring and analysis techniques (WPs 3, 5).

3.3.1 Ability of the consortium to achieve the objectives

The tasks were assigned to participants using a co-construction approach for work programme elaboration. Once the initiating partners established the overall frame of the project, WP leaders were identified in relation to their expertise in the WP domain. Suitable participants were then approached and the tasks defined by the participants under the responsibility of the WP leader. In addition, Study Site partners were sought to achieve an optimal spread of sites both with respect to the cropping systems and agronomic techniques and with respect to the variety of bio-physical, socio-economic and political conditions across Europe.

The consortium will offer the following assets for achieving the objective of the SOILCARE project:

- Significant critical mass is gathered through the main disciplinary fields covered by the project (Table 3.3). To reach the Research and Development objectives, most of the project participants are specialized in agronomy or soil science; either from a biophysical, social, economic, political or institutional point of view. In addition, several participants are very experienced in policy analysis and interaction with policy makers. Expertise in training and dissemination activities as well as in interaction with local stakeholders and trustful collaboration with national and international bodies (like UNCCD and UNCBD) is also available with a number of SOILCARE partners. Efforts to support policy and implementation on a wider scale will receive special attention in the SOILCARE project through dedicated experts in the field of knowledge dissemination and transfer of science to practitioners and policy makers. Thus, the consortium covers the whole range of expertise that is needed to successfully execute the project.
- For each WP, we have defined a reasonable balance between the objectives and the implementation means (critical mass, funding level). This was reinforced by the experience of various partners in the field of European projects funded in the 4th, 5th, 6th and 7th FP of the European Commission and successful former collaborations.
- In case a participant leaves the project, the consortium can guarantee the achievement of objectives by either attributing the allocated tasks to other members of the consortium, when possible, or by contacting new partners. The consortium is formed by participants of high standing and recognition in the global scientific community, thus facilitating future cooperation with new partners.
- The link between the WPs (transmission of data, information, results, models) is an important dimension in the proposal. Such exchanges between WPs are strengthened by the presence of participants in several WPs where the work demands close cooperation.

Table 3.3 Expertise of SOILCARE consortium partners

Field of Expertise	Partners																												
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29
Soil Science	X		X		X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X		X
Soil quality	X		X		X		X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X			X		X	
Soil quality indicators	X		X		X		X	X	X		X	X	X	X		X	X	X		X	X	X	X			X	X	X	
Soil fertility			X		X						X	X	X	X	X	X			X	X		X	X			X	X	X	
Soil functions	X		X		X		X	X	X		X		X	X	X	X	X	X	X	X	X	X	X			X	X		
Soil threats and soil degradation	X		X			X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X				X		
Cropping systems	X		X						X		X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X	X	
Agronomic techniques	X		X					X	X		X	X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	
Land use	X	X	X			X	X	X	X		X	X	X	X	X		X	X	X	X	X	X	X			X		X	X
Crop production	X		X			X						X	X	X	X	X	X	X	X	X		X	X	X		X	X	X	
Sustainable crop management	X		X			X			X		X	X	X	X	X	X	X	X	X	X		X	X			X	X	X	X
Soil improvement	X		X		X		X	X	X			X	X	X		X	X	X	X		X	X	X			X	X	X	
Agricultural equipment														X									X	X					
Technology development		X				X										X							X	X					
Farm economy		X		X		X								X							X			X			X	X	X
Cost-benefit analysis				X			X		X	X			X								X			X	X			X	
Agricultural policies	X	X		X		X		X		X	X	X	X	X	X		X	X	X	X	X					X	X		
European directives and regulations	X	X		X		X		X		X		X	X		X			X	X		X					X			
Policy advice and recommendations		X		X		X		X	X	X	X	X	X	X	X		X								X	X	X		
Social sciences		X		X					X	X	X		X								X				X				
Multi-actor approach		X		X		X			X	X			X		X		X				X					X			X
Demonstration		X		X			X		X	X		X	X	X									X	X	X	X		X	X
Barriers for adoption		X	X	X					X	X			X	X							X				X				
Dissemination		X		X			X		X	X	X	X	X	X	X										X	X			X
Environmental impact	X	X	X		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X		X			X			
Ecosystem services	X	X	X	X	X	X		X	X	X	X		X	X	X	X	X	X		X	X	X	X		X			X	
Environmental Economics		X								X			X								X						X		
Integrated modelling	X		X			X		X			X		X					X	X	X	X	X							
Interdisciplinary research	X	X	X	X		X	X	X	X	X	X		X	X	X		X	X	X	X	X	X		X	X				
Integrated impact assessment	X		X			X	X	X	X	X	X		X				X	X	X	X	X	X							
Data management	X	X	X		X	X	X	X	X	X	X						X	X	X	X	X	X	X	X	X				
Project management	X	X	X	X	X	X	X	X	X	X	X			X	X		X	X		X	X	X		X	X	X			

3.3.2 Complementarities between the participants

- The different tasks of the collaborative project were assigned to specialists in the corresponding scientific domains. As mentioned previously, the project covers a wide range of disciplines and cropping systems. An initial level of complementarities between the participants is their field of competence. Table 3.3 shows that all partners are experienced in research relevant to CS, but also that each partner brings their own unique experiences.
- Another level of complementarity is the type of organisations involved in the consortium. Universities will be an effective gateway to implementing the training tasks of the project. The experience of an applied research structure will be important to implement proven methodologies efficiently, offer facilities for database management, and contribute to demonstration and dissemination. The involvement of SMEs and industry is crucial regarding special tasks and expertise that complements those of universities and research institutes and links science to practice, especially in light of innovation and potential commercialization. Partner 28 (FRAB) is a federation of farmers, and will help to guarantee that there is a close link between SOILCARE and realities faced by farmers in Europe.
- Participants with a Study Site reflect different biophysical, socio-economic, and political conditions and together cover most conditions found within Europe. This enables the research of cropping systems, agronomic techniques, soil functions and soil ecosystem services across the variety of conditions encountered within Europe.
- All participants have a wide network including international organisations, national scientific programs, government, and development agencies. Therefore, we can benefit from such a large panel of potential end-users to fine-tune and sharpen our work activities during the course of the project.

3.3.3 SMEs and Industry

Involvement of SMEs and industry in SOILCARE is mutually beneficial. There are several SMEs and one large company involved in the proposal, which are all discussed below.

RIKS (participant 6) brings three types of contributions to SOILCARE i) substantial amounts of pre-existing Intellectual Property, ii) domain expertise, and iii) experience in working with policy makers and stakeholders. Over the past two decades RIKS has developed the dynamic land use modelling framework Metronamica (www.metronamica.nl), which is used for policy support (e.g Van Delden et al., 2010); and the Geonamica software environment for model integration and decision support system development. The latest versions of both Geonamica and Metronamica will be made available to SOILCARE. Furthermore RIKS brings to SOILCARE domain expertise in land use modelling, scaling issues and the integration of various processes and related models, together with her experience in making (scientific) knowledge available in the policy domain. SOILCARE, in turn, will provide significant benefits to RIKS as an SME. SOILCARE allows RIKS to strengthen its land use modelling capabilities by enhancing the bio-physical modelling of the land system and in particular soil and cropping processes and their feedbacks with other land use dynamics. Extensions to the Geonamica software environment, required for fulfilling the objectives of the project, will contribute to RIKS' future product development. An example of such an extension is an enhanced way of presenting map results to users. Finally, SOILCARE will strengthen and update the LUMOCAP Policy Support System which was developed under FP6 and has since been applied to various European scenario studies. New developments in SOILCARE will ensure the system to be relevant for supporting policy impact assessment and scenario studies at European level beyond the duration of the project.

Milieu (participant 10) can provide a number of contributions to SOILCARE, that all relate to the interface between science, policy and practice. Scientists can be an important source of information for policy-makers and practitioners. Yet, scientific information is often available in a format that is not directly useable for policy-makers and practitioners. Also, it is often challenging to specify the needs of science for policy or daily practice for science. Milieu will provide following contributions: 1) our experience working for a range of public sector clients, including EU institutions as well as World Bank, UN agencies and national organisations; 2) our knowledge of policy issues as well as private sector concerns, gained also through our work on impact assessment and evaluation; 3) our knowledge of the water sector, the energy sector and the water-energy-food nexus; 4) our expertise in the presentation of complex issues in clearly written analysis for decision makers. SOILCARE, in turn, allows Milieu to gain a better scientific understanding on the drivers behind soil and land degradation and solutions that are possible to prevent or mitigate adverse effects. In addition, SOILCARE will also expand our network with the scientific community. Both are important to strengthen our capacity to support policy. Milieu is also keen to learn from the approach and results of SOILCARE to identify and test cropping systems that are both profitable and sustainable. We will learn examples of how the green economy for agriculture can be brought in practice, and what opportunities, bottlenecks and solutions exist. We have an interest to gain more arguments which cropping systems work under which conditions, how the adoption of practices can be facilitated and how adverse effects can be overcome.

BDB (participant 12) brings two types of contributions to SOILCARE i) almost 70 years of experience with field trials in Flanders, Belgium (results were and still are used as input for the development and improvement of fertilisation expert systems, irrigation advice systems and carbon-management tools), ii) experience in working with farmers and access to a vast network of farmers in Belgium and France (who consult us on annual base for fertilisation and irrigation advices). Decision support systems like BEMORGEX (re-use of nutrients in organic manure and waste products), N-INDEX (N-fertilisation recommendations) and BEMEX (P-K-Mg-Ca fertilisation recommendations), models like C-SIMULATOR (long term evolution of organic matter in the soil), IRRIGATION (assessment of day to day irrigation requirement), METEOCLIMA (medium term weather forecasting), EPIPRE (pest and disease management system for spring and winter wheat) will be available to SOILCARE. Moreover, BDB has an impressive database, including data on soil fertility of arable land and grassland as well as data on organic manure composition. These data are intensively used for research and extension purposes. This database will be available to SOILCARE. SOILCARE, in turn, allows BDB to strengthen its network within Europe. It will broaden the scope of BDB and hopefully will result in more international collaborations. Moreover it will allow BDB to improve its services to farmers, as many aspects will be put into a more European perspective and decision support systems can be improved using the results of SOILCARE.

GWCT (participant 14) brings four types of contribution to the project: i) an established research and demonstration farm business in central England with a wide range of pre-existing economic, agricultural and environmental data dating from 1993, a resident research team and field laboratory. The farm has hosted numerous EU, UK government, and industry funded research projects, especially on issues relating to soil management, including externalities such as water quality. ii) landscape scale research and associated data, and farmer engagement and participatory research. Relevant activities involving the local farmer network include a BACI experimental catchment management project, an Arable Business Group, and soil compaction and organic matter data collection and benchmarking. iii) An active programme of dissemination. The Allerton Project has an eco-build visitor centre which is used for an on-going programme of events for farmers, advisors and others from across the UK, and also runs training events elsewhere. There is also active translation of research results into UK government agri-environmental policy. iv) Active engagement with industrial stakeholders in retail and farming sectors. The GWCT will benefit from its participation in SOILCARE through access to expertise and experience across the consortium and from the ability to extend existing research beyond what is currently possible. The results of this process will have benefits for the economic and environmental performance of farm businesses participating in the organisation’s knowledge exchange activities, including those of the national Sustainable Intensification Platform.

SCR (participant 16) will carry out fungal biodiversity measurements and, together with collaborators, analyse them in the context of other measurements ongoing in the framework of SOILCARE. SCR will carry out the soil sampling needed in the Study Sites for the analysis of fungal biodiversity, thus minimising variation in soil sampling and optimising the comparability between samples in the monitoring program (WP3, 4). With the analyses, SCR will investigate the links that exist between fungal biodiversity and soil health & crop production. SCR profits from SOILCARE because of the magnitude of the study across Europe, which optimizes the ability to interpret the biodiversity data in a way that it is useful for farmers, and by extending its network.

Kongskilde (participant 24) provides to SOILCARE 1) a link with Industry, its perspectives, procedures and interests, 2) Innovative equipment relevant to the work done in SOILCARE, as described in section 1.4.2, and 3) additional dissemination possibilities, such as at industrial and agricultural fairs. SOILCARE, in turn, provides access to a large European network with Study Sites in many different locations, and under many different pedo-climatic conditions. This gives Kongskilde the opportunity to test newly developed equipment under different circumstances, and it gives Kongskilde access to latest scientific results with relation to CS.

Project Maya (participant 25) is a not for profit SME with a substantial background in knowledge exchange, public participation, social learning, transdisciplinary research, social innovation and the research and practice of permaculture techniques for agriculture and nature conservation. Project Maya works predominantly across the EU, but also has associates internationally, and has experience in developing and bringing to market training courses based on transdisciplinary research involving stakeholders from a range of disciplinary and practical backgrounds and tailoring these training courses for a range of communities including business, policy and NGOs. We are co-authors of KE guidelines for one of the largest funders of UK research and an EU network of 21 research funding agencies across 15 countries. We have authored >20 peer reviewed papers focussed on participation, social learning and knowledge exchange. Our involvement in SOILCARE allows Project Maya to continue to expand our experience in developing training courses with stakeholders and as a result will enable us to expand our training course offering into the long term. In our experience of running not for profit training courses we have found it extremely beneficial to reinvest the profits made from running courses for social good, in current terms profits from training courses have been reinvested in ensuring course and research materials are made more widely available, and in running training courses at reduced or free rates, as well as further investing into the Project Maya Urban nature reserve programme. We are excited that our involvement in SOILCARE will enable us to extend the reach of the SOILCARE project well beyond the project and into the long term. Our enterprise will also significantly benefit from its involvement in the SOILCARE network by forming new links with stakeholders.

Scienceview (participant 29) is experienced in making documentaries on scientific themes. The film company made several films for Dutch, Belgian and Swiss television about forest fires, climate change, the destruction of the Amazon and agriculture. For Wageningen UR, Scienceview Media recently made a documentary about erosion and desertification. Scienceview Media will be able to make a high-quality film about the work that is done in the SOILCARE project, thus providing a significant contribution to project dissemination. SOILCARE, in turn, will provide partner 29 with the opportunity to shoot footage in several locations in Europe, and will also bring a deeper insight into the processes that threaten soils and crop production as well as the ways in which these processes can be combated. Insight and footage can both be used in future films that partner 29 will make.

3.3.4 Other countries and additional partners

All participating countries are either EU country or Associated Country (Norway and Switzerland). There are no as-yet-unidentified additional participants in the project**.**

3.4 Resources to be committed

3.4.1 Required resources

The total required budget for the SOILCARE initiative amounts to 7,628,403 €, and matches the envisioned efforts and outputs of all partners within the consortium. From the required project budget, 6,999,993 € is requested from the European Commission, while the other 628,410 € will be provided by the Swiss national government.

Division of the different direct cost categories (in %) across the requested EC budget is as follows, direct personnel costs (77%), travel (11%), equipment (3%), other goods and services (8%) and subcontracting (1%) (see Fig. 3.3). Subcontracting is foreseen for several partners, as explained in chapter 4.2. Justification of the requested budgets for travel, equipment and other goods and services is given in section 3.4.3 and in Table 3.4b. Within the SOILCARE initiative 7 out of the 29 partners are SMEs, with a combined financial participation of 21.8% of the total requested EC contribution.

3.4.2. Summary of staff efforts

Within the SOILCARE initiative a total of 781 person months over the whole duration of the planned work are foreseen. A summary of staff efforts across all work packages and partners for the entire proposed initiative is shown in Table 3.4a. Relatively laborious work packages are the ones focusing on monitoring and assessment of CS (WP5), and the one focussing on upscaling and integration (WP6). Project management (WP1) takes up 5% of person months.

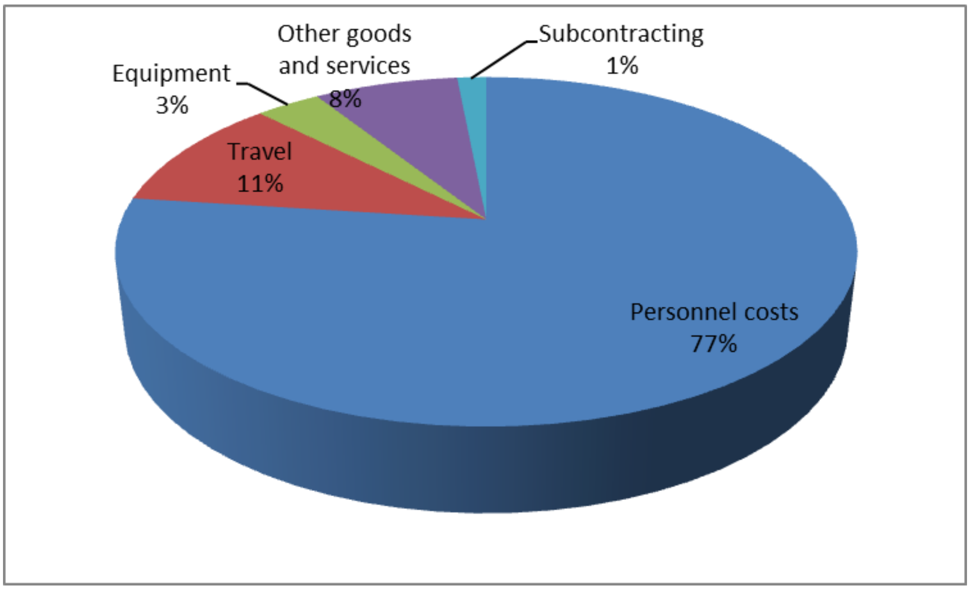


Figure 3.3. Division of direct costs over cost categories. Indirect costs are not shown as these are 25% of direct costs in all cases

3.4.3. Other direct costs

The required budget in the '*Other Direct Cost*' category, consisting of travel and subsistence costs, equipment, and other goods and services, exceeds the 15% level of the personnel cost for the majority of the SOILCARE partners, especially for those partners having relatively low personnel monthly rates. With regard to the requested budgets in the 'other direct cost' category, travel and subsistence costs are major contributors to these totals due to the international dimension of the SOILCARE consortium with 29 European and partners, and inclusion of 16 different Study Sites.

Costs for *Travel and Subsistence* include plenary project meetings and workshops within the consortium, participation at international scientific conferences, policy meetings and dissemination events, for all partners. It also includes costs for meetings of the Scientific Board. The Study Site partners will also need travel budgets for field campaigns. Respective travel and subsistence budgets of each partner are based on the following:

- There will be 6 plenary meetings. It is assumed that 2 people will participate per partner organisation, except for partner 1 (lead applicant & WP2 leader) with 4 persons participating in meetings, and some partners that have a small overall budget or can only attend with one person.
- There will be 6 meetings of the Scientific Board. Each WP leader has been given 1 additional travel in order to be able to visit a partner that might need assistance. Partner 1 as lead applicant has been given 4 additional travels for additional consortium management purposes.
- Several other meetings are also planned within the project, like the multi-stakeholder workshops and meeting related to work in specific WPs. In addition, project results should be presented at scientific and other meetings organised by non-project partners. It is assumed that most partners will visit 3 meetings during the course of the planned activities.
- Partners with case studies are assumed to visit their case study area on average once every 2 weeks, so around 125 times in 5 years. Distance to travel will vary between partners, but has been assumed to be 150 km on average.

Costs for *Equipment* apply to partners with a Study Site. These costs relate to the purchase of equipment needed to monitor soil quality, crop parameters and yield, as specified in table 3.4b.

Table 3.4a: Summary of staff effort

	WP1	WP2	WP3	WP4	WP5	WP6	WP7	WP8	Total Person/ Months per Participant
1/DLO	**35**	**25**	2	5	2	9	2	5	85
2/BCU	1	0	**28**	1	1	4	1	3	39
3 /KUL	1	4	3	8	**32**	5	2	3	58
4/UoG	1	0	2	0	0	1	1	**25**	30
5/UH	0	3	3	4	11	5	3	2	31
6/RIKS	1	2	1	1	1	**23**	1	2	32
7/TUC	0	2	1	3	9	2	2	2	21
8/JRC	0	0	0	0	2	8	1	1	12
9/UNIBE	1	4	3	**14**	13	2	1	2	40
10/Milieu	1	1	3	1	0	5	**25**	4	40
11/Bioforsk	0	2	3	1	10	1	2	2	21
12/BDB	0	2	2	1	12	1	2	2	22
13/AU	0	3	3	1	10	1	2	2	22
14/GWCT	0	2	3	3	13	2	2	3	28
15/Teagasc	0	0	0	0	0	0	6	1	7
16/SCR	0	0	0	6	17	1	0	1	25
17/ESAC	0	3	3	3	13	3	2	3	30
18/ICPA	0	3	4	3	18	4	4	4	40
19/UNIPD	0	1	3	1	10	4	2	2	23
20/IA	0	2	4	2	12	4	2	2	28
21/WU	0	2	0	4	6	6	0	1	19
22/UP	0	3	5	2	11	4	3	3	31
23/SLU	0	1	2	3	9	2	2	2	21
24/KK	0	0	0	1	2	0	0	0	3
25/PM	0	0	3	0	0	0	0	0	3
26/VURV	0	3	3	2	10	2	2	2	24
27/UAL	0	2	3	2	10	2	2	2	23
28/FRAB	0	2	3	1	9	2	2	2	21
29/Scienceview	0	0	0	0	0	0	0	2	2
Total Person/Months	41	72	90	73	243	103	74	85	781

Budgets with regard to *Other goods and services* relate to consumables and supplies, dissemination activities (information, demonstration and training materials), audit certificates, translations, open-access and other type of publication costs, organizational costs of multi-stakeholder workshops, soil and crop analysis, software licences like ArcGIS, maintenance costs for equipment and others, data costs, field rental costs, implementation costs of CS to be tested. Budgets of *Other goods and services* relate to the tasks and responsibilities of project partners, varying mostly between around 10 k€ for partners without and 20 k€ with a Study Site, while some other partners have specific additional costs, e.g. for the purchase of a web-based project management tool (participant 1), set-up and technical maintenance of the website (participant 1) and the production of dissemination materials (participants 1 and 4).

Justification of the '*Other Direct Cost*' items of partners with a total budget in this cost category exceeding 15% of their budgeted personnel costs is given in Table 3.4b. The provided total costs per partner in Table 3.4b are in accordance with the budget table in section 3 of the proposal administrative forms.

Table 3.4b. 'Other direct cost' items (travel, equipment, other goods and services)

Participant Number: 2 (BCU)	**Cost (€)**	**Justification**
Travel	31440	6 plenary meetings, 6 Management Board meetings and 3 conferences. In addition, fieldwork foreseen in WP3 requires that personnel from BCU to visit selected Study Sites
Equipment	-	
Other goods and services	10000	Open Access costs, conference fees, organisation of meetings with stakeholders for WP3
Total	41440	
Participant Number: 4 (UoG)	**Cost (€)**	**Justification**
Travel	23430	6 plenary meetings, 6 Management Board meetings and 3 conferences
Equipment	-	
Other goods and services	35000	Dissemination costs (leader dissemination WP), Open Access costs, conference costs
Total	58430	
Participant Number: 5 (UH)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	3500	Equipment for sampling (grid, soil auger), dispenser, pipette
Other goods and services	22500	Shipping of samples (incl dry ice), chemicals for analysis (a.o. C_{org}, C_{mic}, N_{min}, $P_{mic,}$ pH, enzymes, PLFA, DNA extraction), Open Access costs
Total	49738	
Participant Number: 6 (RIKS)	**Cost (€)**	**Justification**
Travel	29290	6 plenary meetings, 6 Management Board meetings and 3 conferences, additional meetings for WP6 work
Equipment	-	
Other goods and services	10000	Dissemination costs, Open Access costs, conference costs, organisation of meetings for WP6
Total	39290	
Participant Number: 7 (TUC)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	15000	Spectroradiometer for the measurement of vegetation properties on site (13,000), Laptop computer (1,000), Desktop computer for use with processing sensor/satellite image data, reporting (1,000)
Other goods and services	20000	ERDAS software license for processing satellite sensor products relevant to vegetation and soil properties (4 years), office supplies, Field

		consumables & supplies for setup and maintenance of experimental plots, Lab consumables & supplies for assessing soil properties, Open Access costs
Total	58738	
Participant Number: 10 (Milieu)	**Cost (€)**	**Justification**
Travel	29290	6 plenary meetings, 6 Management Board meetings and 3 conferences. WP7 work requires additional workshops
Equipment	-	
Other goods and services	10000	Dissemination costs (leader dissemination WP), Open Access costs, conference costs (attending and organising)
Total	39290	
Participant Number: 11 (Bioforsk)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	15000	Penetrometer for soil compaction (7000), field stations for soil water content (4000), field stations for evapotranspiration (4000)
Other goods and services	20000	Soil physical analysis of soil samples, 3D scanning of soil samples to determine porosity and connectivity, Open Access costs
Total	58738	
Participant Number: 12 (BDB)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	15000	Field balance (5500), portable computer (1500), use of combine harvester
Other goods and services	20000	Fertiliser, seeds, soil analysis, crop analysis, soil physical characteristics, fee to farmer, small field materials, Open Access costs
Total	58738	
Participant Number: 13 (AU)	**Cost (€)**	**Justification**
Travel	30700	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	5000	Equipment for sampling, and computer set-up for data collection.
Other goods and services	14150	Database access and rights. Shipping of samples, chemicals for analysis, Open Access cost
Total	49850	
Participant Number: 14 (GWCT)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	20000	Soil CO2 Flux System for assessment of soil microbial respiration under different soil management treatments. The equipment can also be used to sample N2O etc.
Other goods and services	15000	Laboratory analysis of soil samples (SOM and nutrients) and water samples (sediment and nutrients), Field drain monitoring consumables, Open Access costs
Total	58738	
Participant Number: 15 (Teagasc)	**Cost (€)**	**Justification**
Travel	9000	6 plenary meetings, 3 conferences for 1 person
Equipment	-	
Other goods and services	5000	Office supplies, Open Access costs, dissemination costs
Total	14000	
Participant Number: 16 (SCR)	**Cost (€)**	**Justification**
Travel	31050	6 plenary meetings, 3 conferences. Travel costs include taking samples in all study sites

Equipment	0	-
Other goods and services	4000	Office supplies, Open Access costs
Total	35050	
Participant Number: 17 (ESAC)	**Cost (€)**	**Justification**
Travel	21668	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	15000	2 laptops, field equipment
Other goods and services	20000	Lab consumables (7000), field consumables, rent of machinery, Open Access costs
Total	56668	
Participant Number: 18 (ICPA)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	15000	Air permeameter, Equipment for sampling (grid, soil auger)
Other goods and services	20000	Consumables and supplies (services for soil tillage, seedbed preparation, seeds, chemical fertilisers, pesticides for organising and maintaining the study site, chemicals for laboratory analysis), office consumables, dissemination costs, conference fees, Open Access costs
Total	58738	
Participant Number: 19 (UNIPD)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	15000	Electromagnetic induction (EMI) apparatus, allowing a more precise description of soil profile in the study site and a direct comparison of the effects of the practices used on soil evolution
Other goods and services	20000	Consumables for field study site (fertilisers, pesticides, fuel, seeds) and external services for soil tillage and harvest; lab consumables, dissemination costs (including Open Access), conference fees, costs related to property rights, audit certificates, translation.
Total	58738	
Participant Number: 20 (IA)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	15 000	Equipment for measuring soil water status, pH, temperature, laptop for SOILCARE testing
Other goods and services	20 000	Soil and crop analysis, field/lab consumables, maintaining field experiments, Open Access costs, workshop costs
Total	58738	
Participant Number: 21 (WU)	**Cost (€)**	**Justification**
Travel	15300	6 plenary meetings, 3 meetings in relation to modelling work WP6
Equipment	-	
Other goods and services	10000	Office supplies, software licences, data storage costs, Open Access costs
Total	25300	
Participant Number: 22 (UP)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	4000	3 notebooks with external hard drive
Other goods and services	20000	Soil and plant sampling, soil and crop analysis, soil management and agrotechnical assistance, field/lab consumables for the implementation of the research, mobile phone subscription for contact, Open Access publication costs, workshop costs, conference costs, software licenses
Total	47738	

Participant Number: 23 (SLU)	Cost (€)	Justification
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	25000	The equipment for subsoil improvement will be re-built from a commercially available product – a mechanical subsoil loosening and injection aggregate. The combined equipment will be used to inject finely milled crop residues into subsoil.
Other goods and services	10000	Analysis of physical properties of the subsoil in field plots (bulk density, aggregate stability, clay dispersion), roots, Soil carbon, Open Access costs
Total	58738	
Participant Number: 24 (KK)	**Cost (€)**	**Justification**
Travel	9720	6 plenary meetings, 3 conferences for 1 person
Equipment	-	
Other goods and services	5000	Office supplies, demonstration costs
Total	14720	
Participant Number: 25 (PM)	**Cost (€)**	**Justification**
Travel	9720	6 plenary meetings, 3 conferences for 1 person
Equipment	-	
Other goods and services	1000	Access to journal articles, transcription interviews, printing manual, marketing course WP3
Total	10720	
Participant Number: 26 (VURV)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	9000	Equipment for measuring soil humidity and temperature for tillage trial, pH meter, conductometer, equipment for preparation of high quality demineralised water
Other goods and services	26000	Implementation field trials (seeds, fertilizers, pesticides, use agricultural machines). Chemicals for plot experiments, lab analysis, compensation for pilot farms, conference fees, Open Access costs, translation.
Total	58738	
Participant Number: 27 (UAL)	**Cost (€)**	**Justification**
Travel	23738	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	16900	Scholander pressure chamber for measuring crop water status (5500), Minolta Spad 502DL chlorophyll meter for the control of nitrogen status (3800), Wet sieving apparatus for aggregate stability (7600)
Other goods and services	18100	Consumables for field work, Laboratory material and compounds Ironmongery material to construct plots, English review of articles, Open Access costs
Total	58738	
Participant Number: 28 (FRAB)	**Cost (€)**	**Justification**
Travel	12578	6 plenary meetings, 3 conferences, regular travel to study site
Equipment	800	computer
Other goods and services	19700	Soil analysis, field supplies, database software, maps, office supplies, dissemination costs
Total	33078	
Participant Number: 29 (Scienceview)	**Cost (€)**	**Justification**
Travel	7080	2 plenary meetings, 3 visits to study sites for filming
Equipment	2800	Camera equipment

Other goods and services	500	Office supplies
Total	10380	

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4. Members of the consortium

4.1. Participants

Participant 1 – Stichting Dienst Landbouwkundig Onderzoek (DLO), Droevendaalsesteeg 4, 6708 PB, Wageningen, the Netherlands

Legal entity: Alterra is part of DLO, which is part of Wageningen UR (University and Research Centre).
Description: Alterra is the main Dutch centre of expertise on rural and natural environment and agricultural land use, and engages in strategic and applied research to support policymaking and management at the local, national and international level. Alterra is also involved in both research and education in water, soil and land use from local to global scale. Alterra contributes to sustainable use of water and soil resources and sustainable design and management of the environment. Alterra is partner in a.o. the Partnership for European Environmental Research (PEER), the Global Water Partnership (GWP), Climate-KIC, the World Water Council (WWC), the Netherlands Water Partnership (NWP) and Climate Change and Biosphere (CCB).
Role in project: Project Coordinator, WP2 leader
Past experience: Within FP5-7 of the EU, Alterra has been and continues to be involved, either as coordinator or partner institution, in more than 100 projects, with a large share of projects working on agriculture, degradation, conservation, soil threats and land use, such as the EURURALIS, DESIRE, EUROPEAT, CASCADE, RECARE, SmartSoil, AnimalChange, and Fertiplus. Alterra leads the Flagship Climate-Smart Agriculture Booster under the EIT's Climate-KIC.

Involved personnel

Name of personnel	*Expertise*
Dr. Rudi Hessel (m)	Coordinating large international research projects. Modelling hydrology and erosion, desertification, and designing and executing field work.
Prof. Dr. Oene Oenema (m)	Agronomy, nutrient management, soil fertility. Currently, he is chair of the EU Nitrogen Expert Panel. Coordination of research projects
Dr. Gerard Velthof (m)	Soil fertility, nutrient management, agronomy, emissions of nitrogen and greenhouse gases, coordination of research projects
Dr. Simone Verzandvoort (f)	Research and network projects on land use, climate-smart agriculture, soil information.
Erik van den Elsen (m)	Field monitoring, website development and maintenance. Coordinating large international research projects.

Dr. Rudi Hessel (H-index: 14, cited by others: 604 times) has almost 15 years of experience in applied research in the areas of soil degradation, soil conservation and hydrology. During the last 10 years, he has had coordinating roles in various EU-funded projects, including Project Manager in DESIRE and CASCADE, Scientific Project Coordinator in RECARE and Project Coordinator in WAHARA.

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List of relevant project or activities

- DESIRE (FP6): Desertification mitigation and remediation of land: a global approach for local solutions
- RECARE (FP7): Preventing and remediating degradation of soils in Europe through Land Care
- SMARTSOIL: sustainable soil management aimed at reducing threats to soils under climate change
- FERTIPLUS: Reducing mineral fertilisers and agro-chemicals by recycling treated organic waste as compost and bio-char.
- CASCADE (FP6): Catastrophic shifts in drylands: how can we prevent ecosystem degradation?

Participant 2 – Birmingham City University, University House, 15 Bartholomew Row, B5 5JU Birmingham, United Kingdom

Legal entity: Birmingham City University (www.bcu.ac.uk) is a publicly funded Higher Education Institution.
Description: BCU provides a wide range of taught undergraduate and postgraduate programmes, Masters and Doctoral level research to some 22,000 students. It also delivers many knowledge transfer, community engagement and professional development initiatives. The University has particular strengths in interdisciplinary working and the practical application of knowledge, underpinning a deep commitment to professional relevance and employability.
The Faculty of Computing, Engineering and The Built Environment (CEBE) comprises four schools that, together, are able to respond dynamically to the multiple modern technological challenges posed by fast-paced industries. Research in the faculty extends across the technologies and professions, exploring some of the latest developments in computer science and informatics, and in the built and natural environment. The six-yearly UK Government assessment of research excellence and impact (the Research Excellence Framework or REF) assessed research in 2014. In the Build Environment and Planning category, 100% of research outputs were rated world-leading, internationally excellent or internationally recognized, and 100% of the impacts evaluated were recognised as very considerable or considerable - reflecting high-quality research which influences national and local government policy.
Current research relevant to this proposal focuses on:

- Co-generating knowledge to adapt to environmental change
- Enabling social change through alternative dispute resolution
- Understanding how people can work together to better understand changing values around the built and natural environment
- Governance of ecosystem services

Role in project: WP3 leader
Past experience: BCU has experience in participating in a number of EU-funded research projects. In the sustainability field in particular, it participates to the EnAlgae and BioenNw projects and is a partner of Climate-KIC, the EU main climate innovation initiative. More broadly BCU has been involved in UN funded research about the links between climate change and land degradation and on the costs, benefits, trade-offs of sustainable land management in southern Africa's rangelands. BCU staff helped develop the EU BiodivERsA programme's Stakeholder Engagement Toolkit, and have been extensively involved in the development of carbon markets for the restoration of peat soils in the UK.

Involved personnel

Name of personnel	*Expertise*
Prof Mark Reed (m)	Stakeholder engagement, participatory scenario development, environmental management, environmental governance, ecosystem services, Payments for Ecosystem Services, land degradation in drylands, desertification, sustainable land management, peatland management, multi-functional landscapes, land use policy, sustainable livelihoods, social learning and adaptive co-management.

Julian Sidoli del Ceno (m)	Barrister researching primarily in the fields of alternative dispute resolution, construction, housing and property law. He is particularly interested in the philosophical and jurisprudential aspects of mediation and matters concerning housing rights and professional practice. Areas of expertise include: alternative dispute resolution, land law (particularly landlord and tenant), housing law, construction law, jurisprudence and legal philosophy
Claudia Carter (f)	Environmental governance; Ecosystem approach; Holistic, participatory and creative approaches to environmental planning and management; Beyond risk: uncertainty and complexity; Institutional analysis; Interdisciplinary research; Research methods (especially qualitative and mixed methods

Prof Mark Reed: Interdisciplinary researcher specialising in knowledge exchange, stakeholder participation and the value of nature, helping people to adapt to environmental change in mountains and deserts around the world.

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Participant 3 – Department of Earth and Environmental Sciences, KU Leuven, Celestijnenlaan 200E, 3001 Leuven, Belgium

Legal entity: Department of Earth and Environmental Sciences belongs to the group Science and Teachnology, which is part of the KU Leuven (University).

Description: The department of Earth and Environmental Sciences carries out state-of-the-art scientific research with respect to the functioning of geo- and ecosystems at different spatial and temporal scales, including the interaction between humans and the environment and the sustainable management of natural resources. The department aims at providing attractive academic training at an international level in the fields of Agriculture, Bio-engineering, Geology, Geography and Tourism. The department aims at making an important contribution to the scientific understanding of environmental pollution, food production, climate change, nature and landscape management, soil and water management, exploitation of underground resources, rural and urban development, international development collaboration.

Role in project: WP5 leader, macro-economic modelling in WP6

Past experience:

Leuven participates in over 540 highly competitive European research projects (FP7, 2007-2013), ranking sixth in the league of HES institutions participating in FP7. KU Leuven takes up the 9th place of European institutions hosting ERC grants (as first legal signatories of the grant agreement). To date, the 69 ERC Grantees (including affiliates with VIB and IMEC) in our midst confirm that KU Leuven is a breeding ground (49 Starting Grants) and attractive destination for the world's best researchers. The success in the FP7 Marie Curie Actions is a manifestation of the three pillars of KU Leuven: research, education and service to society. In our 136 Actions, of which 57 Initial Training Networks, hundreds of young researchers have been trained through research and have acquired the necessary skills to transfer their knowledge into the world outside academia. In Horizon 2020, KU Leuven currently has been approved 64 projects.

Involved personnel

Name of personnel	*Expertise*
Prof. Dr. Guido Wyseure (m)	Coordinating large international research projects. Modelling hydrology and irrigation and drainage, soil and water management and executing irrigation experiments.
Prof. Dr. Jan Diels (m)	Soil physics, nutrient management and agronomic field experiments in Europe and in the tropics.
Prof Dr. Jean Poesen (m)	Experimental geomorphology, desertification; soil erosion, degradation and conservation; sediment production,-transport and –delivery reservoir sedimentation; coordination of research projects.
Christof Coeck (m)	Technologist for field monitoring with electronic communication and maintenance of field instrumentation.

Dr. Guido Wyseure (H-index: 13, cited by others: 441 times) has a long experience in applied research in the soil and water management, irrigation and drainage, hydrology in the context of development cooperation. He has and is coordinating various development cooperation projects in Africa, Asia and Latin-America.

Dr Jean Poesen has a H-index of 55 with almost 10000 citations by other and has a track record in soil erosion, tillage and land-slides.

Dr Jan Diels (H-index 16 and 613 citations by others)

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De Vente, J., & **Poesen, J.** (2005). Predicting soil erosion and sediment yield at the basin scale: scale issues and semi-quantitative models. Earth-Science Reviews, 71(1), 95-125. (164 citations).

Govers, G., Vandaele, K., Desmet, P., **Poesen, J.**, & Bunte, K. (1994). The role of tillage in soil redistribution on hillslopes. European Journal of Soil Science, 45(4), 469-478. (204 citations).

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Poesen, J., Nachtergaele, J., Verstraeten, G., & Valentin, C. (2003). Gully erosion and environmental change: importance and research needs. Catena, 50(2), 91-133. (357 citations).

List of relevant project or activities

- DESIRE (FP6): Desertification mitigation and remediation of land: a global approach for local solutions.
- Prof Jan Diels as promotor of "The development of the soil component for a model-based advice system for 'just-on-time' N-fertilisation in field vegetable production" sponsored by IWT (Flemish industrial research fund)
- Prof Guido Wyseure als promotor of "Sustainable management of soil and water resources in Bangladesh: long-term impact on soils of irrigation using lower quality water" sponsored by VLIR (Flemish interuniversity council for development cooperation).

Participant 4 – The University of Gloucestershire (Countryside and Community Research Institute (CCRI)), Oxstalls, Gloucester, GL2 9HW, UK

Legal entity: Established in 1988, the Countryside and Community Research Institute (CCRI) is part of the University of Gloucestershire

Description: The Countryside and Community Research Institute (CCRI) and is one of the leading specialist rural research centres in the UK. It has expertise in all aspects of research in policy and planning for the countryside, agriculture and environment, rural development and rural economy and society, with research staff including geographers, economists, spatial planners, policy analysts, sociologists and environmental scientists. All work is ethically assured and formal systems are in place to enable monitoring and control of progress, finance and quality. CCRI has successfully managed large consortium projects for UK and EU public sector sponsors in recent years.

Role in project: WP8 leader

Past experience: CCRI has been involved in a number of FP5-7 projects as a key partner in stakeholder engagement and dissemination and communication roles related to soil management and agriculture. Recent and on-going projects include RECARE, SmartSOIL, VALERIE, SOLINSA and two H2020 project SUFISA and PEGASUS.

Involved personnel

Name of personnel	*Expertise*
Jane Mills (f)	Interdisciplinary background with special interest in farmer behaviour at the landscape scale in context of agri-environment, and sustainable soil management. Stakeholder engagement and dissemination.
Julie Ingram (f)	Interdisciplinary expertise with special interest in knowledge exchange and agricultural knowledge and innovation systems, sustainable soil management with respect to farmer knowledge, behaviour and decision making. Stakeholder engagement and dissemination.
Mellisa Affleck (f)	Interdisciplinary background with a special interest in using participatory approaches to explore payment for ecosystem services

Jane Mills has almost 20 years of experience of working in natural resource management. As a Senior Research Fellow at CCRI she has particular expertise in farmer behaviour, agricultural knowledge systems and knowledge exchange and the use of advisory services in the context of soil management and biodiversity. She is an experienced project manager and has expertise of engaging with a wide range of stakeholders (research, advice, policy, farming) and of working in interdisciplinary research projects. She is currently leading the dissemination and communication activities for RECARE and is involved in the stakeholder engagement and dissemination WPs for SmartSOIL and VALERIE projects.

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Ingram, J. (2008). Are farmers in England equipped to meet the knowledge challenge of sustainable soil management? An analysis of farmer and advisor views. Journal of Environmental Management 86(1): 214-228.

List of relevant project or activities

- RECARE (FP7) (Preventing and Remediating degradation of soil in Europe through Land Care) (2013-2018) – leading the Dissemination and Communication WP
- SmartSOIL (FP7) (Sustainable farm Management Aimed at Reducing Threats to SOILs under climate change) (2011-2014) - leading the Stakeholder Engagement and Dissemination WP

- VALERIE project (FP7) (VALorising European Research for Innovation in agriculturE and forestry) - leading the Case Study analysis WP (2013-2017)

Participant 5 – Institute of Soil Science and Land Evaluation, University of Hohenheim, Emil- Wolff Str.27, 70599 Stuttgart, Germany

Legal entity: University of Hohenheim

Description: The University of Hohenheim (German: *Universität Hohenheim*) is a campus university located in the south of Stuttgart, Germany. Founded in 1818 it is Stuttgart's oldest university. Its primary areas of specialisation had traditionally been agricultural and natural sciences. The faculty has regularly been ranked among the best in the country, making the University of Hohenheim one of Germany's top-tier universities in these fields. The university maintains academic alliances with a number of partner universities and is involved in numerous joint research projects. The university currently pursues research in the fields of health, nutrition, agriculture, consumer protection and environmental protection, as well as economics and communication. Areas of particular importance include: (1) Agricultural and nutritional sciences within the food chain, (2) Biobased products and bioenergy from agriculture, (3) Biological signals, (4) Bioeffector research and (5) Innovation and services.

Role in project: Study Site coordinator, soil biology expertise

Past experience: Ellen Kandeler has long-lasting experience in fund raising of national and international projects. The total amount of funds was 2,929.000 Euro over a period of eight years. Most projects focus on the response of soil biota to changes in environmental conditions. The EU funded the following project: EU SEE-ERA.NET Plus Project ERA 216/03 "Development and evaluation of innovative tools to estimate the ecotoxicological impact of low dose pesticide application in agriculture on soil functional microbial biodiversity". Currently, Ellen Kandeler is also involved in the following EU project: EU BIOFector (Prof. G. Neumann, Prof. T. Müller) „Effects of Bioeffectors on structure and function of microbial communities in the rhizosphere of different crops" (2012 – 2016). Additional funds come from the German Funding Agency DFG (e.g. SPP 1374 KA 1590/8-1, FOR 918-1 KA 1590/9-1, KA 1590/10-1, KA 1590/11-1).

Involved personnel

Name of personnel	*Expertise*
Prof. Dr. Ellen Kandeler (f)	Focus on soil microbial ecology of agricultural ecosystems; expert in environmental soil microbiology, functional soil ecology and soil science. Leading of interdisciplinary projects

Prof. Dr. Ellen Kandeler (H-index: 45, cited by others: 6,768 times) has almost 25 years of experience in research in the areas of microbial ecology, soil ecology and soil science. During the last 10 years, she has authored or co-authored 110 international referred papers in high ranking journals (e.g. Science, Global Change Biology, Soil Biology and Biochemistry)

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List of relevant project or activities

- DFG SPP 1374 KA 1590/8-1 "Effect of land-use intensity on spatial structure and function of soil microbial communities" (2008-2017).
- DFG FOR 918-1 KA 1590/9-1 Carbon flow in below-ground food webs assessed by isotope tracers – Effects of resource quality on soil microorganisms and their carbon assimilation. (2009 – 2014).
- DFG, KA 1590/10-1 "Agricultural Landscapes under Global Climate Change-Processes and Feedbacks on a Regional Scale". (2011 – 2017).

Significant infrastructure

The Institute of Soil Science of the University of Hohenheim is well equipped to perform modern methods in microbial soil ecology (e.g. measurement of microbial biomass, enzyme activities, DNA extraction, ergosterol, phospholipid fatty acid pattern, oxygen consumption, qPCR, stable isotope probing of signature molecules etc.).

Participant 6 – Research Institute for Knowledge Systems (RIKS), Hertogsingel 11B, 6211 NC Maastricht, the Netherlands

Legal entity: RIKS is a SME.

Description: The Research Institute for Knowledge Systems (www.riks.nl) has over the last 25 years developed itself into both a leading research centre and real-world solution provider in the field of land use science and model integration. RIKS undertakes applied research for public and private parties worldwide, including the European Commission, the Dutch and Puerto Rican national governments and various local and regional government bodies throughout Europe and beyond. To facilitate its research on model integration, RIKS has developed its own software platform, Geonamica, and the generic land use modelling framework, Metronamica (www.metronamica.nl), used by numerous administrations and researchers worldwide.

Role in project: WP6 leader.

Past experience: RIKS has participated in and/or led several FP5, FP6 and FP7 projects, such as MedAction, VISIONS, MODULUS, TiGrESS, LUMOCAP, DeSurvey, PLUREL and RECARE.

Involved personnel

Name of personnel	*Expertise*
Ir. Hedwig van Delden (f)	Coordinating (inter)national projects; civil engineer specialised in water resources and the environment, research related to land use change processes, scaling issues, integration of bio-physical and socio-economic processes, integrated land use modelling, and the science-policy interface.
Roel Vanhout (m)	Senior software engineer and researcher with expertise in designing, implementing and marketing complex software systems, in particular the development of decision support systems with a large spatial aspect supporting policy questions and involving different domains.

Ir. H. van Delden (H-index: 16, cited by others: 948 times) has 15 years of experience in model integration, land use modelling and scenario studies. Her research on the integration of spatially explicit and dynamic models and the use of modelling in combination with facilitated workshops frequently leads to teaching and speaking assignments in universities and scientific and policy-oriented congresses and events worldwide. Besides her research, in her role as Managing and Scientific Director of RIKS, she manages national and international projects that focus on the design, development and use of integrated models for policy support, and has in this capacity coordinated the FP6 project LUMOCAP, is the principle scientist for the Australian BNHCRC hazard mitigation DSS project and facilitated a large number of workshops to support the development and use process of these systems. She is also an Adjunct Associate Professor at the University of Adelaide and an expert evaluator for the European Green Capital Award and the European Green Leaf.

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Kok, K., **Van Delden, H.** 2009. Combining two approaches of integrated scenario development to combat desertification in the Guadalentín watershed, Spain. Environment and Planning B 36: 49-66.

Van Delden, H., Luja, P., Engelen, G. 2007. Integration of multi-scale dynamic spatial models of socio-economic and physical processes for river basin management. Environmental Modelling and Software 22: 223-238.

List of relevant projects or activities

- **ET2050 -** Territorial Scenarios and Visions for Europe (2013-2015); ESPON Project2013/1/19.
- **RECARE -** Preventing and remediating degradation of soils in Europe through land care (2013-2018); FP7 ENV.2013.6.2-4, Grant agreement: 603498.
- **Policy evaluation -** Evaluation of EU policies and their direct and indirect impact on land take and land degradation (2014); EEA, Negotiated procedure EEA/NSV/14/004.

Participant 7 – Technical University of Crete (TUC), Polytechnioupolis, Chania, Greece

Legal entity: Technical University of Crete (TUC) is a higher education establishment.
Description: TUC (http://www.tuc.gr) is a modern technological institution that has established a strong international reputation. The mission of the TUC is to develop modern engineering specialties, to place emphasis on research in fields of advanced technology as well as to establish close cooperation with industry and other production organizations in Greece. The well-equipped laboratories, high technology infrastructure and 129 faculty staff members with international academic careers, testify to the high quality of the educational and research work conducted at TUC. This profile ranks the Technical University of Crete amongst the most prominent research institutions in Greece.
Role in project: Study Site coordinator
Past experience: The Water Resources Management and Coastal Engineering Laboratory of TUC have participated in several Thematic and Infrastructure Programs of the European Commission since 2002. The major activities can be summarized as follows: Climate Change and weather extremes - impact on water resources, hydrological extremes, water balance and water availability, catastrophic shifts in arid environments, hydrologic modelling of surface and ground water, application of GIS/Remote Sensing VHR Technologies. Completed EU-projects in the last 5 years: FP6-IP-WATCH, SCENES and FP7-COMBINE, ECLISE, SATFLOOD and ESA-SIMFLOOD. Current related EU-funded projects are FP7-RECARE, CASCADE, IMPACT2C, HELIX, H2020-IMPREX and EU-National funded REINFORCE.

Involved personnel

Name of personnel	*Expertise*
Prof. Ioannis K. Tsanis (m)	Has managed over 50 projects in areas of climate change impact on water resources, hydrological extremes (flash floods and droughts), hydroinformatics, integrated watershed/coastal management, hydraulic /hydrological/water quality modeling and water availability forecasting.
Dr. Ioannis Daliakopoulos (m)	Water resources with emphasis on combined use of technologies such as GIS, remote sensing and algorithms for R&D purposes. Participates in EU projects (RECARE & CASCADE FP7, SCENES & WATCH FP6).

Dr. Aristeidis Koutroulis (m)	Experience in climate change and impact studies, GIS, hydrological modeling, and water resources management. Participates in EU projects (RECARE, CASCADE, IMPACT2C & ECLISE FP7).
Dr. Dimitrios Alexakis (m)	Experience in applications of satellite remote sensing and GIS in geology, geomorphology and environmental surveillance. Participates in EU (RECARE) and EU-National funded projects (REINFORCE).

Prof. Ioannis K. Tsanis: (H-index: 22, cited by others: 1709 times –Google scholar) Full Professor in the Department of Civil Engineering at McMaster University where he has taught since 1988. Since 2001 he has also been a Professor at TUC. He has published 3 books and over 250 scientific journal papers, conference proceedings and technical reports. He is a member of international research teams, expert panels in research proposal evaluation teams (NSERC (Canada), NSF (USA) and EU (FP5, FP6, FP7, H2020)). Since 2002 he has managed 16 research projects from which 5 as a coordinator.

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Panagea I.S., **Daliakopoulos I.N., Tsanis, I.K.**, Schwilch, G. (2015) Evaluation of Soil Salinity Amelioration Technologies in Timpaki, Crete. EGU, 17-533.

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List of relevant projects or activities

- **RECARE -** Preventing and remediating degradation of soils in Europe through land care (2013-2018); FP7 ENV.2013.6.2-4, Grant agreement: 603498.
- **CASCADE -** Sudden and catastrophic regime shifts in dryland ecosystems (2012 – 2017); FP6 ENV.2011.2.1.4-2 - Behaviour of ecosystems, thresholds and tipping points, Grant agreement:283068.
- **ECLISE -** Enabling CLimate Information Services for Europe – ECLISE (2011-2013); FP7 ENV. Grant agreement 265240.

Participant 8 – Joint Research Centre of the European Commission, E. Fermi 2749, Ispra(VA), 21027, Italy

Legal entity: Commission of the European Communities - directorate general Joint Research Centre - JRC. JRC is one of the Directorate General (DGs) of the European Commission.
Description: The Institute for Environment and Sustainability (IES), located at Ispra (Italy), is a division of JRC carrying a number of interdisciplinary research activities. The Land Resource Unit staff has broad experience in soil studies ranging from soil mapping activities to soil characterization, soil data management and soil modeling. Soil activities within the JRC are concentrated in a specific project, called "Soil Resource Assessment" (SRA). The soil staff operates the European soil portal and the European Soil Data Centre (ESDAC) where data, maps, research reports and publications are available for the scientific community and the public. The soil staff performs a numerous modeling activities relevant to the Soil Thematic Strategy soil threats.
Role in project: participant in WP5-8.
Past experience: Within FP5-7 of the EU, JRC soil team has been involved as a partner institution, in a numerous research projects among others CASCADE, RECARE, SoilTrEC, MyWater, EcoFinders, Geoland-2, eSoter, Digisoil, i-Soil ,SafeLand, Ramsoil and Euroharp.

Involved personnel

Name of personnel	*Expertise*
Dr Agnieszka Romanowicz (f)	Expertise in hydrology and water management including policy implementation; expertise in land use, agri-environment; GIS and data management; expert in soil science; Lead editor of the revised Soil Atlas of Europe (under preparation).

Dr Agnieszka Romanowicz has almost 10 years of experience in applied research and 5 years of experience in policy implementation in the areas of soil degradation, soil conservation and hydrology. Since 10 years she is working for the EU institutions in various roles including policy coordination, research and support to policy developments.

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List of relevant project or activities

CASCADE, RECARE, SoilTrEC, eSoter, Digisoil.

Participant 9 – Centre for Development and Environment CDE, University of Bern (UNIBE), Hallerstrasse 10, 3012 Bern, Switzerland

Legal entity: University.

Description: The Centre for Development and Environment (CDE) is an interdisciplinary research centre of the University of Bern. CDE works to promote sustainable development and solve problems related to global environmental, social, and economic change. Together with partners in Europe, Africa, Asia, and Latin America, CDE conducts research to develop innovative concepts and solutions for the sustainable use of land and water resources. CDE coordinates the International Graduate School (IGS) North-South and hosts the secretariat of WOCAT (World Overview of Conservation Approaches and Technologies), which operates through partnerships in over 50 countries worldwide. CDE implements research- and application mandates on issues of natural resources management and governance, and cooperates with a broad range of stakeholders at micro-, meso- and macro level.

Role in project: WP4 leader, Study Site coordinator

Past experience: CDE cooperates, mostly as WP and case study leader, in several European projects. In the past in SOWAP (Soil and Water Protection), COST Action 634 (On- and Off-site Environmental Impacts of Runoff and Erosion), DESIRE (Desertification mitigation and remediation of land), REDD+ (Impacts of REDD and Enhancing Carbon Stocks) and currently in CASCADE (Catastrophic Shifts in Drylands), RECARE (Preventing and Remediating degradation of soils in Europe through Land Care) and iSQAPER (Interactive Soil Quality Assessment in Europe and China for Agricultural Productivity and Environmental Resilience).

Involved personnel

Name of personnel	*Expertise*
Dr. Gudrun Schwilch (f)	Senior Research Scientist / geographer. Head of CDE's cluster "Natural Resources and Ecosystem Services". Almost 20 year experience in research and implementation projects on sustainable land management; desertification & land degradation; natural resources monitoring; decision support; participatory processes & multi-stakeholder learning in Europe, Africa and Asia.

PD Dr. Abdallah Alaoui (m)	Senior Research Scientist. Over 25 year experience in soil physics with a focus on dual-porosity modelling of flow and transport in unsaturated zone; importance of soils for agriculture, forestry and ecosystem functions; modelling effects of land use and climate change on soil and water resources across scales.
Dr. Etienne Diserens (m) (associate expert)	Scientist / project manager. Agricultural engineer, graduated from ETH Zurich and in charge of research at the Federal Station in Agricultural Technology and Economics (Agroscope ART in Tänikon). Specialist in soil mechanics and in the physical protection of agricultural soils.

Dr. Gudrun Schwilch is the head of the Natural Resources and Ecosystem Services cluster at CDE. She holds a PhD in land degradation and development from Wageningen University, the Netherlands and has long-term experience in sustainable land management issues. She has been work package leader in several EU funded research projects: DESIRE, CASCADE, RECARE and iSQAPER.

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Diserens E, Duboisset A, Dufossez P, **Alaoui A,** 2011. Prediction of the contact area of agricultural traction tyres on firm soil. Biosystems Engineering, 110(2), 73-82.

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Schwilch G, Liniger HP, Hurni H. 2014. Sustainable Land Management (SLM) practices in drylands: how do they address desertification threats? Environmental Management 54(5):984-1004. Doi: 10.1007/s00267-013-0071-3

List of relevant project or activities

Members of CDE act(ed) as overall project / workpackage coordinator of the following projects:

- WOCAT – World Overview of Conservation Approaches and Technologies (www.wocat.net). Global programme funded by SDC and others, secretariat hosted by UNIBE (€ 200k/y to UNIBE since 1993).
- RECARE – Preventing and remediating degradation of soils in Europe through land care (www.recared-project.eu). EU FP7 Collaborative Project (2014-2019) € 11+ M, €586k to UNIBE
- CASCADE - Catastrophic shifts in drylands: how can we prevent ecosystem degradation? (www.cascade-project.eu). EU FP7 Collaborative Project (2012-2017) € 5.89 M, €513k to UNIBE.

Significant infrastructure

CDE is the host of the WOCAT database of Sustainable Land Management (SLM) practices with over 500 practices documented from all over the world.

The partner Agroscope Reckenholz-Täniken ART is fully equipped with field measurement equipment, soil laboratory and electronic devices.

Participant 10– Milieu Ltd., Chaussée de Charleroi 112, 1060-Brussels, Belgium

Legal entity: SME.

Description: Milieu Ltd is a law and policy research firm with a strong track record in working for the European Commission (DG Environment, DG Climate Action, DG Regional and Urban Affairs and others) as well as the European Environment Agency (EEA), the European Chemicals Agency (ECHA) the European Parliament and other international organisations. Milieu has extensive experience in providing technical and legal support for the implementation of EU environmental policy (freshwater, floods, land, biodiversity, climate change adaptation, energy, financing instruments) at the EU and has carried out numerous, in-depth case studies at the Member State level. These include the evaluation of the implementation of Directives, the development of guidance and

documents, organisation of stakeholder consultation across the EU-28 Member States and interdisciplinary studies (including governance, socio-economic and technical aspects).
Role in project: WP7 leader
Past experience: Milieu has a track record of supporting the European Commission in the implementation of various EU directives including the Water Framework Directive, Floods Directive, theUrban Waste Water Treatment Directive, the Drinking Water Directive, the Marine Strategy Framework Directive (MSFD) and the EU Adaptation Strategy. Other recent projects include the *Evaluation of EU policies and their impacts on land take and land degradation* (for EEA) and the *Governing the water-food-energy nexus* (for UNEP). Ordered by the European Commission, following recent projects are relevant: the *EU policy document on Natural Water Retention Measures (NWRM)*, the A*nalysis of the environmental results of EU Cohesion Policy*, the *Fitness Check of the Birds and Habitats Directive*, the *Smart-guide for multi-benefit investments in green infrastructure* and the *Methodologies for climate proofing investments and measures under Cohesion and Regional Policy and Common Agricultural Policy*.

Involved personnel

Name of personnel	*Expertise*
Dr. Jan Cools (m)	Land and water management, governance, stakeholder participation, climate change adaption, risk assessment, science-policy interface
Tony Zamparutti (m)	EU environmental policy analysis, governance water and land management, stakeholder participation
Guillermo Hernández (m)	Economist, cohesion policy, EU economic policies, socio-economic incentives
Sandra Planes-Satorra(f)	Economist, public policy analysis and evaluation, economic incentives regional development and environmental policy.

Dr. Jan Cools (H-index: 8; total citations: 182) has 15 years of experience, in coordination, research and technical implementation of projects on water, soil and ecosystem assessment and management for European institutes (DG Environment, DG Climate Action, DG Research, EEA). Recent references are the EU reference document on Natural Capital Accounting (for EEA), Governing the water-energy-food nexus: opportunities for basin organisations (for UNEP), and the EU policy document on natural water retention measures (NWRM) (for WG PoM of the WFD). Jan also has a key role in the compliance assessment of the Floods Directive and the Marine Strategy Framework Directive. He also had a key role in projects WETwin, Afromaison, FlaFloM, FREEMAN, Twin2Go and EnviroGrids.

References List of relevant publications

Cools, J. et al. (2014). EU Policy Document on Natural Water Retention Measures. European Commission. ISBN 978-92-79-44497-5

Andrew Farmer, Thomas Dworak, Sarah Bogaert, Maria Berglund, Tony Zamparutti, Eduard Interwies, Pierre Strosser, Kieron Stanley, Guido Schmidt, Jan Cools, Guillermo Hernández, Dieter Vandenbroucke, Victoria Cherrier and Stephanie Newman. 2012. Service contract to support the impact assessment of the Blueprint to safeguard Europe's waters. Lot 2: Assessment of policy options for the Blueprint. Final report. Ordered by the European Commission. Available online.

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Nilsson M., **Zamparutti T.**, Petersen J.E., Nykvist B., Rudberg P., and McGuinn J., Understanding Policy Coherence: Analytical Framework and Examples of Sector–Environment Policy Interactions in the EU, Environmental Policy and Governance, 2012

Cools J. (2012). Feasibility study for a Flash Floods and Landslide Risk Assessment and the Setup of an Early Warning System in Wadi Musa, Petra, Jordan – Project Manager / Senior Expert – Focus on feasibility assessment of an early warning system for flash floods for the archaeological site Petra and the nearby village Wadi Musa. (UNDP Jordan, 2012).

List of relevant projects

- **Ex-post evaluation of Cohesion Policy programmes 2007-2013**, focusing on the European Regional Development Fund (ERDF) and Cohesion Fund (CF)- Work Package Six: Environment
- **Climate-ADAPT** science/policy forum: workshops for the dissemination and exchange of adaptation-related knowledge to policymakers – for the European Commission, DG Climate Action (2014).

- **Evaluation of EU Policies and their direct and indirect impact on land take and land degradation** – for the European Environment Agency (EEA) (2014-2015)

Participant 11 – Bioforsk, the Norwegian Institute for Agricultural and Environmental Research. Frederik A. Dahlsvei 20, 1432 Ås, Norway

Legal entity: Bioforsk – the Norwegian Institute for Agricultural and Environmental Research – is a national R&D institute under the Norwegian Ministry of Agriculture and Food.
Description: The main areas of competence of Bioforsk are linked to food quality and safety, agriculture and rural development, environmental and water protection and natural resources management. Bioforsk has a staff of about 500. The R&D activities of Bioforsk are organised in seven research divisions, located in different regions of Norway. Bioforsk encompasses a wide range of competence within natural sciences, with long traditions in field- and laboratory-based experimental studies. This includes also the development and application of various tools and models for management- and policy support linked to agriculture and environment.

Role in project: Study Site coordinator
Past experience: The Environment division that will be involved in this project has been involved in a number of EU projects and coordinated the following: EuroPeat, Mantra-East, PRIMOSE and STRIVER, GENESIS and SoilCam and participated in REFRESH, AWARE and COROADO. Bioforsk leads WP2 of the ongoing RECARE project on remediation strategies for soil degradation at the European scale.

Involved personnel

Name of personnel	*Expertise*
Dr. Jannes Stolte (m)	Head of Land use section, division Environment, senior research scientist. Fundamental and applied research on watershed management and soil-hydrology, participating in large (inter)national multidisciplinary research projects in Asia, Europe, South-America and the Pacific region. Currently leading the Bioforsk team in the RECARE project.
Dr. Sigrun Kværnø (f)	Soil scientist, with her main research interests being soil physics/soil hydrology, flow and transport pathways for particles and nutrients and hydrological and crop growth modeling.
Dr. Lillian Øygaarden (f)	Senior research scientist within soil physics, soil erosion, watershed management. Experience with monitoring programs of runoff from agricultural areas. Coordinator Norwegian consortium in the EU project MACSUR: Modelling European Agriculture with climate change for food security. National representative in Global Research Alliance for reduction of agricultural greenhouse gases (GRA). Coordinator of the AgroPro project (Agronomy for increased food production).
Dr. Mehreteab Tesfai (m)	Research scientist specialized in soil and water management. He has more than 25 years of research experience in degraded soils, ephemeral rivers (particularly spate irrigation water management) in East Africa and also in several collaborative research projects with some European countries.

Dr. **Jannes Stolte** has more than 20 years of experience in fundamental and applied research in the area of watershed management and soil-hydrology, and in participating in and coordinating large (inter)national multidisciplinary research projects. He holds a PhD from Wageningen University, Netherlands. His interest focuses on land-hydrology interactions at different spatial, temporal and climate scales, with special attention to soil physical processes. He participated in a number of international projects, both as researcher and coordinator, in Asia, Europe, South-America and the Pacific region.

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Starkloff, Torsten & **Jannes Stolte**. 2014. *Applied comparison of the erosion risk models EROSION 3D and LISEM for a small catchment in Norway*. CATENA 118:154–167.
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Deelstra, J., **Øygarden, L**. ,Blankenberg, A-G.G., & Eggestad, H.O.2011. Climate change and runoff from agricultural catchments in Norway. International Journal of Climate Change and Management. Vol.3 No 4, 2011: 345- 360. DOI 10.1108/17568691111175641.
Stolte, Jannes, Xuezheng Shi and Coen J. Ritsema. 2009. Introduction: Soil erosion and nutrient losses in the Hilly Purple Soil area in China. Soil & Tillage Research 105 (2009) 283–284.
Tesfai, M. & Stålnacke, P. 2012. Temporal trends of Al, Fe, Cu, Mn, and Zn concentrations in streams draining agricultural catchments of the southeast Norway. Acta DOI: 10.1080/09064710.2012.714398.

List of relevant project or activities

- RECARE (EU-FP7) (WP leader): Remediation strategies for soil degradation at the European scale.
- ApgroPro (Norwegian Research Council) (Coordinator): Agronomy for increased food production
- MACSUR (JPI FACCE): Modelling European Agriculture with climate change for food security

Significant infrastructure

- JOVA program (Agricultural monitoring program) with more than 20 years of monitoring on land use, management and discharge and nutrient losses from 12 agricultural catchments across Norway;
- Soil physics lab, equipped for measuring water retention, (un)saturated conductivity, aggregate stability, soil texture;
- Experimental fields for monitoring of different agricultural management systems.

Participant 12 – Bodemkundige Dienst van België (BDB), W. de Croylaan 48, 3001 Heverlee, Belgium

Legal entity: Bodemkundige Dienst van België is a non-profit organisation.
Description: The Bodemkundige Dienst van België (BDB), the first spin-off of KU Leuven, is an independent research and advisory institute for agriculture, horticulture and the environment. BDB is mainly active in soil and water research, fertilisation advice, irrigation management and environmental incidence studies, in both Belgium and France.
BDB can rely on a long-established and broad expertise, acquired in the field of soil fertility, chemical analysis, fertilisation requirements for agricultural and horticultural crops, fertilisation potential of organic fertilisers and fertilisation advice in both agriculture and horticulture. Since the foundation of BDB in 1946, fertilisation research has been carried out empirically as well as through theoretical models. BDB is able to put its research into practice by converting research data into practical advices for agriculturists, horticulturists and other users. Besides applied research BDB is an active player in policy formulation for regional, federal and European authorities, mainly in the agricultural and environmental field.
Based on in-house research, BDB has developed over time its own expert systems/decision support systems in order to deliver crop-specific fertilisation or irrigation advice. The uniqueness of these decision support systems lies in the reputable scientific basis, present at BDB combined with input originating from the applied research. Research is constantly carried out to optimise, actualise and implement these decision support systems taking into account new agricultural needs and requirements.
BDB acquired various homologations by federal, regional, international and other authorities. Its laboratory is BELAC-accreditated for soil, water and fertiliser analyses. For the research activities BDB is ISO9001:2000 certified. Both project research and field research come under this certificate.
In addition, BDB is also a certified Training Centre, a certified Regional Centre for agricultural education and a certified Centre for the sensibilisation of sustainable agriculture. Professional agriculturists, horticulturists, extension workers and teachers are continuously being informed and trained through informative sessions, trainings and visits to experimental field plots.
The R&D department of BDB has considerable expertise in research and popularisation of scientific data pertaining to different arable crops, with focus on fertilisation and cropping practices.
Role in project: Study Site Coordinator.
Past experience: Bodemkundige Dienst van België has been and continues to be involved, either as coordinator or partner institution, in currently more than 20 national/regional projects, with a large share of projects working on agriculture, soil fertility, nutrient management, soil quality, water use, soil degradation and conservation as well as the environmental impact of agricultural practices on water quality.

Involved personnel

Name of personnel	*Expertise*
Dr. Annemie Elsen (f)	Coordinating research projects, soil fertility, nutrient management, agronomy, soil quality, organic matter, water quality .
Prof. Hilde Vandendriessche (f)	Soil fertility, nutrient management, agronomy, decision support systems, coordination of research projects
Ir. Jan Bries (m)	Soil fertility, nutrient management, agronomy, fertilisation advice, coordination of research projects
Ir. Mia Tits (f)	Soil fertility, nutrient management, agronomy, soil quality, organisch matter, soil-water modelling, water quality.
Ir. Wendy Odeurs (f)	Soil fertility, nutrient management, agronomy, irrigation, soil water management, field trials.
Ir. Pieter Janssens (m)	Irrigation, soil water management, soil quality, crop production, remote sensing

Prof. dr. ir. Annemie Elsen (MSc. Applied Bioscience-Engineering in 1996, PhD. Applied Bioscience-Engineering in 2002 from K.U.Leuven) has been working as a researcher at the Faculty of Applied Bioscience-engineering of the Katholieke Universiteit of Leuven (K.U.Leuven). Since 2007, she is a guest professor at the Faculty of Sciences of the University of Ghent (UGent). In 2009 she joined BDB, where she is heading the Research and Development Department. She is involved in research projects on nutrient management, soil fertility and irrigation.

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De Clercq T, Heiling M, Dercon G, ReschC, Aigner M, Mayer L, Yanling M, **Elsen A**, Steier P, Leifeld J, Merckx R (submitted) Predicting soil organic matter stability in agricultural fields through carbon and nitrogen stable isotopes. Soil Biology and Biochemistry.

List of relevant project or activities

- **Remote sensing as an instrument for soil water management in pear and apple orchards**. Research financed by IWT-Vlaanderen (Institute for Science and Technology), from June 2010 until May 2014, in collaboration with KU Leuven and PC Fruit. Budget of 798475.79 euro.
- **BodemBreed**: Determination of soil characteristics of plots in which conservation tillage has been applied for a long time. An INTERREG project financed by the EU-Interreg, from November 2010 until October 2011. Budget of 56656.00 euro.
- Research on the management of crop residues of vegetables and the possibilities of catch crops and crop rotations in the framework of water quality requirements of the Action program 2011-2014 (**MAP4**). Research conducted in the framework of the Nitrate Directive and the Water Framework Directive, commissioned by Vlaamse Landmaatschappij (Flemish Land Agency), from September 2012 until July 2014, in collaboration with UGent, ILVO, Inagro, PCG and PSKW. Budget of 478431.57 euro.

Significant infrastructure

On annual basis, the Bodemkundige Dienst van België samples and analyses tens of thousands soil samples (147205 samples in 2014) mainly to provide farmers with fertilisation advices or to determine the residual nitrate at the end of the growing season. For sampling an extensive network of qualified technical staff is established, covering Belgium and France. For analysis of soil samples BDB disposes of a state-of-the-art analytical laboratory. Both sampling procedures and analysis of a wide range of soil parameters are BELAC accreditated (in accordance with NBN EN ISO/IEC 17025:2005). For experimental harvests on experimental fields, the Bodemkundige Dienst van België has 2 different types of combine harvesters (one for cereals and one for grass).

As a spin-off of KU Leuven, the Bodemkundige Dienst van België has a close collaboration with Zootechnisch Centrum (Zoötechnical Centre) of KU Leuven. The Zoötechnisch Centrum disposes of a large area of arable land available for experimental field research and lies within the study site area. In the framework of this project the Bodemkundige Dienst van België has access to the arable land of the Zoötechnisch Centrum.

Participant 13 – Aahus University, Department of Agroecology, Blichers Allé 20, P.O. Box 50, DK-8830 Tjele, Denmark

Legal entity: AU-AGRO, Department of Agroecology is a department at the Faculty of Science and Technology at Aarhus University, Denmark
Description: AU-AGRO (www.agrsci.au.dk) is renowned for its integrated agro-ecological research and dissemination on sustainable land management. AU-AGRO has large expertise in studying nutrient cycling and the physical and chemical and biological processes in the soil-crop system under field conditions, including the possibility to perform studies in several unique long-term field experiments on e.g. amount and source of fertilizer (the Askov field experiments) and different levels of liming and P fertilization (St. Jyndevad field experiment). Extensive, state-of-the-art laboratory and semi-field facilities are available for geochemical and isotopic tracer analyses of soils and crops. AU-AGRO has broad competences in analyzing the consequences of agricultural land use changes, agricultural and rural development policies, including schemes for the protection of soils, climate, nature and the environment. In particular, AU-AGRO's core competences include GEO database analyses, modelling in Geographic Information Systems (GIS), methods for stakeholder involvement and the upscaling and generalization of information on agriculture and the environment in support of multi criteria decision making.
Role in project: Study Site coordinator
Past experience: Wide experiences in soil science, environmental impacts assessment, hosting and coordination of landscape and farm site studies, methods for environmental indicators- and impact assessment of land use changes, including effects of agricultural and environmental policy measures, and stakeholder involvement. Earlier experience with study site coordination in the EU Joint Programming project on Climate Change Risk Assessment for European Agriculture and Food Security www.macsur.eu (2015-2017), the EU Integrated Project NitroEurope study landscape component (2007-2011), and the policy scenario assessments during the EU Strategic Research Projects on Impact assessment of multifunctional agriculture (MEA-scope, 2004-2007).

Involved personnel

Name of personnel	*Expertise*
Dr. Tommy Dalgaard (m)	Study site management. Environmental and agricultural policy impact assessment in relation to land use and cropping systems.
Dr. Gitte Rubæk (f)	Sustainable crop production and soil management. Nutrient management and P losses, long term field experiments and soil quality indicators.
Dr. Ingrid K. Thomsen (f)	Cropping systems, soil fertility, nutrient and soil carbon, long term management experiments, agronomy, nitrogen and greenhouse gas emissions.
Dr. Chris Kjeldsen (m)	Interdisciplinary research, stakeholder involvement and integrated impact assessment.

Dr. Tommy Dalgaard (H-index 19, cited by others 1827, source: google scholar). Head of The Danish Nitrogen Research Alliance www.dNmark.org (2012-2017), UN task force on reactive Nitrogen co-chair (2013-), member of the www.biovalue.dk Sustainability Assessment Platform (2013-2017), WP leader of the EU Integrated Project NitroEurope landscape study site activities (2007-2011), the EU Strategic Research Projects on Impact assessment of multifunctional agriculture (MEA-scope, 2004-2007), the EU Joint Programming project on Climate Change Risk Assessment for European Agriculture and Food Security www.macsur.eu (2012-2017), the Velux funded www.fremtidenslandbrug.dk project (2013-2015), and the Danish Innovationsfond project www.buffertech.dk (2014-2017).

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Pugesgaard S., Olesen J.E., Jørgensen U. and **Dalgaard T.** (2014) Biogas in organic agriculture—effects on productivity, energy self-sufficiency and greenhouse gas emissions. Renewable Agriculture and Food Systems 29, 28-41.
Schoumans, O.; Chardon, W; Bechman, M; Gascuel-Odoux, C; Hofman, G; Kronvang, B; **Rubæk, GH**; Ulen, B; Dorioz, JM (2014) Mitigation options to reduce phosphorus losses from the agricultural sector and improve surface water quality: a review. Science of the Total Environment 468-469:1255-66.
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List of relevant infrastructure, projects or activities
- The Askov long-term field experiments on amount and source of fertilizer (1884-)
- EU Joint Programming project on Climate Change Risk Assessment for European Agriculture and Food Security www.macsur.eu study site coordination (2015-2017)
- The Danish Innovationsfond project www.buffertech.dk/en/ (2014-2017).
- The Danish Nitrogen Research Alliance www.dNmark.org (2012-2017).

Participant 14 – Game & Wildlife Conservation Trust, Allerton Project, Loddington House, Loddington, Leics. LE7 9XE, United Kingdom.

Legal entity: GWCT is a UK registered charity 1112023.
Description: GWCT is a registered Charitable Trust employing over 100 people, 60% graduate and post-graduate scientists, in locations throughout the United Kingdom. The Trust owns a 300ha Research Farm in the English Midlands, known as the Allerton Project where over a period of 20 years, research on the interactions between modern productive agriculture and the environment have been researched, resulting in the production of over 200 published papers. The Trust provides independent, science based environmental rural research in collaboration with a diverse range of organisations in the private and public sectors throughout the UK. Much of the work focuses around farmland ecology, farming systems and biodiversity generally, but in the past decade research has expanded into soil cultivation, erosion and water quality research. The Trust is involved in a number of interdisciplinary and participatory research programmes and is noted for its community engagement projects within the farming sector and more widely. The Allerton Project has an active programme of events for farmers, advisors, regulators and others, drawing on a combination of research and practical farm experience and based in the project's eco-build visitor centre (3,000 visitors in 2014).
Role in project: Study Site coordinator.
Past experience: Project Partner or Lead in several UK government research projects relating to agri-environmental issues, and EU projects SOWAP (Soil and Water Protection) and VALERIE (Valorising European Research for Innovation in Agriculture and Forestry).

Involved personnel

Name of personnel	*Expertise*
Prof. Chris Stoate (m)	25 years of interdisciplinary and participatory research, multi-scale agri-environmental research in UK, Portugal and West Africa, including project management and knowledge exchange. Author of >100 papers. 10 years' experience of catchment management, soils and water research. Partner in arable and livestock farm business.
Dr Alastair Leake (m)	30 years in the agricultural industry with expertise in organic, integrated and conventional farming systems. Special interest in soil cultivation & crop establishment techniques, particularly conservation agriculture. Founder member of the European Conservation Agricultural Federation (ECAF) and Chairman of the UK

	Soil Management Initiative (SMI).
Dr Nicola Hinton (f)	Senior Research Assistant at the Allerton Project. PhD in soil science from the University of Edinburgh. Considerable experience in soils research including field trial design, data collection and laboratory analysis techniques.
Jim Egan (m)	12 year of experience in lowland agricultural policy; Chair of the Campaign for the Farmed Environment Delivery & Communications Group. Experience of delivering training to farmers, agronomists and undergraduates demonstrating the benefits of integrated management for soil, water, biodiversity and farming.

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Deasy, C., Quinton, J.N., Silgram, M., Stoate, C., Jackson, R., Stevens, C.J. & Bailey, A.P. (2010) Mitigation Options for Phosphorus and Sediment (MOPS): reducing pollution in run-off from arable fields. *The Environmentalist* 108: 12-17.

List of relevant infrastructure, projects or activities

- SOWAP – Soil and Water Protection (EU)
- PARIS- Phosphorus from Agriculture: Riverine Impact Study (Defra, UK govt.)
- MOPS – Mitigation Options for Phosphorus and Sediment (soil management) (Defra, UK govt.)
- Water Friendly Farming – landscape scale catchment management experiment (Environment Agency)
- VALERIE – Valorising European Research for Innovation in Agriculture and Forestry (EU FP7)

Participant 15 – Teagasc, Agriculture and Food Development Authority, Oak Park, Carlow, Ireland

Legal entity: Teagasc is the Irish Agriculture and Food Development Authority. It is a public, non -profit research performing organization.

Description: Teagasc is a state body that was established under the Agriculture (Research, Training and Advice) Act 1988. Its mission is to support science-based innovation in the agri-food sector and wider bio-economy that will underpin profitability, competitiveness and sustainability. As the leading public sector organisation in the fields of agriculture and food research in Ireland, Teagasc undertakes activities in research, knowledge dissemination and education under the following key programme areas:

- Animal and Grassland Research and Innovation
- Crops, Environment and Land Use
- Food
- Rural Economy and Development

Johnstown Castle is Ireland’s leading research centre for soils and the rural environment. The centre conducts research on soils, nutrient efficiency, recovery and losses, air and water quality and agro-ecology. The research results are used widely by advisors, farmers, scientists and policy makers. Johnstown Castle is home to Ireland’s Soil Information System, the National Soil Database and the National Soil Library. In addition, it has state-of-the-art laboratory facilities in order to support the research programme with soil, water, plant, air and microbiological analyses.

Role in project: Role in WP7, link to LANDMARK project.

Past experience: Teagasc has extensive involvement in participating and managing national, international and EU projects. Our annual research portfolio comprises some 300 research projects, carried out by over 500 scientific and technical staff in our research centres throughout Ireland. Involvement in FP7 funded projects led to contracts worth almost €12 million and involvement in projects worth a total of €228 million. The Environment Research Centre has been involved as either a coordinator or partner in FP7 and Horizon 2020 projects including consortia projects (e.g. BurrenLIFE, ANIMALCHANGE, END-O-SLUDG, ECOFINDERS, LANDMARK, ProIntensAfrica) and has participated in ERA-NETs (e.g. Food Security, Agriculture, Climate Change ERA-NET plus); Joint Programme Initiatives (e.g. FACCE JPI).

Involved personnel

Name of personnel	*Expertise*
Dr. Rogier Schulte (m)	Scientific policy advice, research management, sustainability, livestock productions systems, modelling, soil quality, nutrients, greenhouse gas emissions, water quality, biodiversity.

Prof. Dr Rogier Schulte leads Teagasc's programme on Translational Research on Sustainable Food Production, and is Adjunct Professor at the Latvia University of Agriculture. He is responsible for bringing together all the knowledge on sustainable agricultural production, and to 'translate' this into practical and policy advice. In this capacity, he works closely with colleagues and policy makers in Ireland, the European Commission and increasingly in Africa. *Vice* versa, he is also responsible for translating the policy challenges back into concise research questions.
Prof Schulte has a H-factor of 10, with 53 peer-review publications and 341 citations (285 excl. self-cites). He has supervised 6 PhD students and numerous MSc students, and secured > €10 million in research funding during the last 10 years

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Bouma J, Broll G, Crane TA, Dewitte O, Gardi C, **Schulte RPO**, Towers W, 2012. Soil Information in Support of Policy Making and Awareness Raising. Current Opinions in Sustainability 4:5, 552-558.

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List of relevant project or activities

- Management of LANDMARK (LAND Management: Assessment, Research, Knowledge base): a large-scale Horizon 2020 project on sustainable management of Europe's soil resources. LANDMARK consists of a consortium of 22 EU and non-EU top-ranking academic institutes, national extension services and policy advisors, coordinated by Dr Rachel Creamer (also Teagasc), with a total 4.5-year budget of €5.0m. https://www.LANDMARK2020.eu/
- Chair, FAO Livestock Environmental Assessment and Performance (LEAP) Partnership: 2015 chair of the LEAP Steering Committee. The LEAP Partnership is a partnership of governments, industry and civil society that is developing harmonised global guidelines for the sustainability assessment of livestock supply systems: http://www.fao.org/partnerships/leap/en/
- Joint Programming Initiative on Agriculture, Food Security and Climate Change (FACCE-JPI): Workpackage Leader WP5 (International Coordination): responsible for coordination between FACCE-JPI and other international initiatives on agriculture, food security and climate change, such as CCAFS, GRA, Belmont Forum. https://www.faccejpi.com/

Significant infrastructure

Teagasc has state-of-the-art laboratory facilities in order to support the research programme with soil, water, plant, air and microbiological analyses. The laboratories maintain a key interest in the national soil fertility status and are heavily involved in all aspects of soils and crop nutrition. Teagasc Johnstown Castle is the soil survey centre for Ireland, it has the equipment and knowledge and data available for any soil based research, this includes facilities for chemical, physical and biological characterisation of soils as well as full pedological classification. It boasts a state of the art controlled environment facilities, lysimeter and soil column experimental facilities as well as glass house, plot, field and farm and catchment scale research capabilities

Teagasc has 9 research farms where research experiments are being conducted. The Johnstown Castle estate covers approximately 400 hectares of which 190 hectares is farmland (mainly permanent grassland), the balance being forestry, parkland, and lakes. Our centre is equipped with three research farms on the estate: a dairy farm and two beef farms. These enterprises facilitate field experiments and research on farming systems. In addition Teagasc conducts experiments on commercial private farms and has established long-term research experiments on 6 agricultural catchments.

Participant 16 – SoilCares Research, Binnanhaven 5, 6709 PD Wageningen, the Netherlands

Legal entity: SoilCares Research B.V. is part of Dutch Sprouts B.V.
Description: The mission of SoilCares Research is to contribute globally to sustainable agricultural production by developing widely available and affordable methods for soil and crop quality assessment as well as management recommendations. SoilCares Research believes that soil monitoring and subsequent recommendations form the basis of sustainable agricultural practice. Therefore, SoilCares Research develops novel analysis techniques to determine soil fertility and soil quality for field application, aiming at world-wide availability of such analyses at a locally affordable price. Novel analysis techniques include combinations of innovative sensor technology with data mining and modelling. The company's strength lies in data collection and the conversion of analytical data and sensor data into field-specific recommendations, using our expertise on soil processes, soil biology, plant-soil interactions and agronomy. A key component of systems developed by SoilCares Research is the usage of on-site and in-situ sensors, operating on smart phones and linked via apps to databases. This is combined with expert systems for delivering geo-referenced and crop-specific management advice.
Role in project: Participant in WP4 and WP5.
Past experience: SCR has participated in FP7 project PURE on soil quality indicators. SCR collaborates with multiple organizations including Heifer, SNV, Wageningen Univertsity and Research Centre, ICRAF, and obtains national and international research funding from, a.o., the EU, Melinda and Bill Gates Foundation and the Dutch Government.

Involved personnel

Name of personnel	*Expertise*
Dr. Aad Termorshuizen (m)	Coordinating the soil biodiversity work. Mycologist, plant pathologist.
Dr. J. Wubben (m)	Data management and statistics. Microbiologist.
H. Alsemgeest MSc (m)	Coordination of sample taking. Agronomist.
Dr. Peter van Erp (m)	Interpretation of data. Soil scientist.
Dr. T. Terhoeven-Urselmans (m)	Data analist, agronomist.

Dr. Aad Termorshuizen (H-index: 22 (excl. self-citations), cited by others: 1465 times) has about 30 years of experience in fundamental and applied research in soil biology, ecology of soilborne plant pathogens and soil fertility.

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Van Erp, P.J., **Terhoeven-Urselmans, T.**, van der Meer, R. 2014. Soil fertility status and NPK blends at planting for maize growing in the W-Kenyan counties Uasin Gishu and Busia. pp. 15-23 in Res. Findings e-*ifc* 39: 15-23, Int. Potash Institute, www.ipipotash.org/en/eifc/2014/39/3.

List of relevant project or activities

- Project "**Providing Analytical Services for Informed Farming in Kenya**", partially funded by RVO (Netherlands Enterprice Agency), also involving SoilCares B.V., Heifer, and SNV.
- Project "**Predicting Disease Suppressiveness of Agricultural Soils**", partially funded by STW, the Netherlands, also involving Wageningen University and Netherlands Institute for Ecology, 2 PhDs (finished June 2015).
- Activity "**Development of a Hand-held device for assessing soil fertility**", including setting up of a chemical reference laboratory for calibration studies.

Participant 17 – Polytechnic Institute of Coimbra (IPC) / Agriculture Higher School of Coimbra (ESAC), Bencanta, 3045-601 Coimbra, Portugal

Legal entity: IPC is composes by 6 schools, from which ESAC will be involved in the project.
Description: ESAC is a higher education school which cover the domains of Agriculture, Forestry, Food and Environment. ESAC has always played an important role since its foundation in 1887, supporting the society, specially the farmers of the North and Centre of Portugal. Being an important centre of applied science and technology, it has also an important role in the scientific front, being involved in research projects, funded both by national and international entities. ESAC hosts CERNAS (Study Centre for Natural Resources, Environment and Society), the only Research Centre addressing the themes of Rural World, Agriculture, Forestry, Food Processing, Environment and Society in the Portuguese Centro Region.
Role in project: Study Site coordinator
Past experience: Since 2008, CERNAS has coordinated or participated in 5 European funded research projects, has participated in 22 Portuguese Government funded research and development projects, and has 20 contracts with the industry. Some of the European projects addressed the topics of agriculture, degradation, conservation, soil threats and land use, such as the EMAS, DESIRE and SOLIBAM.

Involved personnel

Name of personnel	*Expertise*
Dr. António Ferreira (m)	Coordinating large national and international research projects. Natural resources management, sustainable development, hydrology and soils, and desertification.
Dr. José Gonçalves (m)	Agronomy, surface irrigation, hydrology modelling, decision support systems. Involved in several national and international research projects.
Dr. Célia Ferreira (f)	Agricultural waste, soil fertility, nutrient management, sustainability and eco-efficiency assessment. Coordination of national research projects and involved in international research projects.
Dr. Pedro Moreira (m)	Research and network projects on farm conservation and management, urban agriculture and stability of crops.
Dr. Maria Conceição (f)	Food science, parasitic diseases, agriculture. Coordination of national research projects and involved in international research projects. Developed a patent on recombinant protein production processes.

Dr. António Ferreira (H-index: 16, cited by others: 710 times) has 20 years of experience in applied research in the areas of hydrology, soil degradation and natural resources management. During the last 10 years, he has had coordinating roles in various Portuguese and EU-funded projects. He coordinated the EMAS, and was involved in Desire EU-funded projects. Since 2013 he is the scientific coordinator of CERNAS research centre.

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List of relevant project or activities

- **DESIRE** (FP6): Desertification mitigation and remediation of land: a global approach for local solutions

Participant 18 – Institutul Naţional de Cercetare-Dezvoltare pentru Pedologie, Agrochimie şi Protecţia Mediului Bucureşti (ICPA), Romania

Legal entity: National Research & Development Institute.

Description: National Research and Development Institute for Soil Science, Agricultural Chemistry and Environment (ICPA), founded in 1970 and reorganized in 2004 as national institute, has as mission promotion and development of strategic research applied in the fileds of soil science, agricultural chemistry and involves both significant scientific contributions and specific consulting activities. ICPA is the leading national organisation in Romania for soil science and the environmental protection in agriculture. During the last years, ICPA developed GIS databases at national scale for soils, terrain and land use together with simulation models linked with these databases predicting crop yield under various management practices considering water and fertiliser movement in soils and crops. During the last period ICPA contributed to the implementation of various agro-environment regulations and directives: designation of nitrates vulnerable zones and action programmes for Nitrates Directive, designation of areas less favoured for agriculture, developing methodologies for applying sewage sludge directive, evaluation of the national potential for biofuels and biocarburants. ICPA was partner in several European research projects related to soil monitoring under the framework of Soil Thematic Strategy and risk assessment for soil threats.

Role in project: Study Site coordinator

Past experience: Within FP5-6 of the EU, ICPA has been and continues to be involved, either as coordinator or partner institution, in different projects working on agriculture, degradation, conservation, soil threats and land use, such as: RECARE, GS Soil, ENVASSO, RAMSOIL, STAMINA, MULINO, SIDASS, ACCELERATES.

Involved personnel

Name of personnel	*Expertise*
Dr. Irina Calciu (f)	Coordinator of research projects. Soil degradation, nutrient management, greenhouse gases emissions
Dr. Catalin Simota (m)	Coordinator of research projects under national (PNDI) and international (FP 5, 6) funding in areas of: development of tools, guides, and indicators for integration of environmental aspects in the agricultural, forestry and water management policies within rural area; evaluation of the vulnerability of agricultural systems for climatic changes; implementation of Nitrates Directive in Romania (designation of vulnerable areas, accomplishing of Codes of good agricultural practices and action programs)
Prof. Dr. Mihail Dumitru (m)	Coordinator of the preparation of environmental quality monitoring system integrated within national Ministry of Waters, Forests and Environmental Protection, in cooperation with foreign consulting teams in the frame of PHARE project; involved in preparing the regulations on soil protection in Romania and identifying of the contaminated sites and their remediation measures.
Dr. Olga Vizitiu (f)	Senior Researcher with background in agriculture. Decision support system for end-users in agriculture and agro-environment. Agricultural management practices – effects on physical quality of arable soils.

Dr. Irina Calciu has more than 15 years of experience in agricultural research. She has been involved in the areas of: identification, characterization and estimation of soil degradation processes, measures for preventing and/or limit soil degradation; implementation of Nitrates Directive in Romania (accomplishing of Codes of good agricultural practices and action programs); evaluation of greenhouse gas emissions; mitigation drought in vulnerable areas in Romania. She has published articles in journals and mononographies indexed in international databases.

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Irina Calciu, **Olga Vizitiu**, **Catalin Simota**, Mircea Mihalache, 2014. „*Assessment of greenhouse gas emissions in Romania – case study for rape crop*”. International Multidisciplinary Scientific GeoConferences, 17-26 June, 2014, Albena, Bulgaria. 14th GeoConference on Energy and Clean Technologies, Conference Proceedings, volume I, ISBN: 978-619-7105-15-5, ISSN: 1314-2704, DOI: 10.5593/sgem2014B41, pp. 25-33;

Olga Vizitiu, **Irina Calciu**, **Catalin Simota**, Mircea Mihalache, 2014. „*Soil water conservation – a measure against desertification*”, 2014. International Multidisciplinary Scientific GeoConferences, 17-26 June, 2014, Albena, Bulgaria. 14th GeoConference on Water Resources. Forest, Marine and Ocean Ecosystems, Conference Proceedings, volume II, ISBN 978-619-7105-14-8, ISSN 1314-2704, DOI: 10.5593/sgem2014B32, pp. 253-259;

Irina Calciu, Mircea Mihalache, **Sorina Dumitru**, **Olga Vizitiu**, 2014. „*Un-used Arable Land Evaluation in Romania for Low Indirect Impact Biofuel Production*”. Advances in Environmenta Development, Geomatics Engineering and Tourism, Proceedings of the International Conference on Environment, Ecosystems and Development (EED’14), June 26-28, 2014, Brasov, Romania, ISBN: 978-060-474-385-8, ISSN: 2227-4359, pp. 184-191;

List of relevant project or activities

- **RECARE** – Preventing and remediating degradation of soils in Europe through land care (www.recare-project.eu). EU FP7 Collaborative Project (2014-2019) € 11+ M.
- **GS Soil -** Assessment and strategic development of INSPIRE compliant Geodata-Services for European Soil Data" (ECP-2008-GEO-318004) European Community programme eContentplus Project (2009-2012) € 5.12 M.
- **MIDMURES -** Mitigation Drought in Vulnerable Area of the Mures Basin. Environment DG of EU Grants (EU Grant No. 07.0316/2010/582303/SUB/D1) (2011-2012) € 0.6+ M.

Significant infrastructure

ICPA is a modern institute with several facilities and an updated research infrastructure of soil physical, chemical and biological laboratories, as well as GIS specialized software. As for the field monitoring case study site, the institute has a number of equipment used for field soil sampling and vehicle for field visits, transport of people, apparatus, and soil samples.

Participant 19 – Dipartimento di Agronomia Animali Alimenti Risorse Naturali e Ambiente (DAFNAE), Università di Padova, Viale dell'Università 16, 35020 Legnaro (PD), Italy

Legal entity: DAFNAE is part of the University of Padova.
Description: The mission of DAFNAE is to promote the quality of human life, the competitiveness of the agrifood sector, and the sustainable use of biotic and abiotic natural resources, through the production and dissemination of knowledge of the management and improvement of plants, animals, soil and microorganisms. Efforts focus on the production of high-quality food and biomass, ensuring the preservation of ecological systems, of plants and animal health, and enhancement of crop environments and biodiversity.
Role in project: Study Site coordinator.
Past experience: DAFNAE has been involved in 9 FP7-Cooperation and 1 FP7-Capacities projects dealing with agriculture, ecosystem dynamics, soil threats and land use, such as RECARE and on structuring of EU-level of long-term ecosystem research platforms (ANAEE).

Involved personnel

Name of personnel	*Expertise*
Prof. Antonio Berti (m)	Agronomy, soil fertility and nutrient management, designing and executing field work.
Dr. Gianluca Simonetti (m)	Soil physico-chemical characteristics, field monitoring
Dr. Elisa Cocco (f)	Modelling of SOC dynamics, emissions of nitrogen and greenhouse gases, field monitoring

Prof. Antonio Berti (H-index: 15, cited by others: 483 times) has almost 30 years of experience in applied research in the areas of the long-term evolution of soil fertility, cropping systems sustainability and soil organic carbon dynamic in cropping systems. During the last 10 years, he participated in various EU-funded projects, and had the role of coordinator in national projects.

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Simonetti G., Francioso O., Nardi S., **Berti A.**, Brugnoli E., Lugato E., Morari F. (2012). Characterization of humic carbon in soil aggregates in a long-term experiment with manure and mineral fertilization.. SOIL SCIENCE SOCIETY OF AMERICA JOURNAL, vol. 76, p. 880-890, ISSN: 0361-5995, doi: 10.2136/sssaj2011/0243

List of relevant project or activities

- FP7-Environment RECARE - Preventing and Remediating degradation of soils in Europe through Land Care
- FP7-Capacities ANAEE - Structuring infrastructures for the analysis and experimentation on ecosystem
- National PRIN (Programmi di Ricerca Scientifica di Rilevante Interesse Nazionale) IC-FAR - ICFAR: Linking Long Term Observatories with Crop Systems Modeling For a better understanding of Climate Change Impact and Adaptation Strategies for Italian Cropping Systems

Significant infrastructure

- Long-term experiment on crop rotation considering 7 crop rotations, 2 organic fertilisation and 3 mineral fertilisation levels (total 288 plots)
- Long term experiment on residue management considering 3 types of residue management, 5 mineral fertilisation levels + unfertilised check (total 64 plots)
- Soil physics laboratory with instruments for soil porosimetry, soil texture, hydraulic properties, microCT, chemical analyses etc.

Participant 20 – Institute of Agrophysics, Polish Academy of Sciences (IA) Lublin, Poland

Legal entity: Research Institute.
Description: The basic tasks of the Institute of Agrophysics (IA) include scientific research, cognitive and application and training staff within the scope of physics in solving problems of management and environmental protection natural, sustainable agriculture and agri-food processing. Currently IA focuses on the physical characteristics of processes and materials relevant to the management of natural environment (tackling soil degradation, monitoring environmental hazards), agricultural production and processing agricultural goods and use of plant for biomass energy. IA is either co-coordinator or partner in MACSUR project (Modelling European Agriculture with Climate Change for Food Security), Trans-border Czech-Polish cooperation on risk and benefits of application of exogenous organic matter to soil, Polish-Belarussian study on the use of zeolites in agriculture and in two projects for European Space Agency including ELBARA_Penetration depth and the fabrication of the radiometer ELBARA-III to assess soil water status. Studies carried out at the Institute give measurable innovative results that support agri-food sector in solving technological issues. Transfer of knowledge generated at the Institute in the years 2005-2014 includes 27 patents and 18 innovative solutions. An example of the innovative solution is the monitoring system for physical and chemical characteristics of soil with access through the Internet (based on TDR-Time Domain Reflectometer technology). Education activity includes conducting PhD studies (currently 28 students) and workshops on soil and plant physics. IA edits and publishes scientific journal International Agrophysics (incuded in database of Journal Citation Reports).
Role in project: Study Site coordinator.
Past experience: The Institute has been and keeps on to participate as coordinator or partner institution in more than 40 international research projects working on soil physical quality, sustainable agriculture, monitoring soil characteristics and renewable energy including SWEX/R (Soil, Water and Energy Exchange / Research), SMOS (Soil Moisture Ocean Salinity) within FP5-7 and other international funds. One of the most important project was the "Centre of Excellence for Applied Physics in Sustainable Agriculture" AGROPHYSICS' QLAM-2001-00428 under the 5th Framework Program of the EU.

Involved personnel

Name of personnel	*Expertise*
Prof. Dr. Jerzy Lipiec (m)	Soil compaction and tillage effects on soil-plant-earthworm relations and soil physical quality and functions

Prof. Dr. Bogusław Usowicz (m)	Metrology, modeling soil thermal, hydraulic and electrical properties, field monitoring, remote sensing
Ass. Prof. Dr. Magdalena Frąc (f)	Environmental protection, mycology of plants and agricultural products, soil microbial genetic and functional diversity, soil biological quality and food quality.
Technical staff	Experience in maintain of experimental fields and soil measurements.

Prof. Dr. Jerzy Lipiec (H-index 18, cited around 1275 acc.to Scopus) with more than 25 years of experience in research concerning management effects on soil physical properties and processes and crops. Throughout the last 10 years he has had working in several EU-funding projects as Centre of Excellence AGROPHYSICS and Trans-border Czech-Polish cooperation on soil organic matter as coordinator of work packages and in MACSUR (Modelling European Agriculture with Climate Change for Food Security) and ELBARA_Penetration depth as partner.

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List of relevant project or activities

- Effect of soil macropores on root and shoot growth and nutrient leaching , Committee for Scientific Research (KBN), Poland 2002-2005, Project coordinator.
- Centre of Excellence for Applied Physics in Sustainable Agriculture, AGROPHYSICS (2004-2006) QLK5-CT-2002-30421, Project coordinator.
- Programme for European Cooperating States (PECS), No.98084SWEX-R, Soil Water and Energy Exchange/Research", AO3275, 2009-2012.

Significant infrastructure

Institute of Agrophysics PAS has well equipped laboratories for studying physical, chemical and biological properties of soils and operates several field automatic agro-meteorological stations for monitoring weather and soil water content and temperature for validation of SMOS (Soil Moisture Ocean Salinity) satellite data and agricultural use.

Participant 21 – Wageningen University (WU), Droevendaalsesteeg 4, 6708 PB, Wageningen, the Netherlands

Legal entity: University.

Description: Wageningen University (WU) is a leading university in Life Sciences focusing on agricultural and environmental education and research and is, according to the NTU Agriculture Ranking 2013, ranked the number one university in agricultural sciences in the world. WU is part of the Wageningen University and Research Centre (WUR), comprising several strategic research institutions focusing on applied research. WU is, amongst others, partner in the Partnership for European Environmental Research (PEER), the Global Soil Partnership (GSP), the World Water Council (WWC), the Global Water Partnership (GWP), and Climate Change and Biosphere (CCB).

The Soil Physics and Land Management (SLM) Group of Wageningen University focuses on: i) flow and transport processes in soil systems and surrounding water bodies, ii) interactions between soil, water and plants, and iii) land use and management with regard to ecosystem degradation, and the design and economic impact assessment of technologies for soil and water conservation and restoration.

Role in project: Participant in WP2, 3, 4, 5, 6, 8.

Past experience: The SLM group has long-term experience in areas affected by different forms of soil and water degradation in Asia, Africa, Latin America, and in Europe. SLM coordinated and participated in a range of EU-funded projects focusing on soil, water and agricultural soil management related topics, including EROAHI, WEELS, WAHIA, AWACAD, OLIVERO, DESIRE, WAHARA, CASCADE, RECARE and iSQAPER.

Involved personnel

Name of personnel	*Expertise*
Prof Dr. Coen Ritsema (m)	Professor Soil Physics and Land Management with >25 years' experience in fundamental and applied research in the area of land, soil and hydrology interactions, and in coordinating large (inter)national multidisciplinary research projects and programs. At present, Coen Ritsema is Head of the Soil Physics and Land Management Group at Wageningen University, and amongst others Honorary Professor at the Chinese Academy of Sciences.
Priv. Doz. Dr. Violette Geissen (f)	Associate professor with >20 years' experience in soil sciences and agronomy in temperate and tropical climatic zones. She has published >50 articles in international scientific journals. Other relevant experiences include the coordination of large international projects, such as the on-going EU-funded projects CariWatNet and CASCADE.
Dr. Luuk Fleskens (m)	Associate Professor with >15 years' experience working on sustainable land management focussed on Southern Europe and Africa. His current research concentrates on model-based integrated, spatially-explicit assessments of land management on soil quality and farm viability. He currently acts as scientific coordinator of the EU Horizon2020 iSQAPER project. He has published over 20 articles in ISI-ranked journals.

Prof Dr. Coen Ritsema ((H-index: 31, cited: around 3500 times) has >25 years' experience in fundamental and applied research in the area of land, soil and hydrology interactions, and in coordinating large (inter)national multidisciplinary research projects and programs. During the last 15 years, he has successfully coordinated 12 EU-funded research projects.

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List of relevant project or activities

- iSQAPER – Interactive Soil Quality Assessment for Agricultural Productivity and Environmental Resilience in Europe and China (www.isqaper-project.eu). EU Horizon2020 Collaborative Project (2015-2020) €6.87 M.
- RECARE – Preventing and remediating degradation of soils in Europe through land care (www.recare-project.eu). EU FP7 Collaborative Project (2014-2019) € 11+ M
- CASCADE - Catastrophic shifts in drylands: how can we prevent ecosystem degradation? (www.cascade-project.eu). EU FP7 Collaborative Project (2012-2017) € 5.89 M
- DESIRE - Desertification mitigation and remediation of land: a global approach for local solutions (www.desire-project.eu). EU FP6 Integrated Project (2007-2012) € 9+ M

- WAHARA – Water harvesting for rainfed Africa: investigating dryland agriculture for growth and resilience (www.wahara.eu). FP7 Collaborative Project (2011-2016) € 2.7 M

Significant infrastructure
Wageningen University has excellent experimental facilities with dedicated soil physical, chemical and biological laboratories, including field monitoring stations, and supporting GIS and model development departments.

Participant 22 – University of Pannonia (UP), Georgikon Faculty, Department of Crop Production and Soil Science, Deák F. u. 16., 8360 Keszthely, Hungary

Legal entity: University.
Description: The University of Pannonia (UP) is an excellent Hungarian higher educational institute with Veszprém seat. UP is the leading institution in teaching and research in Agricultural, Environmental Sciences and Information Technology in Hungary. The Georgikon Faculty of the University is the first regular agricultural higher education institution on the Continent of Europe (established in 1797), and it performs extensive international research programs in soil and environmental sciences, land use, plant production as well as agro-informatics. The university has a wide range of graduate and postgraduate courses for international students, as well as established doctoral schools in the different disciplines. The Department of Plant Production and Soil Science has been running several long-term field experiments since the 1960-ies in which the effect of different rates and forms of fertilizers, soil tillage and crop rotation as well as different systems of organic matter and crop residue management can be studied. The department is also in charge of organizing and supervising the National Long-term Field Trial Network. Data base consisted of soil, plant and climatic data from the field experiments and pilot areas are available for research.
Role in project: Study Site coordinator
Past experience: UP has lead several national projects on soil fertility, soil tillage, soil quality, land use and was involved in EU projects related to the present proposal such as DIGISOIL and MyWater. UP has developed an internet-based land evaluation and farm data collection system (D-e-METER) to support land use management planning.

Involved personnel

Name of personnel	*Expertise*
Prof. Dr. Tamás Kismányoky (m)	Coordination of research projects, soil fertility, nutrient management, agronomy, analysing organic and inorganic nitrogen, phosphor and potassium content of soils, soil physical properties in different types of soil managements.
Dr. Zoltán Tóth (m)	Soil fertility, fertilization, soil tillage, influence of crop rotations and crop residue management on crop production and soil properties, coordination of research projects.
Dr. Brigitta Tóth (f)	Soil physics, soil hydrology, data mining, soil databases, climate change impacts on soil water regime, pedotransfer functions.

Prof. Dr. Tamás Kismányoky is Professor Emeritus, at the Department of Plant Production and Soil Science of the University of Pannonia. he has near 40 year experience in research of soil fertility in long-term field experiments. He lead over 20 projects related to soil fertility, main topics were analysing organic and inorganic nitrogen, phosphor and potassium content of soils, soil physical properties in different types of soil managements. From the above mentioned field experiments he wrote about 370 publications.

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List of relevant project or activities

- iSQAPER - „Interactive Soil Quality Assessment in Europe and China for Agricultural Productivity and Environmental Resilience" H2020 project (635750) (2015-2020)
- "Regional effects of weather extremes resulting from climate change and potential mitigation measures in the coming decades" - TÁMOP-4.2.2.A-11/1/KONV-2012-0064 (2012-2015)
- MyWater – Merging Hydrologic models and EO data for reliable information on Water (www.mywater-fp7.eu). EU FP7 (263188) Collaborative Project (FP7, 2011-2014)

Significant infrastructure

Department of Plant Production and Soil Science has been running long-term field experiments for four decades (crop rotation, maize monoculture, organic and inorganic fertilization, different soil cultivation systems).

Participant 23 – Swedish University of Agricultural Sciences, SLU, 750 07 Uppsala, Sweden

Description: SLU develops the understanding and sustainable use and management of biological natural resources. This is achieved by research, education and environmental monitoring and assessment, in collaboration with the surrounding community. SLU is characterized by strong links between education and research. Research, education and environmental monitoring are pursued in collaboration with selected higher education institutions and sectors, and the wider society. Research findings are used in society. There is a strong international dimension, for example by strategic collaboration with universities and research institutes abroad. Students and employees have a work environment and working conditions that are attractive. SLU has distinct leadership and uses resources efficiently. Gender equality and diversity perspectives have a strong position throughout operations.

Role in project: Study Site coordinator.
Past experience: SLU has been involved as a partner institution in a number of international projects within EU and bilateral with developing countries.

Involved personnel

Name of personnel	*Expertise*
Prof. Dr. Holger Kirchmann (m)	Soil fertility, nutrient management, agronomy, nutrient recycling
Prof. Dr. Johan Arvidsson (m)	Soil tillage, soil compaction, soil physics
Docent Dr. Gunnar Börjesson (m)	Soil microbiology, soil fertility, long-term field studies, agronomy

Prof Dr. Holger Kirchmann is section head for research in plant nutrition and soil fertility (Citations: 2708; h-index: 30), supervised 9 PhD students and is involved in projects dealing with micronutrients, P recycling, fertilizer placement and P speciation in soils. His research includes decomposition and nutrient turnover from organic manures in soil, changes in soil fertility, phosphorus reactions in soil, development of countermeasures for P leaching. He is responsible for a large number of long-term field experiments running since the 1950th.

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List of relevant project or activities

- Project by the Swedish Research council for Environment, Agriculture and Spatial Planning: '*Future Crop Production Relies on New Management Strategies for Soils*' by H. Kirchmann, J. Arvidsson, J. Stenström, L. Bergström, C. Sundberg, T. Kätterer;
- Project by the Swedish Foundation for Plant Nutrient Research: *'Carbon sequestration in subsoils cropped continuously with cereal or ley'* by G. Börjesson, T. Kätterer, H. Kirchmann;
- Swedish Farmers' Foundation for Agricultural Research. Tracks instead of tyres on large tractors and combine harvesters. Johan Arvidsson main applicant. 2011-2015.

Significant infrastructure

A key component of this work package is the device required to mechanically improve the subsoil complemented with equipment allowing to inject water-dispersed or powdered crop residues and organic amendments into subsoil. This device is not a commercial product but will be put together from existing products.

Participant 24 – Kongskilde Industries A/S, Skælskørvej 64, 4180 Sorø

Legal entity: Kongskilde Strategic Development; Kongskilde Industries A/S, Skælskørvej 64, 4180 Sorø, Denmark.

Description: Kongskilde Industries is a full range manufacturer and supplier of agricultural machinery for plant production, known for its particular competence in regard to high-precision farming equipment. Kongskilde Industries develops and sells agricultural implements for all types of farmers, ranging from the small mountain farmers to large intensive thousand hectare farms all over the world. The main office is located in Denmark and the Kongskilde Group is owned by DLG (the Danish Cooperative Farm Supply). The Kongskilde Group has subsidiaries in Denmark, Sweden, Norway, England, France, Germany, Spain, Poland, Russia, the USA and South Africa, with production facilities in Denmark, Sweden, Poland, Germany and the US. Kongskilde Industries develops methods and equipment for soil cultivation and plant care marketed under the brands; Kongskilde, Howard, Nordsten, Överum and Becker. The engineering department is ready to carry out a detailed design of entire systems. Kongskilde Industries R&D department consist of more than 50 engineers. Kongskilde Industries will contribute knowledge on machinery and equipment for plant production; and in depth knowledge of marked and end-user within the agricultural domain. The main focus of the Strategic Development division is intelligent machinery with low power demands. The aim of Kongskilde development is to develop unique machines that differentiate from competitors, based on automated and intelligent implements design with multi functionality and based upon high level sciences, agronomy and engineering knowledge. Kongskilde products are developed with a focus of sustainability in the primary plant production.

Role in project: Role in WP4 and WP5, Industrial experience

Past experience:

- EU Horizon2020 R&D project: INTO CPS - INtegrated TOol chain for Cyber Physical Systems (2015-2017)
- EU FP7 R&D project: RECARE (2013-2017)
- EU ICT-Agri Eranet R&D project: Grassbots (2013-2014)
- Polish R&D projects: POIG (2012-2015),
- Danish R&D projects: SAFE - Safer autonomous farming equipment (2014-2017) funded by Danish Advanced Technology Foundation; OPTIMEK - Optimized seeding and mechanical weed control (2013-2017), RowCrop (2014-2018), NewCut (2014-1018) funded by Green Growth and Development Program; Grassbots (2013-2015), ROOK - Resource optimization in the cooling chain (2014-2015) by Region Midt, Denmark; BioValue SPIR (2013-2017) by Ministry of higher education and science; Intelligent sensor based tillage (2012- 2015) funded by ErhvervsPhD fonden; WideSpanGantry (2011-2014) by Renewal foundation; OptiSeedDry (2010-2012), Slurry injection and maize seeding (2010-2011), SICAT – Satelite, internet and computer aided trails for plant production (2007-2010), Controlled traffic farming in cereals (2005-2008) by DFFE.

Involved personnel

Name of personnel	***Expertise***
Dr. Ole Green (m)	The interaction within tillage, soil compaction and soil fertility from a technical perspective. Precision farming technologies, specifically within soil tillage optimization and crop establishment. And farm management systems for tillage and crop growth optimization, route planning and operations optimization
Dr. Gareth Thomas Charles Edward (m)	Field Readiness Indicator and Decision Support System

Dr. Ole Green. Scientific publications: 33 peer review papers and book chapters, 8 patents and 186 conference presentations.

References

Gassó-Tortajada, Vicent; Grøn Sørensen, Claus; Oudshoorn, Frank W; **Green, Ole**. *Controlled traffic farming: A review of the environmental impacts.* European Journal of Agronomy, Vol. 48, 03.2013, s. 66-73.

Bochtis, Dionysis; Sørensen, Claus; **Green, Ole**. *A DSS for planning of soil-sensitive field operations.* Decision Support Systems, Vol. 53, Nr. 1, 04.2012, s. 66-75.

Green, Ole; Lamandé, Mathieu; Schjønning, Per; Sørensen, Claus Aage Grøn; Bochtis, Dionysis. *Reducing the risk of soil compaction by applying "Jordværn Online"® when performing slurry distribution.*. Acta Agriculturae Scandinavica. Section B. Soil and Plant Science, Vol. 61, Nr. 3, 04.2011, s. 209-213.

Bochtis, Dionysis; **Green, Ole**; Sørensen, Claus. *Spatio-temporal constrained planning software for field machinery*. Journal of Agricultural Machinery Science , Vol. 7, Nr. 4, 2011, s. 399-403.

Edward, G.T.C: PhD thesis: Development of a Field Readiness Indicator and Decision Support System. Aarhus University. 2015.

List of relevant project or activities

- EU Horizon2020 R&D project: **INTO CPS -** INtegrated TOol chain for Cyber Physical Systems (2015-2017)
- EU FP7 R&D project: **RECARE** (2013-2017).
- Various Danish R&D projects: SAFE - Safer autonomous farming equipment (2014-2017) funded by Danish Advanced Technology Foundation; OPTIMEK - Optimized seeding and mechanical weed control (2013-2017), RowCrop (2014-2018), NewCut (2014-1018) funded by Green Growth and Development Program; Grassbots (2013-2015), ROOK - Resource optimization in the cooling chain (2014-2015) by Region Midt, Denmark; BioValue SPIR (2013-2017) by Ministry of higher education and science; Intelligent sensor based tillage (2012-2015) funded by ErhvervsPhD fonden; WideSpanGantry (2011-2014) by Renewal foundation; OptiSeedDry (2010-2012), Slurry injection and maize seeding (2010-2011), SICAT – Satelite, internet and computer aided trails for plant production (2007-2010), Controlled traffic farming in cereals (2005-2008) by DFFE.

Participant 25 – Project Maya, 54 Tetherdown, London, N101NG, UK

Legal entity: Community Interest Company (PIC No. 934837016)
Description:.Project Maya is a community interest company established by environmental scientists to create impact from research and to found a global network of permaculture nature reserves. Maya has three main arms, 1) running campaigns, 2) running profitable enterprises 3) carrying out research and training courses relating to knowledge exchange and participation.
Role in project: WP3 collaborator
Past experience: substantial background in knowledge exchange, public participation, social learning, transdisciplinary research, social innovation and the research and practice of permaculture techniques for agriculture and nature conservation. Project Maya works predominantly across the EU, but also has associates internationally, and has experience in developing and bringing to market training courses based on transdisciplinary research involving stakeholders from a range of disciplinary and practical backgrounds and tailoring these training courses for a range of communities including business, policy and NGOs

Involved personnel

Name of personnel	*Expertise*
Dr. Ana Attlee (Evely) (f)	Knowledge exchange and participatory research, development and implementation of training courses, campaigns and enterprises based on cross-disciplinary research.

Dr Ana Attlee is CEO of Project Maya. She has developed a research based commercial gardening product, available >100 independent shops and garden centres across the EU. Dr Attlee has had a Developed Knowledge Exchange training course based on postdoctoral research, delivered since 2013 to Universities in the UK and EU, as well as government departments. Experienced in conservation campaigning and public speaking. Experienced in marketing and sales, with a strong social media focus. Experienced in lecturing, course design and management as well as supervising staff and students. Developed Knowledge Exchange Guidelines for RCUK Living with Environmental Change partnership and a Stakeholder Engagement Toolkit for the EU Biodiversa programme. Co-designed and co-managed an international academic conference on conservation conflict. Dr Attlee is a researcher with > 20 academic publications.

References

Attlee A, Reed MS, Carter CE, Scott AJ, Vella S, Hardman M (in review) Tools for assessing ecosystem services futures: a review. *CABI*

Evely AC, Reed MS, Adams D, Lambert E (in press) Sustainability 2.0. New Strategies for achieving behaviour change in a more connected world. Chapter 8. Sustainability: Key Issues (Kopnina H & Ouimet E Eds.) Routledge

Reed MS, Bryce R, **Evely AC** et al. (2013) Knowledge management for land degradation monitoring and assessment: an analysis of contemporary thinking. *Land Degradation & Development* 24: 307-322.

Fazey I, **Evely AC**, Reed MS et al. (2012) Knowledge exchange: a research agenda for environmental management. *Environmental Conservation* 40: 19-36.

Evely AC, Fazey I, Reed MS, Pinard M (2011) High levels of participation in conservation projects enhance learning. *Conservation Letters*, 4: 116-126

List of relevant project or activities
Developed knowledge exchange training course based on research from the Sustainable Learning Project and now administer the course on a not for profit basis as part of Maya’s core business.

Participant 26 – Crop Research Institute (CRI), Drnovská Street 507, 161 06, Prague, the Czech Republic

Legal entity: Crop Research Institute is a public research institute under the Ministry of Agriculture of the Czech Republic.
Description: The Crop Research Institute (CRI) is the leading public research institute devoted to crop production research in the Czech Republic. It has about 300 employees and conducts basic and applied research, ranging from

traditional studies of genetics, plant breeding, plant nutrition and plant health to the fast-developing fields of molecular biology, biotechnology, food and feed safety, agroecology and the use of bio-wastes and biomass for energy production. Moving to the forefront of CRI research are the issues of sustainable agriculture production and organic farming with the aim to maintain high soil fertility, support natural processes and biodiversity, reduce water pollution and overall minimise the negative impacts of agricultural production on the environment and human health. The CRI is the leading institution in the Czech Republic in the field of crop nutrition and nutrient dynamics in agroecosystems. Amongst others, the CRI runs long-term experiments to study changes in soil fertility and soil properties, examining the effects of inorganic and organic fertilisers and crop rotation on the nutrition and yield of a number of crops, changes in weed communities and soil fertility. The long-term experiments are located all around the country in productive as well as marginal conditions. The requirements of modern farming are to maintain high yields while minimizing the negative impacts of agriculture on the environments.

Role in project: Study Site coordinator
Past experience: The Institute is active in getting involved in bilateral, international and European projects. The CRI has been involved in two FP5 projects, one FP6 projects, five FP7 projects in the position of partner organisation, one ERA-NET project, and a good number of mobility projects. Since 2013 CRI is a coordinator of its first FP7 project with 16 partners involved. Participation of CRI staff in international projects is however still far from satisfactory. It is necessary to open more possibilities of participation of young scientists in international projects and in bilateral foreign study stays.

Involved personnel

Name of personnel	*Expertise*
Dr. Pavel Čermák (m)	Coordinating large national & international research projects. Solving soil fertility, plant nutrition, nutrients balance in environment, fertilisers & fertilisation, soil testing, field & pot experiments.
Dr. Pavel Růžek (m)	Soil fertility & technology, agronomy, emissions of nitrogen and greenhouse gases, coordination of research projects
Dr. Helena Kusá (f)	Soil fertility, nutrient management, agronomy, emissions of nitrogen and greenhouse gases, coordination of research projects
Dr. Gabriela Mühlbachová (f)	Field monitoring, soil fertility, nutrient management, agronomy, nutrient losses to environment, coordination of research projects
Věra Přenosilová (f)	Project coordinator, dissemination of information, website development and maintenance.

Dr. Pavel Čermák has almost 25 years of experience in applied research in the areas of soil testing, soil conservation, nutrients management (nutrient balance calculation), field and pot experiments. During the last 10 years, he has had coordinating roles in various EU-funded projects (INTERREG III), and participation in next scientific projects.

References

Čermák, P.: Agrochemical soil testing-base for rational plant nutrition and environment protection; Proceedings-international conference „Soil, Plant and Food Interactions“, Brno, 2011.

Čermák, P., Vácha, R., Čechmánková, J., Hofman, J., Sáňka, M.: Use of dredged sediments on agricultural soils from viewpoint of potentially toxic substances; Plant, Soil and Environment; 57, 2011 (8): p. 388-395.

Čermák, P., Smatanová, M. 2012. Nutrient Balance in Long-Term Field Experiments in the Czech Republic, *e-ifc* No. 31: 3 – 7.

Hlavinka, P., Trnka, M., Kersebaum, K. C., **Čermák, P.**, Pohanková, E., Orság, M., Pokorný, E., Fisher, M., Brtnický, M., Žalud, Z.: Modelling of yields and soil nitrogen dynamics for crop rotations by HERMES under different climate and soil conditions in the Czech Republic; Journal of Agricultural Science, Page 1 of 17. © Cambridge University Press 2013, doi:10.1017/S0021859612001001.

Šíp V., Vavera R., Chrpová J., **Kusá H., Růžek P.** 2013. Winter wheat yield and quality related to tillage practice, input level and environmental conditions. Soil and Tillage Research, 132: 77-85.

Participant 27 – University of Almería, Carretera de Sacramento s/n, 04120, Almería, Spain

Legal Entity: University of Almería

Description: The University of Almeria (UAL) is a research-education oriented public university, founded in 1993. It is a non-profit organization and has currently 34 degrees available, including 854 professors. A total of 30 departments (125 research groups) are devoted to research and training. In addition to the research work of the departments, the UAL has 7 research institutes. The research institute linked to the field of the proposal is BITAL ("Center for Agrifood Biotechnology Research"), an institute associated to the International Campus CeiA3. CeiA3, Agrifood Campus of International Excellence, is the largest Spanish Center for research & specialized development in Agronomy. Formed by joint effort of the Andalusian Universities of Almeria, Cadiz, Huelva and Jaen, is headed by the University of Cordoba, this Campus has a long scientific career path at the service of the productive system and the agrifood industry development.

Role in project: Study Site Coordinator

Past Experience: The UAL's researcher has a wide experience in international and European projects. The University had participated in projects from different International Programmes. Some of the most important are IV Framework Programme (9 projects), V Framework Programme (3 projects), VI Framework Programme (6 projects), VII Framework Programme (11 projects) and Horizon 2020 (4 projects in 2014).

Involved personnel

Name of personnel	*Expertise*
Dr. Julián Cuevas (m)	Plant Physiology. Deficit irrigation in Mediterranean and Subtropical fruit crops. He worked on weed science in the past.
Prof. Dr. Virginia Pinillos (f)	Management techniques for improving fruit quality. Fruit maturation. Deficit irrigation.
Dr. Fernando del Moral (m)	Soil fertility. Nutrient and Water balance. Organic agriculture, Soil chemical degradation, mainly by heavy metals. Soil restoration. Agronomy.
Dr. Yolanda Cantón (f)	Assessment and monitoring of soil degradation, with special focus on water erosion, effects of biocrusts on water and carbon balances and soil restoration
Dr. Emilio Galdeano (m)	Research and network projects on environmental economics, agricultural economics and policy, and rural sustainable development.
Dr. Jose Angel Aznar (m)	Research on rural sustainable development. Environmental economics, agricultural economics and policy.
Dr. Juan José Hueso (m)	Plant physiology and water relations, fruit crop management, protected cultivation, coordination of research projects.

Dr. Julián Cuevas (H-index 14, cited 524 times) full professor in Pomology with experience (+25 years) in the area of physiology of fruit crops (bud rest, flowering, and fruit thinning) and its manipulation by cultures practices. During the last 15 years, IP in projects related to the management of irrigation in order to promote flowering, enhance fruit quality and minimize yield losses in Mediterranean and Subtropical crops. Head of the Department of Agronomy.

References

Cuevas, J., Pinillos, V., Cañete, M.L., Parra, S., González, M., Alonso, F., Fernández, M.D. **and J.J. Hueso, J.J. (2012)** Optimal duration of irrigation withholding to promote early bloom and harvest in 'Algerie' loquat (Eriobotrya japonica Lindl.). Agricultural Water Management, 111, 79-86.

Hueso, J.J. and **J. Cuevas** (2010) Ten consecutive years of regulated deficit irrigation probe the sustainability of this water saving strategy in 'Algerie' loquat. Agricultural Water Management, 97, 645-650.

Del Moral, F., González, V., Simón, M., García, I., Sánchez, J.A. and S. de Haro (2012) Soil properties after 10 years of organic versus conventional management in two greenhouses in Almeria (SE Spain). Archives of Agronomy and Soil Science, 58, S226-S231.

Cantón, Y., Solé-Benet, A., de Vente, J., Boix-Fayos, C., Calvo-Cases, A., Asensio, C., and J. Puigdefábregas (2011) A review of runoff generation and soil erosion across scales in semiarid south-eastern Spain. Journal of Arid Environments 75, 1254-1261.

Galdeano-Gómez, E., Aznar-Sánchez, J. A. and J.C. Pérez-Mesa (2013) Sustainability dimensions related to agricultural-based development: an experience over 50 years of intensive farming in Almería (Spain). International Journal of Agricultural Sustainability, 11, 125-143.

List of relevant project or activities

- Project: Mejora de la precocidad y de la calidad del fruto del níspero japonés mediante estrategias de riego deficitario. Determinación de los niveles de estrés óptimos pre y postcosecha. ("Earlyness and fruit quality improvement in loquat by déficit irrigation strategies applied before and after harvest") (2008-2012). Funding: Junta de Andalucía. Funds: 183569,59 €. IP: Julián Cuevas.
- Project: Infraestructura integral para la evaluación y mejora del sistema de producción ecológico de hortícolas en invernadero (Infraestructure for the evaluation and improvement of vegetable organic production in greenhouses) (2005-2008). Funding Agency: (FEDER), European Comission. Funds: 727582,31. Participant: Fernando del Moral
- Project: Effects of physical and biological soil crusts on water balance and erosion in semiarid environments. (2009-2013). Funding Agency: Regional Government of Andalucía. Funds: 218949 €. IP: Yolanda Cantón.

Significant infrastructure

Three labs equipped with all necessary to perform soil studies and experiments related to sustainable vegetable and fruit production in the fields of crop irrigation and fertilization.

Two Experimental Stations with a large number of orchards and greenhouses available where specifics trials could be conducted if necessary on specific annual and perennial crops.

Participant 28 – Fédération Régionale des Agrobiologistes de Bretagne, ZI SUD EST, 17 rue du Bas Village, CS 37725, 35577 Cesson Sevigné cedex

Legal entity: FRAB is an organic farmer organization, member of FNAB, which is the National Federation of Organic Farmers.
Description: FRAB is an organic farmer organization, member of FNAB, which is the National Federation of Organic Farmers. FRAB is the Brittany's organic farmer organization (the western region of France). FRAB gathers 4 local groups of organic farmers, called GAB ("Groupement d'Agriculteurs Biologiques) : GAB56, GAB22, GAB29 and Agrobio35. FRAB is connecting these local groups of farmers to the national organization, called FNAB.
The GAB-FRAB network has 4 priorities :

- Developing organic farming in Brittany : transfer of organic practices to conventional farmers, research and development activities, promoting organic farming
- Supporting organic farmers : training, tools development, food supply chains development
- Supporting installation and transition to organic farming (*conversion* process)
- Representing and defending organic farmers of Brittany

Today, more or less 50% of Breton organic farmers are members of GAB-FRAB network. 80 farmers are implicated in it as administrators or active members of commissions. About 35 employees work in GAB-FRAB network, doing technical support, transition to organic farming support or food supply chains advising.
Role in project: Study Site coordinator
Past experience:
GAB-FRAB network is conducting research actions for years about organic pratices, soils quality, animal welfare or health, crops… either as coordinator, either as partner. These actions are very mostly carried on organic farms of GAB-FRAB network. They are based on innovative practices of our members. Research centers (INRA), technical institutes (ITAB, IDELE), Chambres d'Agricultures or local companies are involved or associated to these projects.
Here are some examples of several projects GAB-FRAB network is actually working on :

- Coordinating a project about soil fertility in crop organic systems (8 farms involved)
- Coordinating a project about winter pasture (12 farms involved)
- Coordinating a project about transition to organic farming for milk farms (14 farms)
- Coordinating a project about maize seeds (29 farms)
- Partner of a project about agroforestry (ARBELE)
- Partner of a project about food autonomy in milk farms (OPTIALIBIO)

About soil analysis, the GAB-FRAB network is using the Herody method. This method is based on field and soil observation, and specific soil analysis. It is then used to provide advices about liming, recovering organic matter, field "rotation" and tillage. The author of this method is called Yves Hérody (geological doctor, specialised in pedolody and agronomy).

Involved personnel

Name of personnel	*Expertise*
Goulven Maréchal (m) (FRAB)	Coordinating research projects, link with partners, stakeholders and valorization of results. Organic farming, rural development, farming systems
Gaëtan Johan (m) (Agrobio35)	Soil fertility and quality, agronomy, crop systems, organic farming. Technical support to farmers
Yann Evenat (m) (GAB29)	Soil fertility and quality, agronomy, crop systems and cattle growing, organic farming. Technical support to farmers
Céline Rolland (f) (GAB56)	Soil fertility and quality, agronomy, crop systems, organic farming. Technical support to farmers
Olivier Linclau (m) (GAB44 – Local group outside Britanny	Soil fertility and quality, agronomy, cattle feeding and growing. Technical support to farmers

References

"La rotation en grandes cultures", Fiche technique GAB-FRAB Grandes Cultures n°1 : http://www.agrobio-bretagne.org/wp-content/uploads/2010/09/rotation_GCultures1.pdf

"L'approche Hérody", Fiche technique GAB-FRAB Grandes Cultures et Agronomie n°10, 2012 : http://www.agrobio-bretagne.org/wp-content/uploads/2012/04/Fiche_herody.pdf

"Fertilité des sols, la clé de voûte des fermes biologiques", Gaëtan Johan, Yann Evenat, Céline Rolland, Régis Le Moine, Symbiose n°193, septembre 2014.

"La méthode BRDA HERODY", Olivier Linclau, septembre 2009, Fiche technique CAB N°25 : http://www.biopaysdelaloire.fr/documents_blocs/167.pdf

List of relevant project or activities

- Development and testing of an innovative method about soils quality : "Herody method", with a network of scientist, farmers and technicians in France,
- Soil analysis in farms,
- Work on soil quality with catchment areas : training of technicians, farmers, meetings.

Participant 29- Scienceview Media B.V., Film company,Eekhoornstraat 33, 1215 AP Hilversum, The Netherlands.

Legal entity: SME, Ltd.
Description: Scienceview Media B.V. is a film company specialized in the production of scientific documentaries and reports for Dutch public television, universities and scientific organizations.
Role in project: Scienceview will make a documentary about the SOILCARE project as part of WP9.
Past experience: Scienceview has produced several documentaries related to erosion and ecology. Several documentary's where made about soil erosion(on location in Portugal/ Cape Verde, Tunisia, Norway, Romania and Spain) and before documentaries were made about the destruction of the Amazon, virgin forests in Europe, farmers in mountain areas, forest fires in boreal areas and forest fires in tropical areas.

Involved personnel

Name of personnel	*Expertise*
Manfred van Eyk (m)	Director, producer. Experience of about 27 years in making documentaries, reports about scientific issues.

Chris Blokhuis (m)	Cameraman, producer. 25 years of experience in the production of several scientific documentaries.

References:

- 2011 DESIRE-film (Wageningen UR),
- 2014 Three part series about the future of the Wadden Sea. (VARA, Dutch public t.v.),
- 2015 RECARE-film.

4.2. Third parties involved in the project (including use of third party resources)

The tables below show which participants plan to have subcontracting or involvement of other third parties. Sub-contractors will be selected using a transparent bidding procedure, and following the principles of best value for money and equal opportunities. Sub-contracting procedures will be applied in accordance with the national law that applies to the contractor, and may or may not include a tendering procedure.

Participant 1: Alterra-DLO

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	Y
Report on the implementation of the gender action plan (20000)	
Does the participant envisage that part of its work is performed by linked third parties	N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N

Participant 2: BCU
No third parties involved

Participant 3: KUL
No third parties involved

Participant 4: UoG
No third parties involved

Participant 5: UH
No third parties involved

Participant 6: RIKS
No third parties involved

Participant 7: TUC
No third parties involved

Participant 8: JRC
No third parties involved

Participant 9: UNIBE

No third parties involved

Participant 10: Milieu
No third parties involved

Participant 11: Bioforsk
No third parties involved

Participant 12: BDB
No third parties involved

Participant 13: AU

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	Y
For the Danish study site analyses we will be dependent on and benefit from the access to databases and technical knowledge for the Danish Knowledge Centre for Agriculture (www.SEGES.dk). This is especially relevant for soil data in relation to the Danish square net database. The SEGES contact person is Dr. Leif Knudsen. The estimated budget is 20000 EURO.	
Does the participant envisage that part of its work is performed by linked third parties	N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N

Participant 14: GWCT
No third parties involved

Participant 15: Teagasc
No third parties involved

Participant 16: SCR

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	Y
Sequencing of DNA extracted from soil samples. This should be done by a laboratory highly specialized in sequencing using up-to-date equipment. Doing this ourselves is not possible given the high costs of the equipment that is needed. Budget foreseen: 25000 EURO	
Does the participant envisage that part of its work is performed by linked third parties	Y
DNA extraction from soil samples. Budget foreseen 15000 EURO. The third party is Clear Detections B.V., which falls under Dutch Sprouts B.V. (like SCR, which also falls under Dutch Sprouts B.V.).	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N

Participant 17: ESAC
No third parties involved

Participant 18: ICPA
No third parties involved

Participant 19: UNIPD
No third parties involved

Participant 20: IA
No third parties involved

Participant 21: WU
No third parties involved

Participant 22: UP
No third parties involved

Participant 23: SLU
No third parties involved

Participant 24: Kongskilde
No third parties involved

Participant 25: PM
No third parties involved

Participant 26: VURV
No third parties involved

Participant 27: UAL

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	N
Does the participant envisage that part of its work is performed by linked third parties	N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	Y
Personnel (Dr. Juan J. Hueso) of the Experimental Station of Fundación Cajamar will contribute to the work developed by team 27, establishing irrigation programs based on climactic data and designing deficit irrigation strategies to save irrigation water and increase water efficiency and productivity. He will be also in charge of tuning fertilization programs when reduction in nitrogen applications is performed. Fundación Cajamar covers Dr. Juan J Hueso salary and this is considered a contribution in kind.	

Participant 28: FRAB

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	Y
We plan to subcontract some soil analysis and expertise to an independent consultant on soil fertility and quality. Budget foreseen is 18000 euro. We usually subcontract this subject to Yves Hardy. Yves Hardy has a large experience of soil analysis and provide training to technicians from our network.	

Does the participant envisage that part of its work is performed by linked third parties	Y
We envisage to perform part of the work by some of our local organic farmers groups: GAB29, GAB56 and Agrobio35 which are 3 of the 4 local groups adherent to our regional federation. Each one of them has 1 technician dedicated to agronomy, crops and soils in organic farming. *We also envisage the participation of GAB44 which is a local organic farmer group of the closest region, les "Pays de la Loire", as an expert. GAB44 is adherent to our national network (FNAB) and it has a technician dedicated to agronomy and crops, who has a good experience of soil quality.*	
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N

Participant 29: ScienceView

Does the participant plan to subcontract certain tasks (please note that core tasks of the project should not be sub-contracted)	Y
• *Sound engineering for film. Budget foreseen: 950 EURO* • *Editing and post production of film. Budget foreseen: 8718 EURO*	
Does the participant envisage that part of its work is performed by linked third parties	N
Does the participant envisage the use of contributions in kind provided by third parties (Articles 11 and 12 of the General Model Grant Agreement)	N

5. Ethics and Security

5.1 Ethics

We have not flagged any issues in the ethical issue table in the administrative proposal forms.

5.2 Security

Please indicate if your project will involve:

- activities or results raising security issues: NO
- 'EU-classified information' as background or results: NO

Annex 1. Study Site descriptions

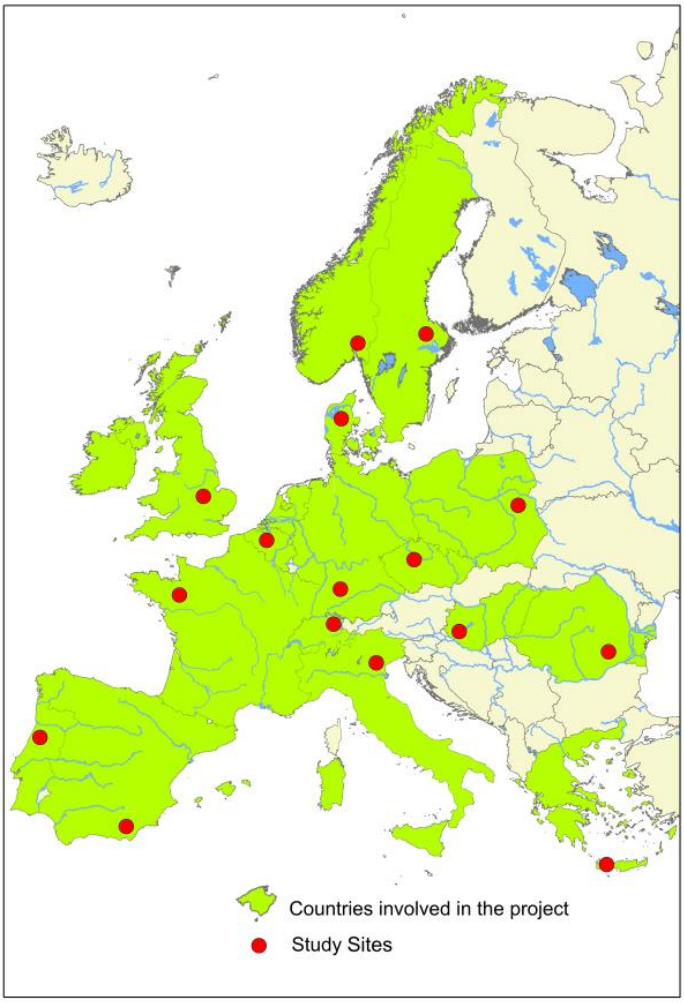

Figure 1: Location of the SOILCARE study sites across Europe.

Table 1: the SOILCARE study sites, country and the responsible partners.

1. Flanders BE	2. Akershus NO	3. Keszthely HU	4. Frauenfeld CH	5. Viborg DK	6. Allerton GB	7. Stuttgart DE	8. Bukarest RO
12 - BDB	11 - Bioforsk	22 - UP	9 - UNIBE	13 - AU	14 - GWCT	5 - UH	18 - ICPA
9. Legnaro IT	10. Szaniawy PL	11. Coimbra PT	12. Chania GR	13. Orup SE	14. Prague CZ	15. Almeria ES	16. Bretagne FR
19 - UNIPD	20 - IA-PAN	17 - ESAC	7 - TUC	23 - SLU	26 - VURV	27 - UAL	28 - FRAB

STUDY SITE 1: Flanders, BE
Responsible partner: 12, Bodemkundige Dienst van België

1. General information

Geographical description
The study site is situated East of Leuven (indicated as blue area) at an elevation varying between 20 and 100 masl. It includes the communities of Leuven, Holsbeek, Lubbeek, Boutersem, Bierbeek and Lovenjoel. The Bodemkundige Dienst van België is situated at the Western border of the study site, while the Zoötechnisch Centrum lies within the study site. On the map the long-term (since 1997) compost trial (in green), as well as some of the long-term (since 2002) trials on reduced tillage (in purple) are indicated.

Figure 1: Map of study site in Flanders, Belgium. The study site is indicated in blue.

The maritime temperate climate in Flanders is characterised by significant precipitation in all seasons (no dry season),fresh/humid summers and relatively mild/rainy winters (according to the Köppen climate classification: Cfb). The average annual temperature is 10.5°C (3.3 in January and 18.4 in July), while the average minimal temperature is 6.9°C and the average maximal temperature is 14.2°C.The average annual rainfall is 852.4 mm.
The study site is characterized by sandy, sandy loam and loamy soils (see Figure 2). At parcel level also a variation in soil erosion potential is present in the study site. (see Figure 3).

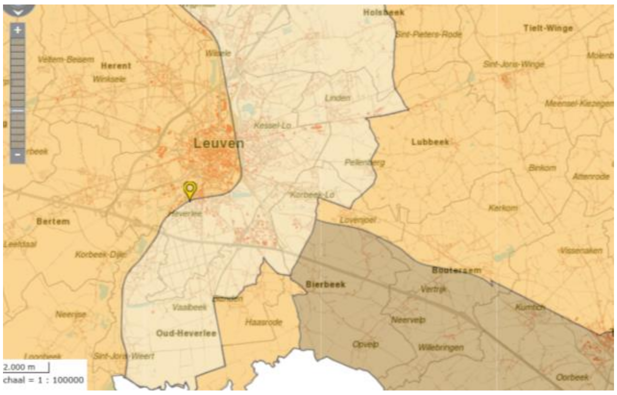

Figure 2: Map indicating the different agricultural regions present in de study site. From light to dark colour, Flemish sand region, Sandy loam region and Loam region.

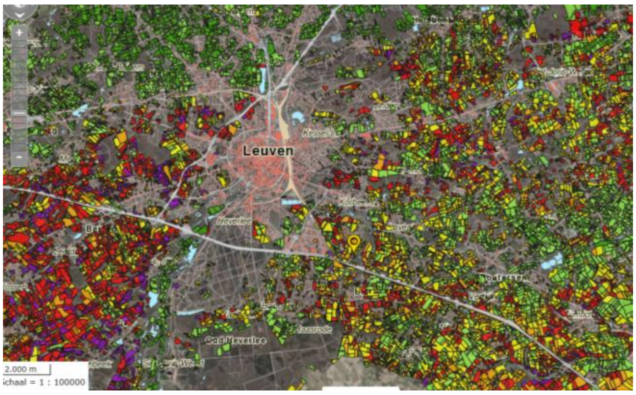

Figure 3: Map indicating the potential soil erosion at parcel level. Green: soil erosion potential is very low, yellow: soil erosion potential is low, orange: soil erosion potential is medium, red: soil erosion potential is high and purple: soil erosion potential is very high.

Pedo-climatic zone
Atlantic Central; sandy, sandy loam and loamy soils.

2. Cropping systems

Cropping intensity
The study site is characterised mainly by conventional cropping systems. However, also conservation cropping systems (e.g. reduced tillage) and to a smaller extent organic cropping systems are present. In general in Flanders, crop production is highly intensive (high inputs, high yields).

Types of crop
Mainly cereals, sugar beet, potato, maize, grass, apple and pear orchards

Management of soil, water, nutrients and pests
Soil management: typically conventional tillage (ploughing), but also reduced tillage (e.g. as a measure against erosion). In the framework of CAP and cross compliance attention is being paid to maintain good soil conditions in terms of acidity (pH) and soil organic carbon.
Water use: drip-irrigation in pear-orchards (common practice), sprinkler irrigation in arable crops and vegetables
Soil fertility management: high nutrient input, mainly organic fertilisation, but also use of mineral fertilizers. The tradition of high inputs of organic fertilisers resulted in a poor water quality (especially high concentrations of nitrate and phosphate). As a consequence the Manure Decree sets fertilisation limits for both organic and mineral fertiliser input.
Pest management: Since 2014 integrated pest management (IPM) is common practice, implementing the EU directive 91/414 and the EU Regulation 1107/2009.

Soil improving cropping system and techniques currently used
Minimised input and tillage, crop rotation, use of cover crops, application of organic amendments

Problems that cause yield loss or increased costs
Water deficit: on average, irrigation in pear production results in an higher yield of 800 euro/ha.year
Poor soil quality (low soil organic carbon content): application of compost compared to only mineral fertilisation results in a higher wheat yield of 50-250 euro/ha
Erosion: increased cost of 122-342 euro/ha.year on highly sensitive parcels
Soil compaction: yield loss of 100-200 euro/ha.year

3. External drivers and factors

Institutional and political drivers
Water quality and nutrient input: Nitrate directive, Water Framework Directive, Manure Decree in Flanders
Integrated Pest Management: EU directive 91/414 and the EU Regulation 1107/2009
Soil quality (pH, soil organic carbon, erosion): EU CAP (Common Agricultural Policy), MTR (Mid Term Review) and Cross Compliance

Bio-physical drivers
Impact of soil compaction, acid pH, low soil organic carbon

4. Multi-actor approach

Relevant end-users and stakeholders
Farmers, farmers associations (like Boerenbond and Algemeen Boeren Syndicaat), governmental extension services (ADLO in Flanders), policy makers like VLM (Flemish Land Agency), LNE (the Environment, Nature and Energy Department of the Flemish Government), but also other stakeholders of the rural area, e.g. inhabitants, tourists.

Involvement stakeholders in study site
Stakeholders will be involved in the study site at different levels:

- Direct participation in field trials
- Field trial visits
- Information meetings
- Open farm days
- Publications

5. Past and on-going work

Past and on-going projects

- Soil management: research and demonstration projects on cover crops, compost, reduced tillage, soil compaction and the use of triticale.
- Water management: research projects on irrigation in pear orchards, use of remote sensing for differential irrigation management at parcel level.
- Soil fertility management: research and demonstration projects on the use of compost, humic acids, sulphur fertilisation, in row fertilisation (potato, sugar beet, maize), application of slurry in wheat and triticale, application of discharge water.
- Pest management: IPM in winter wheat, research on occurrence and management of aphids and grain beetle in wheat.

Availability of long-term data

1. Fertilising and soil-improving characteristics of VFG-compost in a typical arable crop rotation: A long-term field trial with VFG compost was set up by BDB in 1997 on a loamy soil. Twelve treatments were laid out in four replicates, including unfertilised control, control treatment with only mineral fertilisation, treatments with 15, 30 and 45 tonnes VFG-compost per hectare, applied annually, bi-annually and tri-annually. Winter wheat, sugar beet, potato and carrot are included in the rotation.
2. Long term effects of reduced tillage on nitrogen dynamics and on the physical soil quality: In total, nine long-term field trials were set up in 2000 on sandy loam and loamy soil. Two treatments were laid out: conventional tillage and reduced tillage (with 4 replicates within one treatment). All selected parcels are sensitive to erosion. Typically maize, sugar beet, winter wheat, oil seed rape and potato are cultivated on these parcels.

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STUDY SITE 2: Akershus, Norway
Responsible partner: 11, Bioforsk

1. General information

Geographical description

The study site is located in Akershus county in south-eastern Norway, one of the main areas for cereal cropping systems. The total area of Akershus county is 4918 km^2 with agricultural area covering ca. 900 km^2. Marine sediments with clay and silt dominate. Artificial land levelling was performed in the 70-80ties to promote use of larger machinery and cereal cropping systems. In some municipalities, up to 40 % of the agricultural area is levelled, resulting in high erosion risk. The county area will be used for stakeholder analyses. Precipitation range between 665-785 mm annually and winter period with frozen soils and snowmelt has a major influence and soil processes (infiltration, erosion). Soil data is available for each farmer's field.

The catchments Skuterud (6.8 km^2) and Mørdre (4.5 km^2) within Akershus county will be used for more detailed analyses. Skuterud and Mørdre represent cereal production in undulating landscapes with erosion problems. In addition, use will be made of two experimental field sites: Apelsvoll cropping system experimental site and Kjelle experimental fields. The Apelsvoll cropping system is located on Apelsvoll, near the largest lake in Norway, Mjøsa, in Central South-east Norway (120 km north of Oslo). The altitude is 250 m.a.s.l. The cropping system was established in 1988/1989, it covers 3.2 ha. The experiment comprises 12 mini-farms, each having a four-year crop rotation. Altogether six cropping systems are represented (two replicates): Three systems with cash-cropping (mainly cereals) and three systems with both arable and fodder crops, representing mixed dairy production. Kjelle is located near Bjørkelangen, about 60 km east from Oslo, on an area with shallow slopes. The experiments started in 2014, with emphasise of this experiment (9 plots, each 8 x 50 m in size) on analysing soil management effects on soil surface discharge and infiltration.

Figure 1:Skuterud catchment

Figure 2 Mørdre catchment

Pedo-climatic zone

Nemoral/Boreal, marine clay soils

2. Cropping systems

Cropping intensity

Akershus County is dominated by conventional agricultural cropping intensity; organic farming is ongoing on a small scale. Conservation methods and precision management is promoted and under research, but not widespread. Grain and oil seed production covers 69% of the agricultural area, 26% is used for forage crops. In Skuterud catchment, 90 % of the area is used for grain and oil seed production and 10 % for grass cultivation, while in Mørdre catchment 85% of the area is used for grain production, 6 % for potatoes and 4% for grass production. Skuterud has 43% autumn wheat, 30% oats and 19% barley, while Mørdre has 40% oats and 33% barley. The arable crops at Apelsvoll experimental site include spring cereals (wheat, barley, oats) and potatoes and oats with peas. Fodder crops include grass–clover leys and meadow grasses with red clover. Kjelle has an annual grain production with focus on soil management.

Management of soil, water, nutrients and pests
Autumn ploughing has dominated cereal production. Subsidies promoting reduced tillage has led to increased spring tillage (53% for total cereal area) and light autumn harrowing replacing ploughing. All farmers are obliged to have a fertilizer plan based on soil samples to receive production support.

Soil improving cropping system and techniques currently used
The Regional Environmental Programme supports, by use of subsidies:

- reduced tillage
- leaving area in stubble until spring
- light autumn harrowing (leaving minimum 30 % straw on soil surface)
- direct drilling
- use of catch crops.

In addition, support is given for grass on areas with high erosion risk, buffer zones, grassed waterways and sedimentation ponds.

Problems that cause yield loss or increased costs
From 1991 the area of cereal production has decreased in Norway. From 2000 it is reduced by 14 %. Part of the area has shifted from cereal to grassland production - promoted by subsides for grassland to reduce erosion and improve water quality. Subsidies for meat production has also increased the area of grassland. In addition, the crop yield/unit area has shown stagnation and even a decreasing trend, but with high variations. An expert group appointed by the Ministry of Agriculture and Food in 2013 has explained losses due to: soil compaction, lack of good drainage, lack of crop rotation, plant diseases, choice of variety, genetic material, suboptimal level of fertilizer, plant health issues.

Reduced tillage to reduce erosion can increase fusarium and reduce yields. A follow up project- from evaluation to action – is now focusing on dissemination activities to extension service and farmers to increase yields. The expert group has also listed both economic and societal reasons for lower yields.

3. External drivers and factors

Institutional and political drivers
Regional Environmental Programmes (RMP) support different farming practices and tillage systems to reduce erosion and nutrient losses. This affects both soil quality and environmental effects like drinking water quality (link to the Water Frame Directive). Support is given in accordance with the erosion risk of the specific area. In some watersheds used for drinking water supply, specific regulations and subsidy payment regulate farming practices and tillage systems.

Production support program supports the different productions systems and regulates Norwegian production systems in specific regions for cereal cropping and livestock production. The political decisions about canalisation of production systems influence on soil management and environmental issues.

Societal drivers
40 % of agricultural land is being rented from other farmers, entrepreneur contracts are increasing- influencing the willingness to invest in e.g. drainage. Most farmers with cereal production are part time farmers, due to small farm sizes and small income. Part time farming might lead to simple and practical solutions for soil management and cropping systems with little workload. Management operations might be performed when farmers has time and not when soil conditions are optimal.
Public awareness and requirements to fulfil the Water Frame directive has led to restriction of agricultural activity in catchments in Akershus county.

Bio-physical drivers
Climate change is expected to give increased precipitation and more extreme events. Weather conditions will influence management possibilities like timing of sowing andharvesting possibilities. Delayed sowing can reduce yield and wetter conditions will influence on crop quality, plant health, harvesting security, risk of runoff and pollution.

4. Multi-actor approach

Relevant end-users and stakeholders:
Relevant end-user are:
Water boards in Akershus county: Pura. Haldenvassdraget, waterregion Glomma, Regional Agricultural authorities, Akershus County, Norwegian Extention Service, Farmers Union, Education: students at Kjelle secondary school (the location of the experimental fields).

Involvement stakeholders in study site
Stakeholders at the Akershus county level will be involved when identifying and prioritising measures to be implemented, from both the water regions, agricultural authorities, extension service and farmers organisations. On farm studies in the Agropro project (cereal production) has already started a process to identify measures to increase food production. Soil management is included and suggested measures planned in SOILCARE are foreseen to be tested at these on farm studies together with the
Kjelle experimental field and other plot experiments. Stakeholders involved in AGROPRO will be linked to SOILCARE by the joint annual meetings in Agropro. This includes researchers (different disciplines), extension service, farmers, agricultural authorities.

5. Past and on-going work

Past and on-going projects
JOVA- Agricultural Environmental Monitoring Programme has monitored agricultural catchments since 1991. Monitoring of farming activities, runoff, erosion and nutrient losses. Several research projects are located within the study area and the monitoring catchments. Measurement of soil erosion, effect of tillage practices and other measures on runoff and nutrient losses are studied in several projects. Plot studies have measured soil loss from different soil tillage management starting in the mid 80-ties. The project “AGROPRO is looking at challenges and possibilities is an interdisciplinary project joining natural science, economical and societal research for solutions to increase food production.
Availability of long-term data
The Agricultural Environmental Monitoring Programme; 1991- ongoing.
Available data: Climate and runoff data from 1991.Water proportional sampling, analysed for nitrogen, phosphorus, pesticides, erosion material. Farmers supply information for each field about cropping systems, data for sowing, fertilizing, amount of fertilizer used, pesticides, yields and tillage operations.

6. Key references

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STUDY SITE 3: Keszthely, Hungary

Responsible partner: 22, University of Pannonia, Hungary

1. General information

Geographical description

The study site is located in Keszthely in western part of Hungary (46°44' N, 17°13' E, 112 m above sea level). The climate is semi-continental with maritime influences, is moderately warm, moderately humid, while the number of sunshine hours per year is high. The 100 year average annual precipitation was 683 mm, the long-term annual mean temperature as 10.8 °C. The main soil type is Eutric Cambisol (WRB, 2006). The texture of the soil is dominantly clay loam with medium soil hydraulic conductivity and high water holding capacity. The bulk density of the undisturbed soil was 1.53 g cm^{-3}. The pH of the soil is slightly acidic, surface horizon does not contain calcium carbonate. The naturally available phosphorus content of the soil is low (ammonium-lactate [AL] soluble P2O5: 60-80 mg kg^{-1}), the potassium content medium (AL-K2O: 140-160 mg kg^{-1}) and the soil organic matter content fairly low (16-17 g kg^{-1}). Land use type is arable land.

Pedo-climatic zone

Pannonian, brown forest soils.

Figure 1. Conventional and reduced soil tillage systems in Keszthely study site.

Figure 2. Crop rotations and fertilizations in Keszthely study site.

2. Cropping systems

Cropping intensity

Conventional, Conservation.

Types of crop

Crops: wheat, maize, winter and spring barely, alfalfa, red clover, rape, oat, sudan grass, vetch, pea and potato. The typical crop rotation is wheat – wheat – maize – maize.

Management of soil, water, nutrients and pests

Conventional tillage, no irrigation, different rates of organic and mineral fertilization, integrated pest management.

Soil improving cropping system and techniques currently used

Rotation, intercropping, green manure, mulching, minimum tillage.

Problems that cause yield loss or increased costs

Effect of cropping years, soil compaction, SOC decline, climatic parameters: rainfall

Coefficient of variation is 20-30% depending on the treatments.

3. External drivers and factors

Institutional and political drivers
The relevant and existing legislation and directives are in harmony with the EU legislation.

Societal drivers
The public opinion of farmers is positive about the improving of farm systems and last and not least because of monetary allowance.

Bio-physical drivers
Recently it is not proved yet, but the yearly variability of yields are getting higher and higher.

4. Multi-actor approach

Relevant end-users and stakeholders
Agricultural and Rural Development Agency

Involvement stakeholders in study site
Current of information from the research to the farmers through Agricultural and Rural Development Agency.

5. Past and on-going work

Past and on-going projects

- D-e-METER – Developing an Internet-based land evaluation and farm data collection system to integrate environmental resources appraisal and agricultural information management. NKFP 3/004/2001.
- Research Foundation of Hungarian Scientific Academy F 042641/2003-2006/: effect of crop rotations on the nutrient cycles and pH in soil, optimal forecrop advise for farming, diversification in land use.
- Research Foundation of Hungarian Scientific Academy T 030768/1999-2002/: maintenance and increase of soil fertility on arable land. NPK combinations, manuring, residue management. Optimal amount of fertilization its effect on soil function and fertility.
- Research Foundation of Hungarian Scientific Academy T 046845 /2004-2007/: nutrient cycling in long-term field experiments. Nutrient balance and its consequences. Environmental aspects.

Availability of long-term data

- Comparative study of organic and inorganic fertilizers in different crop rotations: to investigate the effect of organic and inorganic fertilizers on yield and soil fertility in crop rotation with and without alfalfa: 51 years (1964).
- Maize monoculture: to investigate corn production in different NPK application rates without residue incorporation: 46 years (1969).
- Investigation of soil tillage systems in wheat and maize bi-culture: 43 years (1972).
- International experiment for investigation the effect of organic and inorganic fertilizers (IOSDV): 31 years (1984).

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STUDY SITE 4: Frauenfeld, Switzerland
Responsible partner: 9, UNIBE, Switzerland

1. General information

Geographical description

The study site is located near Frauenfeld (47° 34’ N, 8° 52’ E), the capital of the canton Thurgau, in the north-eastern part of the Swiss Midlands. The main river is the Thur, a tributary to the Rhein. The soil, situated on a wide valley bottom at 385 m above sea level, is a calcaric fluvisol (alluvial deposits). The topsoil is a sandy loam. Layers of coarser material are found in the subsoil. The organic carbon content varies between $5x10^{-3}$ and $0.5x10^{-3}$ kg kg^{-1}. The bulk density is 1.4 kg l^{-1} and the pre-consolidation load is 80 kPa. The experimental area of 1 km^2 is situated in the plain of the river Thur with a surface area of about 15 km^2.

Pedo-climatic zone

The site is under two predominant influence climates: the continental and the Alpine South climates. Annual average temperature is about 11.2 °C and precipitation is abundant (906 mm $year^{-1}$) due to the proximity of the pre-alpine relief in the South. The study site situated in low sloping land has low risk to surface runoff generation but filed inundation is not excluded, while it has high susceptibility to leaching (fluvisol, draining soil structure until the ground water table at about 1.5 m depth).

2. Cropping system

Cropping intensity

In Frauenfeld site, both conventional and conservation cropping systems are used. Depending on the soil moisture conditions and the rut depth after the harvest, rotary cultivator or plow (furrow wheel) are used, especially before sugar beet and potato crops. All produced animal excreta (pig liquid manure, rotted manure including straw from beef fattening), straw residues of maize and beet leaves will be returned or incorporated to the soil. Minimum soil tillage (harrow) is used after potato. The rotation constellation including artificial meadow and special cultures (strawberries) is not favorable for controlled traffic farming (CTF).

Types of crops

The rotation includes the following crops: corn as starter crop, then sugar beet, potato and cereal (winter wheat or spring barley). In the case of annual artificial grassland or annual strawberries, sowing or planting occurs after cereal.

Management of soil, water, nutrients and pests

The management has to be done according to the proof of ecological requirements of FOAG, Federal Office for Agriculture. The root and tuber crops occupy an important place in the rotation (between 60% and 75%) weakening soil structure of the topsoil. In summer, when the crops suffer from drought, irrigation overcomes this deficiency for root, tuber crops and strawberries and helps to establish artificial grassland in August. Water used for irrigation is provided from the water table with a level of about 1.5 m from soil surface. Except for the strawberries, the organic fertilizers in form of liquid manure (from pig production) or rotted manure (from fattening cattle) will be applied directly after harvest for the nitrogenous, phosphate and potash needs. Additional drilled mineral nitrogen fertilizers are reserved for cereals (ammonium nitrate), potato (ammonium sulfate) and corn (urea). For the fight against weeds, selective herbicides will be applied: corn, sugar beer, strawberries (soil and foliar herbicide) and cereals (contact herbicide). Fungicide and insecticide are used especially for potato: between 7 and 10 applications for potato blight *(Phytophtora infestans)*, and 1 application for Colorado beetle (*Leptinotarsa decemlineata)*.

Soil improving cropping system and techniques currently used

Soil cropping systems and techniques used in the site are: soil tillage, reduced plowing, combination seed drill for cereals after potato, flotation tires on traction vehicle (Fig. 1A). The precision by sowing and planting is ensured by mean of GPS. Trickle irrigation is used for strawberries.

Figure 1. A) Flotation tires by seeding with a combination seed drill (Photo of the study site, 14.10.2010) *B) effect of topsoil degradation due to heavy machines in corn field (Photo of the study site, 22 Sept. 2000)*

Problems that cause yield loss or increased costs
Yield loss is closely linked to soil properties, climatic conditions, selected crops in the rotation and the peak workload over the year. Although the water reserves are abundant, soil suffers from drought during summer months when rain becomes rare due to its high infiltration capacity and low organic carbon content. In autumn, depending of the precipitation intensity, the risk of compaction is high. Yield loss in the corn is about 20 % in the ruts of heavy propelled harvester. Due to the peak workload during September and October, the harvest of silage maize and sugar beet is often delayed. The compaction risk under wet soil conditions causes crop loss. There is, also, not enough time remaining for cover cropping and green manuring in autumn. Stubble and organic residues are hardly decomposed and nitrogen mineralization remains blocked prejudicing the next culture (Fig. 1B). The structure degradation associated with rainfall regime and the harvest calendar is generally limited on the topsoil and disappears in the short or medium term.

3. External drivers and factors

Institutional and political drivers
While agricultural and environmental policies of Switzerland have been defined autonomously with regard to Europe, basic features of the respective European and Swiss policy frameworks are rather similar (e.g., high degrees of protectionism, direct payments for ecological and other services, strong presence of public regulation). The national ordinance on direct payments contains a clause that farmers who intend to receive direct payments must take suitable protection measures against soil degradation and water contamination. Subsequently, cantonal authorities, such as soil protection agencies and agricultural offices, began to develop different approaches to implement these regulations: they devised special control systems using soil erosion risk maps and agricultural inspectors. They are also conducting training courses, producing information leaflets, and implementing financial support programs for no-tillage.

Societal drivers
Public opinion: there is an increasing demand of local and biological products in Switzerland. There is also a real competition with European products that offer equivalent but cheaper products. These facts create a food system in which the buyers influence the prices, and farmers must comply. Biological products take an important place in the demand, since they have become part of conventional markets (from farm gate sales to major retail chains).

Bio-physical drivers
Based on regional climate models, future summers are likely to occasionally favor more frequent extreme events that result in catastrophic flooding, despite a general trend toward drier summer conditions. These changes will have significant impact on crops in many ways (e.g., delay in harvest and increase in the peak workload during some months). In addition, soil degradation and deficient soil aeration will be caused by the use of heavy agricultural machinery.

4. Multi-actor approach

Relevant end-users and stakeholders

- Farmers and their families
- Agricultural contractors (e.g., providing no-till machinery), mechanists
- No-till association, e.g. SWISS NO-TILL
- Building and other infrastructure insurances
- Representatives of the commune
- Cantonal and federal experts for soil and water conservation
- Education (farmer schools) and agricultural advisory service (Agridea).

Involvement stakeholders in study site

Multi-actor platforms will be established in order to facilitate knowledge exchange and mutual learning between the different stakeholders from local to national level. Cropping systems and agronomic techniques will be jointly elaborated and selected in an open atmosphere. The stakeholders will also be involved in the monitoring of the selected cropping systems and agronomic techniques in order to ensure a holistic and comprehensive assessment.

5. Past and on-going work

Past and on-going projects

Our experiences gained from previous and on-going projects, such as iSQAPER, DESIRE, RECARE and CASCADE, in technical as well as social and human approaches will serve as basis and support material. This knowledge concerns various issues such as type of measures, cost-benefits, impacts, spread, and participative approach.

Availability of long-term data

Long experimental data to simulate soil degradation under different cropping systems and machinery impact is available (Alaoui and Helbling, 2006; Bastgen and Diserens, 2009; Battiato et al., 2013; Diserens et al., 201; Kulli et al., 2003). The cited studies are all carried out in Frauenfeld and simulate controlled treatments under various soil, crop and weather conditions.

6. Key references

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STUDY SITE 5: Viborg, Western Denmark
Responsible partner: 13, Aarhus University, Department of Agroecology


Figure 1: Incorporation of straw in soils with combinations of after crops at The Askov Experimental Research station.

Figure 2: Slurry application with heavy machinery.

1. General information

Geographical description

The Danish site centered in the Municipality of Viborg, and the Region of Central Denmark where our main Agricultural Research Centre and the Aarhus University, Department of Agroecology is also situated. From here we can draw on extensive long-term data from our field stations (see below), and nearby agricultural landscape study sites, from where data collection has been coordinated in the NitroEurope EU integrated project (2007-2011), the MEA_scope EU strategic research project (2004-2007) etc. and and series of other research projects (1994-present).

The Danish site represents the most agriculture and livestock intensive western parts of Denmark, with extensive data available for upscaling and generalization. The area is dominated by loamy moraines (about 40-70 m above sea level), with agriculture and rotation cropping systems as the dominating land use. The climate is temporal coastal with significant surplus rainfall, especially outside the main growth season. Moreover, for the studies we will include our very near collaboration with the Danish Farmers extension services (www.seges.dk) and the strong local farmers associations.

Pedo-climatic zone

Dominated by sandy-loamy soils, with some peat soils. Situated on the border between the atlantic and the continental biogeographical region, Atlantic North climate. Some sandy soils are irrigated, and we have data on both irrigated and non-irrigated conditions.

2. Cropping systems

Cropping systems
About 80% of the agricultural area is dominated by winter cereals in rotation with winter rape at pig and cash crop farms, and in rotation with forage crops at dairy and cattle farms. About 10-20% permanent grasslands, mainly in river valleys.

Cropping intensity
Both conventional (about 92% of the area) and organic farming (8%). Intensive use of livestock manure (especially on the about 60% of the area with livestock farms), with precision fertlisation of slurry and fertlisers. Good examples from precision farming.

Types of crop
Winter cereals in rotation with winter rape at pig and cash crop farms (mainly winter wheat, 25% of total area), and in rotation with forage crops at dairy and cattle farms (mainly grassland in rotation, 5-10%, and fodder maize, 5-10%). About 10-20% permanent grasslands, mainly in river valleys.

Management of soil, water, nutrients and pests
Strict norms on fertilizer application (18% below economic optimum), and documentation of nutrient efficient crop rotations.
Irrigation widespread on the most sandy soils, and cropping systems with for e.g. potatoes or forage crops.
Most soils are ploughed but minimum tillage are practiced.

Soil improving cropping system and techniques currently used
Examples on succesful minimum tillage, and soil incorporation of straw and cover crops (maybe strip harvest). More use of grasslands to prevent nutrient losses and erosion. Examples on Short Rotation Coppice energy crops.

Problems that cause yield loss or increased costs
Loss in organic Matter (primarily caused by ploughing and other soil tillage)
Soil Compaction (primarily caused by heavy machinery for instance for slurry application).
Erosion (especially a problem in cereals and maize)
Severe nutrient losses (N and P) to the environment (especially from livestock farms)

The yield gaps are up to 40% for irrigated winter cereals and about 20% for non-irrigated. About the same or less for maize, and less for grasslands.

3. External drivers and factors

Institutional and political drivers
The main institutional and political drivers are legislation and the implementation hereof. Especially in relation to 1) the Danish targets for a fossil free society by 2020, and the Danish commitments to the Kyoto protocol article 34 about documentation of carbon pooling in soils etc. (this e.g. relates to the present Danish practice of using straw for energy), and 2) The implementation of the water framework directive with targets for significantly reduced nutrient losses and soil erosion. Finally, there is a political target (3) to double the organically farmed area.
Moreover, the farmers organizations promote low tillage systems (without or with very little ploughing). And organic farmers promote systems with special emphasis on soil fertility.

Societal drivers
Among consumers there is a concern for sustainable production. This includes a concern for the large exports of protein from the world market, and thereby a demand for more homegrown crops, which again I most cases would mean a shift towards more balances soil fertility and carbon management.
Denmark is among the countries with the highest demand and supply of organic products, driving an agenda towards production systems better integrating soil fertility protection.
With a high livestock density, there is a high demand for systems with little odour and little ammonia losses, including technologies for low los manure handling.

Bio-physical drivers
More than 60% of the total Danish land area is agriculture and from that about 80% is for the present in rotation. This is thereby one of the most intensively used soil systems in the world, and conversion to systems with more low tillage and less land in rotation would have a significant potential for mitigation of problems related.
With climate change more rainfall is expected (especially during winters) and more extreme events (including summer drought and heavy rainstorms); this drives the demand for adapted cropping and soil management systems.
Especially in soils with a high clay and loam content, there is severe risk for soil fertility if the carbon content is reduced (measured by the Dexter index), and adaptions in cropping patterns, addition of biomass C to soils and sustainable soil management techniques are demanded.

4. Multi-actor approach

Relevant end-users and stakeholders
The most relevant end-user will probably be the farmer, to change his cropping, manure and soil management techniques. Other end-users will be consultants (especially in the farm advisory services) and politicians and administrative workers in public bodies. Moreover, researchers are relevant to involve.
The main stakeholders are in addition to the end-users especially people from the industry, including the machine industry, and policy-makers at different levels.

Involvement stakeholders in study site,
From series of other EU and national projects (e.g. www.macsur.eu, www.nitroeurope.eu.dk , www.buffertech.dk , www.dnmark.org , www.agree.aua.gr) we have good access to stakeholders in the study area, and a suite of methods for the involvement of these stakeholders for the promotion of sustainable change.
The stakeholders include the relevant end-users and stakeholders above, with all land owners in the area, the citizens in general, and the green NGO's listed with relevance to the topic and the local area.

5. Past and on-going work

Past and on-going projects
www.nitroeurope.eu.dk , www.buffertech.dk , www.dnmark.org , www.agree.aua.gr www.fremtidenslandbrug.dk among many others.

Availability of long-term data
The Askov Long-Term Experiments on Animal Manure and Mineral Fertilizers (Askov-LTE)
The Askov-LTE was initiated in 1894 on two sites, only a kilometre apart but with contrasting soil texture: Sandmarken with a sand soil enriched in fine sand, and Lermarken with a sandy loam soil. The overall objective of the experiments was to test crop responses to different levels of nutrients (0, ½, 1, 1½, 2) added in animal manure (AM) or in mineral fertilizers (NPK). Plots given N, P and K individually or in combinations of two or three were included. Each site includes four fields in a four-course crop rotation of winter cereals, row crops, spring cereals and grass/legumes. Christensen et al. (1994 and 2006) describe in detail the experiments, the adjustments in experimental layout and selected results.

The St. Jyndevad long-term field experiment on effects of and interaction between liming and P fertilisation (St. Jyndevad-LTE).
St. Jyndevad-LTE was established in 1942 at St. Jyndevad, Denmark on a sandy acid soil. The experiment includes three fields, four levels of liming combined with four levels of P fertilisation each field has each 3 replications of the 16 treatments. Plots size is 90 square meters, and the design is a spit plot design with lime as main plot factor and P fertilisation as split plot factor. Spring barley is the main crop on two of the fields. A third field which had received the same treatments from 1942 to 1994 has since1994 been in fallow and liming and fertiliser treatments ceased at that time. Initial soil pH was 4.5 the intended level of the treatments with the highest pH are 6.7. Lime is added every 5-7 years and while P is does yearly to fertilised treatments (Rubæk, 2008)

The Danish Square Grid system (7 x 7 km national square grid sampled at four depths in 1987, 1997, 2007 and about to be sampled again. Hosted by farmers, data on farming practise gathered yearly)
Foulum Long term experimental site with two decades field data collection (dairy farm rotations, energy crops etc.).
Vindum Overgaard (Very high resolution Soil sampling at two depth in two undulating fields in 2010. C and P analyses made, soil sensors has been applied (NIR, Em-38).
The Nitroeurope.eu Danish study landscape with soil, and farm management data sampled for 20-40 farms sampled since 1994 (including data on emissions).

6. Key references

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Dalgaard T, Durand P, Dragosits U, Hutchings NJ, Kedziora A, Bienkowski J, Frumau A, Bleeker A, Magliulo E, Olesen JE, Theobald MR, Drouet JL, Cellier P (2012) Farm nitrogen balances in European Landscapes. Biogeosciences 9, 5303–5321, 2012.

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Rubæk, G.H. 2008. Long-term effects of liming and phosphorus fertilisation on soil properties. In (Christensen, BT, Petersen, J. and Schact, M. (eds.) Long-term field experiments - a unique research platform: Proceedings of NJF Seminar 407. Aarhus Universitet, Det Jordbrugsvidenskabelige Fakultet, 2008. ps. 56-59 (DJF Plant Science; Nr. 137).

STUDY SITE 6: Loddington, Leicestershire, England
Responsible partner: 14, GWCT Allerton Project

1. General information

Geographical description
The Allerton Project runs a 333ha mainly arable farm at Loddington in central England. The soils are mainly Hanslope and Denchworth clays overlying Iron stone. The farm is at approximately 150 metres asl and receives approximately 650mm annual rainfall.

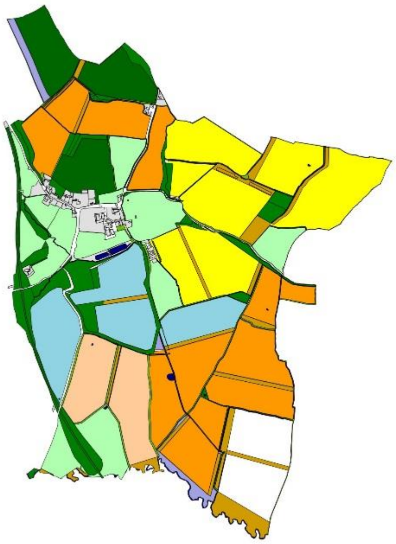


Figure 1: the Case study farm at Loddington, central England.

Pedo-climatic zone
Atlantic Central/ North, clay soils

2. Cropping systems

Cropping intensity
The cropping system is broadly typical of others in the area but adopts an Integrated Farm Management approach with the creation of habitats to encourage beneficial predatory and pollinating insects and other wildlife.

Types of crop
The crop rotation is wheat, rape, wheat, beans or oats but pasture is also present on the farm and grass leys are being brought into the rotation. A three or four course rotation including wheat, ape and beans or oats is typical of the local area, although a two course wheat rape rotation has been practiced until recently.

Management of soil, water, nutrients and pests
Over the past decade, there has been a move from plough based to reduced tillage and most recently, a no till approach to crop establishment. Crop residues are returned to the soil. Cover crops are adopted before spring sow crops. Soil are tested for P, K and Mg at least once in each rotation. Some fields mapped for soil type and nutrients. Variable rate N application using Yara's N Sensor. No irrigation.

Soil improving cropping system and techniques currently used
Reduced tillage or no-till, crop residue returned, cover crops.

Problems that cause yield loss or increased costs
Soil compaction and low organic matter affect rooting capacity, nutrient uptake and soil moisture, as well as runoff and water pollution. Blackgrass (*Alopecurus myosuroides*), often associated with waterlogged soils, causes severe competition and high herbicide costs.

3. External drivers and factors

Institutional and political drivers
CAP Greening has increased stages in crop rotation locally, but not at Loddington itself. Sustainable Use of Pesticides Directive influences pesticide use and encourages IPM. Water Framework is a major policy driver influencing soil management, fertiliser application, cropping and pesticide use.

Societal drivers
Environmental criteria such as popular interest in wildlife conservation influence production of cereals for human consumption (e.g. Conservation Grade, Kelloggs). Conservation of farmland birds and pollinating insects.

Bio-physical drivers
Prolonged heavy rainfall in 2012 affected yields over a two-year period. Increasing intensity of winter storm events, and dry summers could supress yields in future. Soil management needs to adapt accordingly.

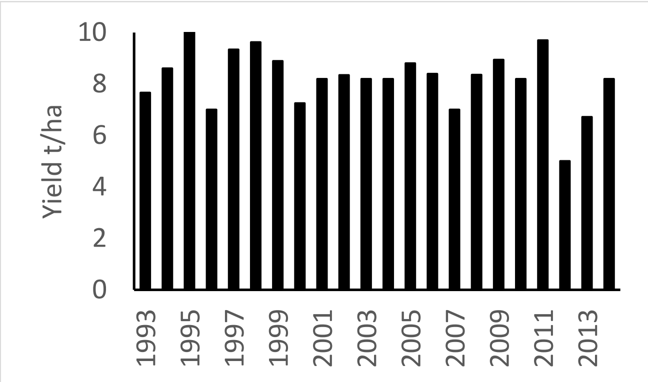


Figure 2 Yield variation in the study site from 1993-2014.

4. Multi-actor approach

Relevant end-users and stakeholders
Farmers (local and national), agronomists and land agents, National Farmers Union, Kelloggs, BASF, Syngenta, Environment Agency, Natural England, Defra, water companies, Riverst Trusts, Welland Valley Partnership.

Involvement of stakeholders in study site
Our main current farmer engagement is with Kelloggs growers (approx.. 20 farm businesses), and the local farming community involved in the Welland Valley Partnership and Defra's Sustainable Intensification Platform (approx. 20 farm businesses). The Sustainable Intensification Platform provides a mechanism for disseminating research results and practical experience widely to UK government agencies as well as the farming community.

5. Past and on-going work

Past and on-going projects
The most relevant to SoilCare are:
Past
- SOWAP – Soil and Water Protection (EU)
- PARIS- Phosphorus from Agriculture: Riverine Impact Study (Defra, UK govt.)
- MOPS – Mitigation Options for Phosphorus and Sediment (soil management) (Defra, UK govt.)
- MOPS2 - Mitigation Options for Phosphorus and Sediment (constructed wetlands) (Defra, UK govt.)
- Tramline – Tramline management to reduce runoff (Defra and industrial sponsors)

Ongoing
- Water Friendly Farming – landscape scale catchment management experiment (Environment Agency)
- VALERIE – Valorising European Research for Innovation in Agriculture and Forestry (EU FP7)

Availability of long-term data

The above are mainly three-year research projects carried out over the past 12 years. Results are available. Original data are sometimes held by research partners and sometimes by ourselves. We have our own long term data (up to 22 years) for crop yields, inputs, economics, soil nutrients, water chemistry etc which are independent of externally funded research projects.

6. Key references

Stoate, C., Leake, A., Jarvis, P. & Szczur, J. (2015) *Fields forthe future: The Allerton Project – a winning blueprint for farming, wildlife and the environment*. GWCT, Fordingbridge. 36pp.

www.allerrtonresearch.blogspot.co.uk

Study Site 7: Tachenhausen, Germany.

Responsible partner: 5, University Hohenheim (UH)

1. General information

Geographical description

Tachenhausen, Germany (48°38’57” N, 09°23’04” E). The experimental site is located 360 m above sea level.

Pedo-climatic zone

Atlantic Central climate with average annual temperature of 10.2 °C and an average annual precipitation of 856 mm. The soil type is classified as Luvisol with a silty loamy texture and with the following characteristics: 1.4 mg P and 1.6 mg K kg^{-1} dry soil (extractable in calciumacetate-lactate solution) indicating sufficient phosphorous and potassium supply, pH ($CaCl_2$) 6.8 (VDLUFA, 2007).

2. Cropping systems

Cropping intensity

Conservation agriculture with the intention to improve soil fertility and resilience of the soil, to maximise economic return in the long-term

Types of crop

Maize, wheat, soybean, maize

Management of soil, water, nutrients and pests

Long-term non inversion, no irrigation, application of nutrients according to official recommendations (VDLUFA-method) and expected yield, pests according to decision support systems, such as proplant or isip, etc.

Soil improving cropping system and techniques currently used

No tillage and conservation tillage as a means to improve soil biology, rootability, aggregate stability, and to reduce erosion and run-off from the field.

Cover crops compiled of at least 5 species are sown before a following spring crop, to improve soil biology and chemistry, to control weeds and to protect the soil from erosion and water losses. The cover crops are established as soon as possible after harvest of the pre-crop and kept on the field over winter. As the species are not winter-hard, they are expected to die off over winter and to produce a mulch layer on the soil until sowing the following crop.

Problems that cause yield loss or increased costs

The yields of winter wheat and winter oilseed rape are not as high as expected at this site: 7.4 t/ha winter wheat (8.5 – 9.5 t/ha should be possible), 3.5 t/ha oilseed rape (4.0 – 4.5 t/ha should be possible). The reasons are not fully understood. Suboptimal soil structure and soil biology may be one of the reasons.

3. External drivers and factors

Institutional and political drivers

Since 2015 Common Agriculture Policy (CAP) requires greening measurements. Additionally, national agri-environment schemes, e.G. FAKT in Baden-Württemberg, support means to improve soil fertility and the agro-ecosystem in total. These means should enable the farmers to adopt conservation agriculture more easily than in the past. Conservation Agriculture (CA) consists of soil conservation by zero-tillage, an adequate crop rotation and permanent plant cover using cover crops.

Societal drivers

The society is not aware of the problem of soil erosion and water pollution by run-off of agricultural sites. Production systems without soil tillage or very litte tillage that reduce erosion and run-off, imply a higher demand for adequate weed control, hereby making a clearance of the field necessary to count for omitted tillage. The usage of additional herbicides, in particular non-selective herbicides such as glyphosate or glufosinate is seen as most problematic by the public. Recently, glyphosate was evaluated as potentially cancerogen. So, it will be a great challenge to create non inversion or even zero-tillage systems without using non-selective herbicides. The aim of Conservation Agriculture is to control weeds by fast growing cover crops instead.

Bio-physical drivers

Conservation Agriculture has the potential to improve yields and especially to enhance yield stability under conditions of climate change. Climate change for most parts in Germany, particularly the south west, is predicted to result in increased rainfall in the winter and decreased rainfall in summer. At the same time temperatures are expected to rise and the probability of extreme weather events is assumed to increase as well. So, in the future systems are needed which can withstand heavy rainfall as well as longer drought periods. Permanent plant cover fulfils both functions. It protects the soil against erosive rainfall and it reduces unproductive evaporation during the vegetation period. Additionally, soil structure and biological activity may be enhanced due to additional C-input via plant material and root exsudates which have the potential to enhance soil life.

The content of fusarium toxins in wheat kernels 2014 is shown in Table 1. Apparently, the concentration of fusarium toxins was reduced in plots where cover crops had been grown two years before (after wheat 2012, before maize 2013). In addition, microbial biomass was increased in plots where cover crops had been grown 2012 and 2014. These preliminary results show that there may be effects that need further elucidation. Presumably, also nutrient availability will be affected by cover crops growth.

Mykotoxine Weizen	DON (ppb)	Fum (ppb)	Zea (ppb)
DSoZF	1358,0 **b**	1,8	88,5 **b**
DSmZF	771,0 **a**	2,7	31,2 **a**
MSoZF	1177,0 **ab**	0,0	80,0 **b**
MSmZF	1178,0 **ab**	0,8	63,7 **ab**

Table 1: Concentration of mycotoxins Deoxynivalenol (DON), Fumonisin (FUM) and Zearalenon (ZEA) in wheat kernels 2014 as a function of tillage regime and cover crop in 2012. DS = No Tillage, MS = non inversion tillage, o ZF = no cover crop between wheat 2012 and maize 2013. mZF = multi-species cover crop in summer 2012 after harvest of winter wheat. In 2013 maize was grown, in 2014 winter wheat followed. Different letters indicate significant differences at $p <= 0.05$ (Tukey Kramer). For FUM no statistical test was possible.

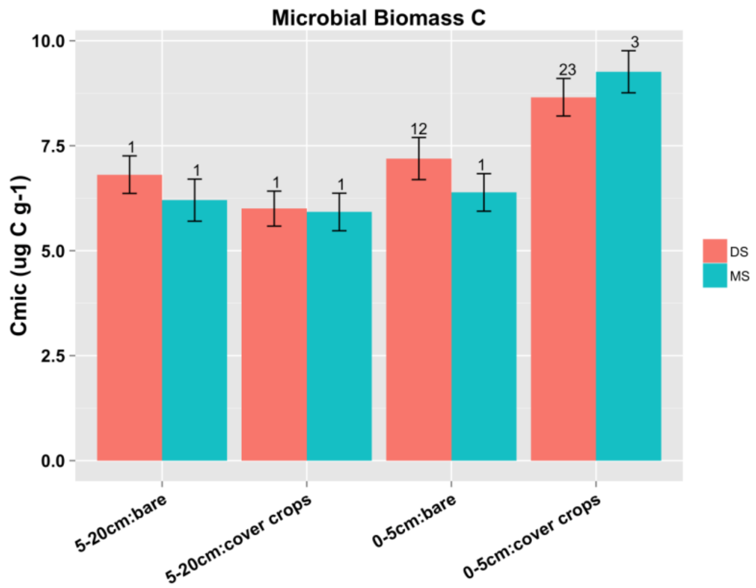


Fig. 1: Microbial biomass as a function of tillage and cover crop in spring 2015.

4. Multi-actor approach

Relevant end-users and stakeholders

Within the project of “Conservation Agriculture” in Baden-Württemberg stake-holders are farmers, extension personal, and the state institute for agronomic research and transfer which is a good link between pure science and application. The Agricultural Ministry of Baden-Württemberg being the funding institution, with a strong involvement of the Ministry for Environmental Care, it can be expected that results from the project will develop into agri-environment schemes or general recommendations of management in German farms.

Involvement stakeholders in study site

The farmers are involved in SOILCARE via the project “Conservation Agriculture with minimal tillage, including strip tillage and improved cover cropping to reduce run-off of phosphate and pesticides in water courses and to reduce nitrate leaching into groundwater.

5. Past and on-going work

Past and on-going projects

In the State of Baden-Württemberg there are several field experiments spread which address the question of Conservation Agriculture with special focus on cover crop effects interacting with the tillage regime. In the past a large number of tillage experiments have been carried out at many sites, under conditions of practical farming as well as on experimental farms, such as Ihinger Hof or Meiereihof.

Availability of long-term data

The above described experiment at Tachenhausen was planned with a focus of 10 years at least. It started in summer 2012 and therefore should be managed according to the experimental plan until 2022. Apart from this experiment further experiments have been established in Baden-Württemberg. These will be financed until 2018, hopefully longer.

6. Key references

The key references provide information about the importance of microbiological quality indicators for management of agro-ecosystems:

Kandeler E., Tscherko D. and Spiegel H. (1999) Long-term monitoring of microbial biomass, N-mineralisation and enzyme activities of a Chernozem under different tillage management. Biology and Fertility of Soils 28, 343-351.

Marschner P., Kandeler E., Marschner B. (2003) Structure and function of the soil microbial community in a long-term fertilizer experiment. Soil Biology and Biochemistry 35, 453-461.

Kirchmann H., Haberhauer G., Kandeler E., Sessitsch A., Gerzabek M.H. (2004) Level and quality of organic matter input regulates biogeochemistry of soils – Synthesis of a long-term agricultural field study. Global Biogeochemical Cycles 18, 1-9.

Tscherko D., Kandeler E., and Bárdossy A. (2007) Fuzzy classification of soil microbial biomass and enzyme activity in grassland soils. Soil Biology and Biochemistry 39, 1799-1808.

Lagomarsino A., Grego S., Marhan S., Moscatelli M.C., Kandeler E. (2009) Soil management modifies micro-scale abundance and function of soil microorganisms in a Mediterranean ecosystem. European Journal of Soil Science 60, 2-12.

Giacometti C., Demyan M.S., Cavani L., Marzadori C., Ciavatta C., Kandeler E. (2013) Chemical and microbiological soil quality indicators and their potential to differentiate fertilization regimes in temperate agroecosystems. Applied Soil Ecology 64, 32–48.

STUDY SITE 8: Draganesti Vlasca, Teleorman County, Romania
Responsible partner: 18, ICPA Bucuresti

1. General information

Geographical description

Location: The study site no. 8 is located in the arable land of Draganesti Vlasca commune. Draganesti Vlasca is located within Burnas Plain in the eastern part of Teleorman county. (photos below).

__Size__ Three villages take part of the commune: Draganesti Vlasca, Comoara and Vaceni. **Draganesti Vlasca has an territorial administrative area of 10324 ha. The commune has 4852 citizens.**

__Elevation__ The territory of Draganesti Vlasca is covered by plain with an altitude ranging between 85-95 m. The plain is fragmented by different valleys (Valea Alba, Valea Comoarei, Valea Valcenilor, Valea Hotoaicii and Valea Dumitranii), which are seasonally flooded.

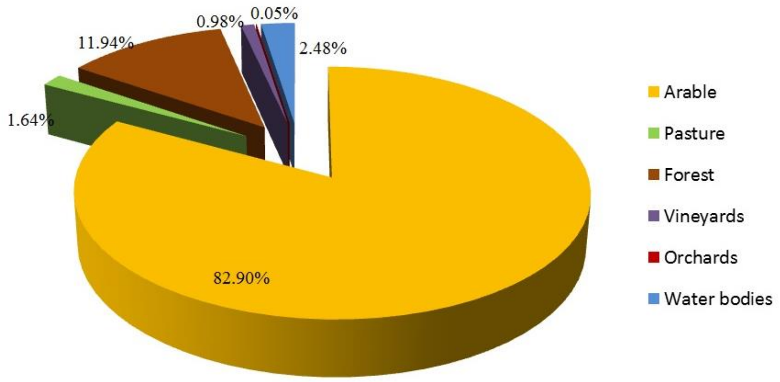
__Climate__ In the study area the climate is temperate continental. The yearly average air temperature is 10,6°C, the values ranging between – 3,5°C in January and 22,7°C in July, meaning that the winters are mild and summers are cool. The droughty periods are in August and October prolonging even in November, affecting negatively the autumn crops.

__Soils__ The dominant soil in Draganesti Vlasca is phaeozem in different degradation stages, having a low fertility and in some areas with risk of erosion occurence.

__Geology__ In the upper part, there is a reddish brown silty clay layer, which stands on a loess layer of 7-8 m thickness.

__Hydrology__ There are three rivers passing the commune: Calnistea, Valea Alba and Suhat. The total area of surface water bodies is 246 ha. The ground table level ranges between 1 – 4 m in the flood plain area and between 20 – 30 m in the plain area.

__Land use types__: The main agricultural activities practiced in the area are related to crop and livestock production. The areas under different land use types are the following: arable – 8220 ha, pastures – 163 ha, forest – 1184 ha, vineyards – 97 ha, orchards – 5 ha, surface water bodies – 246 ha. In the graph below percentage of areas under different land use types from the total administrative area of commune are presented. The main crops cultivated on arable land are: wheat, maize, sun-flower.



Pedo-climatic zone
The study area is located in Panonnian pedo-climatic zone. The area is covered by a Phaeozem.

2. Cropping systems

Cropping intensity
Conventional and conservation agricultural systems are mainly used in the study area.

Figure 1: impressions of the study site.

Types of crop
The common crop rotation used in the study area is: wheat, maize, sunflower.

Management of soil, water, nutrients and pests
The conventional agricultural system was used for a long time in the study area. In the last years, improved technologies were implemented such as: reduced tillage without mouldboard ploughing and seedbed preparation with heavy machinery; conservative tillage without mouldboard ploughing, seedbed preparation and sowing done in one pass, the soil being covered more than 30 % with plant residues from previous crop. The nutrient status is maintained by applying, for example in case of wheat, of complex NPK 300 kg/ha during the growing period. Pesticides are used for combating pests, in case of wheat, 2 kg/ha.

Soil improving cropping system and techniques currently used
Reduced soil tillage is applied by using of heavy machinery. In the crop rotation, in the study area, crops with deep rooting system are included. Irrigation system is presented also. Mineral fertilisation is applied in different doses according to the crop requirements. The soil presents an intrinsic compaction, which may be improved by deep loosening.

Problems that cause yield loss or increased costs
Water deficit in periods of drought may be a major cause of yield loss. Water excess in the wet periods also may affect negatively the yield. Within the soil profile there are compacted layers which affect the root development. The soil in the study area has a high clay content which lead to occurrence of compacted layers.

3. External drivers and factors

Institutional and political drivers

European Nitrate Directive is transposed in Romanian legislation by Water Frame Law. Every four years, starting with 2005, vulnerable areas to nitrate pollution from agricultural sources are designated and action plans are accomplished in order to monitor and protect the surface and ground water bodies. Codes of Good Agricultural Practices for farmer use are accomplished/revised. Action Programs which include concrete measures for implementing the Codes are accomplished. Currently one Action Program is applied at national level, because all water resources are discharged in Black Sea which is affected by eutrophication.

In order to implement EU Directive 2009/28/CE at county (NUTS 3) level greenhouse gas emissions and energy consumption on the entire chain of biofuel and bioliquid production were evaluated.

Societal drivers

More than 80 % of farming systems are of small and medium size, with less than 8 and 8-100 animal unit respectively. The choice of farm type (vegetal, animal or both) depends on the financial capacity of the farmers. The farmers may apply for subsidies within agricultural commune policies, having the obligation to fulfil minimum requirements related to environmental protection, as well as maintaining of land in good agricultural and environmental conditions (cross compliance rules).

Bio-physical drivers

The effects of climate changes are reflected in weather variables (air temperature and precipitation), which have a major impact on crop growing and yields. In this context, the climate changes determined the occurrence of frequent drought and temporary water excess on large agricultural areas, the most vulnerable being in the south part of the country. Measures for climate change adaptation includes: optimising the growing period of agricultural crops, selection of genotypes resistant to extreme temperatures, water deficit/excess.

4. Multi-actor approach

Relevant end-users and stakeholders

Relevant local stakeholders who may be included in the project research are:

- Agricultural Research and Development Station Teleorman – SCDA Teleorman
- Farmers
- Local authorities
- Local advisory services

Involvement stakeholders in study site

The study area is included in the agricultural land belonging to SCDA Teleorman. Workshops for dissemination of project results will be organised at local level. Farmers, local stakeholders, local advisories will be invited.

5. Past and on-going work

Past and on-going projects

Past research:

- Research project: Components of agricultural technology systems for soil and water conservation coordinated by ICPA Bucuresti.
- Research project: Soil degradation processes in intensive and extensive agriculture: risk, and vulnerability, evaluation, measures for prevention and improvement – case study in specific areas.

Availability of long-term data

10 years: different tillage systems.

STUDY SITE 9: Legnaro, Padova, Italy
Responsible partner: 19, UNIPD

1. General information

Geographical description
Location: Legnaro, Padova, Italy (Exp. 1: 45° 20' 52" N, 11° 57' 17" E, Exp. 2: 45° 21' 04" N, 11° 56' 51" E), 5 m a.s.l., Fluvi-Calcaric Cambisol (CMcf).
The study area is located in the low venetian plain and is characterized by sedimentary loamy soils with shallow groundwater (<2 m). The local climate is sub-humid, with annual rainfall of about 850 mm. Temperatures increase from January (minimum average: 1.5 °C) to July (maximum average: 27.2 °C). SOM content is strongly affected by the peculiar texture (low physical protection) and climatic conditions, and usually ranges from 10 to 20 g kg-1 in the top layer.

Pedo-climatic zone
Mediterranean North, Cambisol

Figure1: Localization of the case study in NE Italy


Figure 2: Overview of part of the long-term experiment (50-yrs old).

2. Cropping systems

Cropping intensity: Conventional.

Types of crop
Exp. 1: wheat, maize, soybean, sugarbeet, alfalfa, permanent meadow, 7 crop rotations: six-years (maize, sugarbeet, maize, wheat, alfalfa, alfalfa), four year (sugarbeet,soybean, wheat, maize), two years (wheat, maize), continuous maize, continuous wheat, continuous silage maize, permanent meadow
Exp. 2: wheat, maize, tomato, sugarbeet, four-year rotation

Management of soil, water, nutrients and pests
Exp. 1: Moldboard ploughing in autumn; due to the shallow water table (ranging from 60 to 200 mm) irrigation is used occasionally; nutrient status is regulated through organic (cattle slurries or farmyard manure) and mineral inputs + introduction of soybean and alfalfa in 4-year and 6-year rotation respectively; chemical weed and pest control.
Exp. 2: Moldboard ploughing in autumn; due to the shallow water table (ranging from 60 to 200 mm) irrigation is used occasionally; nutrient status is regulated through organic (residue incorporation or residue incorporation + poultry manure) and mineral inputs; chemical weed and pest control.

Soil improving cropping system and techniques currently used
Rotation, organic fertilisers (different types and amounts)

Problems that cause yield loss or increased costs

The main threat considered is the loss of organic matter (SOM) in mineral soils. It causes both GHG emissions and a worsening of soil functions (e.g. soil nutrient supply, hydraulic properties), pushing farmers to rely on external chemical input. In the last fifty years, SOM in NE Italy decreased at rates ranging from 0.02 to 0.58 t C/ha/year as a consequence of the intensification and simplification of cropping systems (e.g. monoculture) and the uncoupling of crop and livestock production. Most recently, the removal of crop residue for bioenergy production raises concern about its potential impact on SOM evolution. Application of EU conditionality measures (i.e. mandatory crop rotations) has had only a marginal effect on SOM recovery while other voluntary measures supported by the Regional Government (e.g. input of organic amendant, no-tillage) showed low acceptance by the farmers. Indeed, implementation of measures has been hindered by a) technical, logistic and economic constraints (e.g. distance between amendant source and potential users); b) farmer's cultural diffidence; c) uncertainties of their bio-physical effectiveness, due to a large variability in pedo-climatic conditions which strongly affect the interaction between organic input and C cycle.

3. External drivers and factors

Institutional and political drivers

The area is included in the Vulnerable Zone of Veneto Region for the Nitrate Directive. Veneto Region has recently implemented a specific agro-environmental measure to increase SOM content through amendant input and conservative tillage. However these measures showed low acceptance.

Societal drivers

The agricultural system of Veneto region is struggled by different external factors. A first constraint is a strong competition for land by industrial and urbanisation, leading to a prevalence of highly fragmented and small farms with a relatively low technological level. This reduces the competitiveness, in particular considering the dynamic of product prices in the last years, and frequently pushes toward a simplification of cropping systems.

Bio-physical drivers

In the last years the increase of inter-annual variability of climatic variability is becoming an important constraint for the main summer crops; this is partially mitigated in maize anticipating sowings from mid-april to the end of March, thus allowing an earlier flowering, before droughts normally occurring in July. Frequent summer droughts tends to increase pest incidence, particularly for micotoxins-producing fungi.

4. Multi-actor approach

Relevant end-users and stakeholders

- Italian Ministry of Agriculture
- Veneto Region: Veneto Agricoltura (Regional extension service)
  Assessorato all'Agricoltura della Regione Veneto
  Agenzia Regionale per la Prevenzione e Protezione Ambientale del Veneto
- Farmer's associations: Confagricoltura Veneto
  Coldiretti Veneto
  Confederazione Italiana Agricoltura

Involvement stakeholders in study site

In the first phase of the project, a stakeholder platform will be established with farmer associations, extension service and policy makers. Preliminary meetings will be organized to identify optimal strategies to restore soil functions. The results obtained in the study sites and potential constrains will be analyzed in periodical meetings and field days organized in cooperation with other WPs.

A dedicated web platform will be built to share information among stakeholders with a blog to discuss demonstration and monitoring relevancies and to have a continuous feedback.

5. Past and on-going work

Past and on-going projects

Two long-term experiments started from 1962 to 1966, with different rotation, soils and fertilization inputs.

Availability of long-term data

Exp. 1: started in 1962 – ongoing. Split-plot experimental layout; 3 randomized blocks; plots area 46,8 m^2 (m 7.8 x 6) for a total of 288 plots

- 7 crop rotations: six-years (maize, sugarbeet, maize, wheat, alfalfa, alfalfa), four year (sugarbeet,soybean, wheat, maize), two years (wheat, maize), continuous maize, continuous wheat, continuous silage maize, permanent meadow;
- 2 types of organic fertilisation: crop residue incorporation or crop residue incorporation + 40 t ha^{-1} $year^{-1}$ cattle slurry (monocultures, two-year and four-year rotations); 20 t ha^{-1} $year^{-1}$ farmyard manure or crop residue incorporation + 40 t ha^{-1} $year^{-1}$ cattle slurry (six-year rotation only);
- 3 levels of mineral fertilization: 0, 70 N + 70 P_2O_5 + 90 K_2O, 140 N + 140 P_2O_5 + 180 K_2O (no N distribution in leguminous crops)
- 8 further continuous maize treatments:

Fertilization	Residue incorporation	Residue removal
Unfertilised	-	-
Organic	120 t ha^{-1} cattle slurry	60 t ha^{-1} FMY
Mineral	NPK 300-150-420	NPK 300-150420
Mixed	½ Org.+½ Min	½ Org.+½ Min

Exp. 2: started in 1966 – ongoing; 35 m^2 plots in a silty loam soil. The experimental treatments derive from the factorial combination of 3 management methods of crop residues (burial of the previous crop residues, burial with the addition of 1 t ha-1 of chicken manure, removal of the residues) with 5 levels of nitrogen fertilisation (0, 60, 120, 180, 240 kg ha^{-1}). All treatment have been given the same amounts of P (150 kg ha^{-1} of P_2O_5) and K (150 kg ha^{-1} of K_2O) by mineral fertilisers. There is also an unfertilised control. Prior to 1984, the trial was conducted with maize monoculture, following this an open rotation was adopted, similar to that in the previous trial. The trial design is a partial split-plot with 4 replications, the management of the residues on the plots and the other fertilisation treatments being randomised.

For both experiment all the yield and biomass data are available plus sets of soil analyses (SOC, nutrient content etc.)

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Study Site 10: Szaniawy, Poland.
Responsible partner: 20 – Institute of Agrophysics, Polish Academy of Sciences (IA) Lublin, Poland

1. General information

Geographical description

Location, size, elevation, climate, soils, land use types, geology.

The site Szaniawy (N 51° 59' 24", E 22° 33' 37") of area about 30 km^2) is located in region Podlasie (county Łuków). Main type of land use include agricultural lands (80.5%) and forests/shrubs (13.5%) (Figure 1). Elevation is approximately 160 m. The topography is mostly flat (Figure 2), with little variation in absolute altitudes (less than 20 m). The climate is continental with high temperatures during summer and long and frosty winters. The average annual air temperature is 7.3 °C. Long-term annual total precipitation is 536 mm and the vegetation period last 200 to 210 days. Rainfalls are substantially higher during summer (212 mm) than winter (83 mm). The highest rainfall occurs in June and July (over 70 mm) and the lowest in January, February, and March (less than 30 mm). The soils were derived from loose sands, loamy sands, and loams. On average they contain 13% of clay and <1% of organic matter and are acidic or neutral (average pH 4.3 in KCl and 4.8 in H_2O) (Usowicz et al., 2004). The average value of the cation exchange capacity is 10 cmol kg^{-1}.

Figure 1. General view of Szaniawy study site.


Figure 2. Area surrounding study site.

Pedo-climatic zone
Continental, sandy and loamy soils

2. Cropping systems

Cropping intensity
Traditionally conventional farming system is mostly used. Organic farming, conservation tillage and precision agriculture are scarcely used.

Types of crop
The most frequent crops in crop rotation are cereals (60%), maize (35%), potatoes and others (5%). Choice of crops by small farmers who dominate in the region is profit driven.

Management of soil, water, nutrients and pests
Conventional tillage is the main type of tillage with percentage higher than 90%. The implementation of reduced tillage out of total arable land is several percents. This figure for zero tillage is approximately 1 percent (Sánchez et al., 2013). Mineral fertilizers and animal manures or farmyard manure are used to maintain/improve nutrient status. Methods used to combat pests include, mechanical controls such as trapping or weeding or selective spraying of pesticides with consideration the cost of different control options. Rain-fed crop production is most common.

Soil improving cropping system and techniques currently used
1. Main soil improving measures include: the use of legume crops in crop rotation, cover or intermediate crops (e.g. peas, vetch, lupin, rape, serradella), mulching, liming, organic fertilizers and mineral fertilizers. They are particularly useful on dominant sandy soils, but not used extensively.
2. Forestation of poor and coarse textured soils is going on.
3. Conversion of arable land into grasslands in wet and undrained areas.

Problems that cause yield loss or increased costs
Majority of land in Poland has a crop yield ratio (actual over potential) between 40-55% (Królczyk et al., 2014). Based on edapho-climatic conditions the potential yield is estimated to be 8 Mg ha^{-1} for wheat and 4 Mg ha^{-1} for rapeseed. Main causes of the relatively low yields include poor natural farming conditions due to prevalence of light, sand-derived soils (60%). These soils are acidic and very acidic (pH <5.5) due to post glacial and strongly acidified deposits and insufficient liming. About 55% of arable soils show content of soil organic matter (SOM) in the range below 1%-2.0% and only 3% of the soils show the SOM above 3%. The intensification of soil use combined with the simplified crop rotation and predominance of cereals in crop rotation (about 60-70%) together with an expansion of farming systems based on crop production with a reduced number of livestock or without animals intensifies the process of organic matter degradation (Rutkowska and Pikuła, 2013). In such farms the main source of soil organic matter is fertilization with ploughed straw. Another environmental problem is water deficit during growing season (especially on sandy soils) in predominantly rain-fed crops.
Other causes of the low yields include insufficient implementation of the most advanced agricultural technologies, the use of poor quality of seeds (not certified) for planting and inadequate use of legume crops (1% in cropped area) to improve soil structure and increase biological N fixation and thus reduce fertilizer needs. Moreover, unfavourable economic situation, especially of small farms limits the prospects for investing. This information indicates that the study site and other areas in Poland have a high potential to sustainable increase of crop yields and productivity.

3. External drivers and factors

Institutional and political drivers
1. Legislation on subsidizing cultivation of beneficial legume crops by the Ministry of Agriculture and Rural Development in Poland.
2. Act on renewable energy sources (20 February 2015) defining between others conditions for using plant biomass for energy production.
3. Strategy of sustainable rural development, agriculture and fisheries for 2012-2020. (25 April 2012)
4. defining main actions for development of rural areas including increase the productivity and competitiveness of the agri-food sector and environmental protection and adaptation to climate change.

Societal drivers

Choice of cropping system towards sustainable increasing crop yields and productivity can receive strong public support. This can be due to that greater crop productivity can be a scheme to mitigate competitiveness of land use for energy crops and to maintain the increased demands for land under the protection of biodiversity ('greening') (Królczyk et al., 2014). Another societal driver associated with improving crop productivity yield in a sustainable manner will be an opportunity for farmers to get better knowledge and capacity for accessing innovative agricultural management practices.

Bio-physical drivers

Unfavourable rainfall's distribution and increasing frequency of the risks including excessively dry and hot or excessively wet periods during growing seasons are observed (Lipiec et al., 2013). Comprehensive understanding the complexity of the crop and soil responses and adaptive changes in response to drought and heat stresses will enable farmers to make relevant choices to mitigate the adverse effects. Also rainfall associated with hurricanes and storms cause significant flooding and damage in agriculture.

4. Multi-actor approach

Relevant end-users and stakeholders

1. Farmer Marek LASOCKI, 21-040 Trzebieszów 110, County Łuków, Poland,
2. Commune (govermental branch) of Trzebieszów, County Łuków, Poland
3. Commune (govermental branch) of Mielnik (17-307 Mielnik, County Siemiatycze), Poland.
4. The Agricultural School in Czartajew, 17-300 Siemiatycze, Poland

Involvement stakeholders in study site

Multiple stakeholders as listed above will be involved in the validation and demonstration of the innovative soil-improving cropping systems. With the collaboration with individual farmers, local staff of government and agricultural school, most beneficial management practices will be identified and applied in agriculture. In addition to the agricultural aspect, several SMEs around the study site are engaged in the production of poultry farms, mushrooms and mill and sawmill services. The SMEs may also use new soil- improving cropping systems for more rational use of their waste organic matter to improve soil structure and biodiversity and reduce soil contamination and erosion. Adding this aspect for cooperation with the funded SFS-2B projects will be relevant."

5. Past and on-going work

Past and on-going projects

Since several years Time (or Frequency) Domain Reflectometry soil water content, soil temperature, meteorological parameters (air temperature, speed of wind, humidity), net radiation balance, Photosynthetic Photon Flux Density (PPFD), rainfalls and pan evaporation are monitored in the frame of two projects: European Space Agency Programme for European Cooperating States (PECS), No.98084 „SWEX-R, Soil Water and Energy Exchange/Research", AO3275 and No. 4000107897/13/NL/KML „ELBARA_PD (Penetration Depth)", AO 1-7021. Recently effect of biochar on soil organic matter content and water holding capacity is tested.

Availability of long-term data

We have data on soil texture, SOC, pH, cation exchange capacity, electric conductivity, thermal properties, particle density and bulk density. Meteorological data are available for years 1964-1980 and 2007-present. In the latter period automatic weather station for recording air temperature, speed of wind, air humidity at 0.5, 1, 2 ,3 and 5 m above ground level), net radiation balance, Photosynthetic Photon Flux Density (PPFD), rainfalls, pan evaporation are used. Moreover, monitoring of soil water content (FDR sensors) and temperature (thermocouples) at 2, 5,10, 20, 30, 40, 60 and 100 cm depths is going on.

6. Key references

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STUDY SITE 11: Caldeirão, Bico da Barca/Quinta do Canal, Portugal

Responsible partner: 17, ESAC

1. General information

Geographical description

The two study areas are located in the Mondego lower valley, an alluvium plane area located between Coimbra at the east and the sea to the west. Rainfall is around 1000mm.yr-1, Wet Mediterranean climate, with dry summers, the soils are alluvial soils built on naturally during historical times (due to the floods of the Mondego River. The entire valley is between 0 and 25 meters above sea level. The east part is mainly used for corn, while the west, closer to the river mouth is used mainly for rice.

Pedo-climatic zone

Lusitanean, silty-clayey soils

2. Cropping systems

Cropping intensity

Maize: We will make a comparison between the conventional and the organic cropping systems, and will study the demands of the new Common Agriculture Policy in terms of crop rotation. Use of conventional varieties.

Rice: We will study mainly the conventional and organic cropping systems, and the potential for other land uses. A special attention will be given to the reduction of the flooded time period. Dry seeding is another potential technique to reduce the environmental impacts.
There is a process of transferring the rice fields to maize fields, due to the environmental impacts of

Vineyards: The vineyards will be studied in what concerns the management of the grass in-between the plant orchards. This includes a non-tillage conservative approach and the traditional tillage to include the grasses and pruning materials within the soil.

Types of crop

Crops: Maize, Rice and Vineyards
Maize: first year with Maize second year with potatoes and 2 years of Lucerne *Medicago sativa* L. at the end. In the winter we can have a cover-crop *Lupinus luteos* or turnips or oats, that then is included in the soil.
Rice: first year with rice second year with maize and 2 years of Lucerne *Medicago sativa* L. at the end. No winter cover-crops are used, the fields are flooded. We will study the introduction of a cover-crop for environmental reasons

Vineyards are a permanent culture. For this reason, different management options will be addressed, namely in what concerns the use (or not) of tillage, and the incorporation of different organic matter amounts in the soil to assess soil quality

Management of soil, water, nutrients and pests

Maize: Chisel tillage in the conventional system, for the organic before the chisel ploughing the soil is tilled with a disc harrow. Irrigation is delivered with a pivot. In the conventional low release fertilizers will be used, in the organic we will use compost fertilizers produced at ESAC. ESAC uses the standard pesticides authorized for the conventional and organic farming.

Rice: mouldboard plough for both conventional and organic systems, a seed bed preparation is performed with a rotary harrow. Irrigation is by flooding. Conventional fertilization for the conventional system, and approved products are used in the organic. The rotation with Lucerne implies that the fertilization is not needed in the first year after the rotation. Herbicides are used in the conventional whereas in the organic a manual weeding is performed.

Vineyards: in the conventional system, soil is tilled with a disk harrow, while in the organic system, grasses are allowed to colonise the space between the vineyard lines. In addition, there is a reduction of the pesticides used in the organic system and a more judicious use of fertilizers (that in some cases are organic compost fertilizers).

The conventional systems in Portugal are considered sustainable agriculture.

Soil improving cropping system and techniques currently used
The foreseen improvements are threefold:

- Implementation of more organic systems, including the use of compost and reduction of synthetic fertilizers and pesticides.
- The implementation of rotation, which is in line with the new common agriculture policy requirements, so to some extent SOILCARE will address the impacts of the novel CAP policies.
- Optimization of irrigation, also in line with the new policy framework on water that will increase the price of water.

Problems that cause yield loss or increased costs
SOILCARE will be used assess the new policies and tendencies that are undergoing or will shortly be implemented in Portugal, namely a shift from traditional to organic systems, the introduction of rotation, which will be pushed by the novel CAP, and the increase in the price of water, that will require a more judicious use.

3. External drivers and factors

Institutional and political drivers
As previously stated, part of the SOILCARE effort made by the Portuguese (ESAC) team will be a consequence of the implementation of the forthcoming new priorities set by the Common Agriculture Policy. In addition, the new reading made of water framework directive will imply an increase of the water price for agriculture.

Societal drivers
There is an ongoing tendency to shift from the traditional to the organic systems which is pushed by a younger and urban population fringe. This implies that the organic farming systems are gaining territory.

Bio-physical drivers
Being under a wet Mediterranean type of climate, the Portuguese study areas are affected by water shortages that occur during the vegetative growth season. The absence of proper irrigation systems and the proper water amounts for irrigation have an overwhelming effect on crop productivity.

4. Multi-actor approach

Relevant end-users and stakeholders
The Regional Agriculture Agency
The Regional Environment Agency
The Farmers Associations and the farmers individually.

Involvement stakeholders in study site
The Regional Agriculture Agency will be involved in the project, providing some of the rice fields, along with a farmers association in the lower Mondego Valley, that will be actively involved in the proposal and will provide agriculture fields if necessary, especially in the rice crop area.

5. Past and on-going work

Past and on-going projects
Nothing structured. The Corn part has been subject to a FP7 project – SOLIBAM - Strategies for Organic and Low-input Integrated Breeding.

Availability of long-term data
Soil samples and analysis of fertilizers are available at least one in every couple of years since the 1990 decade.

STUDY SITE 12: Chania, Crete, Greece

Responsible partner: 7, Technical University of Crete (TUC)

1. General information

Geographical description

Crete is the largest of the Greek islands (Figure 1), and the 5th largest in the Mediterranean, with a total area of 8,265 km^2. While retaining its own local cultural traits, the island shapes a significant part of the cultural heritage of Greece, but also contributes 5% of the national Gross Domestic Product (GDP), with agriculture and tourism as its main industries.

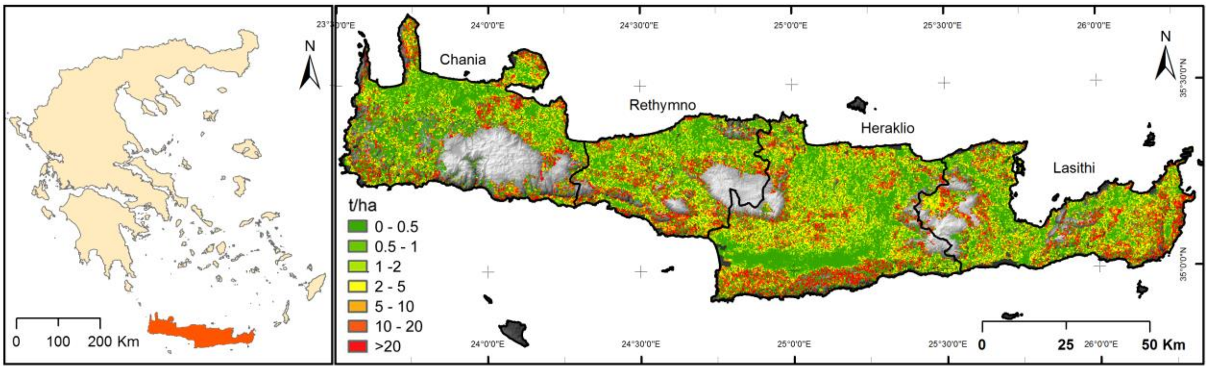

Figure 1: Spatial distribution of soil erosion (source: Panagos et al., 2014) on the Island of Crete.

Pedo-climatic zone

Crete's climate is classified as dry sub-humid (Csa according to Köppen and Geiger, Mediterranean South). About 53% of the annual precipitation occurs in the winter, 23% during autumn, 20% during spring while there is negligible rainfall during summer (Koutroulis and Tsanis, 2010). Annual rainfall ranges from 300 to 700 mm from east to west in the low areas along the coast, and from 700 to 1000 mm in the plains of the mainland, while in the mountainous areas it reaches up to 2000 mm. The annual water balance breaks down to 68-76% evapotranspiration, 14-17% infiltration and 10-15% runoff. Soils are mainly Calcisol.

2. Cropping systems

Cropping intensity

Almost 40% of the island is cultivated at various intensities depending on desired end product quality and intended market: e.g. olive trees can be non-irrigated (traditional/household use) or irrigated (modern/intense), vineyards may be conventional or organic, etc.

Types of crop

Agriculture is an important source of income, contributing to Crete's GDP by 13%. Olive is the most important crop, cultivated on all soils and terrain slopes up to altitudes of about 900 m. Specifically for Chania, agricultural land is divided in 5 main crop categories: grapes 3%, trees 90% (olive trees 70%, other trees 20%), vegetables 2%, and other crops 5%.

Management of soil, water, nutrients and pests

Irrigation types on the island vary depending on crops and local water availability (e.g. olive trees are either regularly irrigated or not irrigated at all, orange groves are often waterlogged and vineyards are often drip irrigated). Fertilisation also varies (chemicals vs animal manure). Due to high ownership fragmentation and rough topography, management is seldom large scale, and crop picking is almost always traditional and labour intensive using minimal mechanical equipment.

Soil improving cropping system and techniques currently used

Several technologies, mainly associated with cropping intensity and traditional versus moderns techniques, are currently practices in the island. For example, olive trees are cultivated with little or no irrigation and minimum agricultural inputs, minimised tillage and minimised removal of rocks from the fields. Also, vineyards focused on producing quality winemaking grapes practice green manuring, green strips and minimised tillage with lightweight machinery.

Problems that cause yield loss or increased costs

Crete represents Mediterranean soils under imminent threat of desertification, characterized by loss of vegetation, water erosion, and subsequently loss of soil. Several large scale studies have estimated average soil erosion in the island between 6 and 8 t ha^{-1} y^{-1} but more localised investigations assess soil losses one order of magnitude higher (Panagos et al., 2014). Olive orchards and vineyards often suffer from extreme soil erosion by water due to farm slope and recent intensification of till practices. Depending on practices, tilling and irrigation can increase soil erosion, but the potential net yield of a non-irrigated olive field can drop by about 30%. Nevertheless, irrigated trees are less resilient to water stress due to shallow root depth. The long-term impact of soil erosion on farm yield due to the loss of soil profile can be detrimental. During the project, soil erosion estimates will be validated and innovative techniques will be assessed for their potential to improve soil quality and mitigate erosion.

3. External drivers and factors

Institutional and political drivers

By joining the European Economic Community in 1981, Greek agriculture became subject to the Common Agricultural Policy (CAP). Until 1992, the aim of the CAP was to increase production, and to provide cheap rural products accompanied by reasonable rural incomes. Accordingly, agricultural production was intensified and mechanized, unique endogenous varieties were replaced by hybrids aimed for the needs of globalized markets, and the adoption of monocultures led to some extent to the loss of self-sufficiency. In addition, regional development, infrastructure, spatial planning policies and the implementation of Integrated Mediterranean Programmes constitute the factors that have considerably affected the exploitation of natural resources (Daliakopoulos and Tsanis, 2014).

Societal drivers

The rapid development of Crete in the last 30 years has exerted strong pressures on many financial sectors in the region. Urbanization and growth of agriculture, tourism and industry had strong impact on the water resources of the island by substantially increasing water demand. Total water uses in the region in 2000 amounted to 420 million m^3, approximately 5.5% of the precipitation of a normal year (Fasoulas et al., 2002). Of this, 16% is used for domestic, tourist, and industrial uses, 3% for livestock and a vast 81% for irrigated agriculture on approximately 30% of the total cultivated land, using mainly ground water in drip irrigation methods. Irrigation and tourism create peak demands resulting in a marked seasonal pattern in water demand with an annual volume of water abstracted exceeding 50% of the average annual runoff and 35% of the groundwater potential. Regarding future water demands, recent estimates (Koutroulis et al., 2015) forecast total uses for the year 2015 in the order of 550 m^3/y. It is therefore considered essential to encounter the increasingly severe water problems faced in the Island only by strategic policies using integrated water management.

Bio-physical drivers

The state of the art on climate change research for the Mediterranean region indicates a strong susceptibility to change in hydrological regimes. During the last decade, the island of Crete has faced an increased number of floods and droughts. While future regional precipitation patterns are uncertain, a mean temperature increase of 3.4^{o}C is projected over the next century in the northern Mediterranean (Daliakopoulos and Tsanis, 2014). This warming trend and the resulting drought episodes will potentially force Crete to exceed ecological thresholds of water and vegetation stress that can be potentially mitigated with the use of more resilient and sustainable agricultural practices. Also, the analysis of climate models data indicates that today's extreme events will intensify, i.e., precipitation on average is likely to be less frequent but more intense and droughts are likely to become more frequent and severe in some regions (Koutroulis et al., 2015), thus leading to greater erosion events.

4. Multi-actor approach

Relevant end-users and stakeholders

Relevant stakeholders encompass a wide range of groups, from farmers, farmer's unions of various scales and priorities, agricultural consultants, SMEs that deal with processing and distribution of agricultural products, as well as regional and national authorities concerned with water resources, agricultural and environmental policy.

Indicatively, stakeholders include: several farmers, 2 wineries, a winery union, and the Directorate of Water of Decentralized Administration of Crete.

Involvement stakeholders in study site

Stakeholders will be kept updated about the progress of the initiative, and when possible, become actively involved or closely linked to this project, for instance either as affiliated partners, a member of the scientific advisory board, or as a representative of the stakeholder and end-user board. Stakeholders will participate in all phases of the project, from measure selection, testing and evaluation towards adaptation, as well as disseminated of relevant project results. A number of typical farms will be used for retrieval of cost and yield data, soil sampling, and assessment of measures.

5. Past and on-going work

Past and on-going projects

- **RECARE:** Preventing and Remediating degradation of soils in Europe through Land Care. Collaborative Large Integrated Project (2013-2018)
- **SoilTrEC:** Soil Transformations in European Catchments. FP 7 Collaborative Project (Grant Agreement No. 244118)
- **CASCADE:** CAtastrophic Shifts in drylands: how CAn we prevent ecosystem DEgradation? Collaborative Project/ Large Scale Integrated Project FP7-ENV-2011 (2011-2015).
- **ECLISE**: Enabling CLimate Information Services for Europe - Programme "Environment" FP7-ENV-2010.1.1.4-1. Underpinning work to enable provision of local scale climate information.
- **WATCH:** WATer & global CHange (Integrated Project) FP6 – Global Change and Ecosystems Priority – 4th Call Paragraph II.1.1 Global Water Cycle, Water Resources and Droughts).
- **SCENES:** Water Scenarios for Europe and for Neighboring States (Integrated Project), Sub-Priority 6.3 – Global Change and Ecosystems. (2006 - 2011)
- **CRINNO**, Regional Program of Innovative Action for Crete, "Best Water use innovative Practices towards a Sustainable Water Resources Management", European Community innovative Program.

Availability of long-term data

A recent time series from at least 4 10-min resolution precipitation gauges in Chania, as well as 20 long term monthly dataset are available to estimate rainfall erosivity, the measure of the erosive force of rain, used as in the Revised Universal Soil Loss Equation (RUSLE) as the rainfall factor (Alexakis et al., 2013). A set of 91 soil samples from the pan-European LUCAS topsoil dataset (Panagos et al., 2014) and the SoilTrEC project, from selected locations in Chania will be enriched with new measurements focused on agricultural farms and upscaled to land use level. Soil sample characteristics will be used in the soil erodibility equation of RUSLE. CORINE land cover/use data used to estimate vegetation retention parameters will also be validated on-site. Finally, agricultural inputs, yield and costs are available for various crops (olive trees, orange groves, vineyards) and locations in Chania for over 10 years. With the participation of stakeholders, this information will be used to assess the range of applied agricultural technologies. At the same time, spectral information of selected crops will be acquired and transformed to vegetation health indices (e.g. NDVI, SAVI, etc.) to assess the effect of soil health on the crop phenology at farm and regional scale. For this purpose, measurements from a field spectroradiometer will be combined with various satellite products (e.g. ESA's newly launched Sentinel 2 in the frame of Copernicus programme) and models (e.g. SEBAL).

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STUDY SITE 13: Orup, Sweden

Responsible partner: 23, SLU

1. General information

Geographical description

The site is located in in the county Skåne in Southern Sweden (55^o 49’ N, 13^o 30’ E, altidue 75 m). Precipitation varies between 500 and 1000 mm per year. Mean temperature is around 0 °C in January and 16 °C in July. The area is relatively small (11 000 km^2) but has a high population density; 1.275 million people. 900 000 of these are living near the coast in the South-West part, which also is the most intensive agricultural part (Fig. 1). Soil types are clayey (ca. 15% clay or more).

Focus in this study will be on Orup soil, a coarse-loamy, mixed, frigid, Aquic Haploboroll (Soil Taxonomy). The site is a sandy loam throughout the profile (0-100 cm) and non-calcareous. The subsoil (below 30 cm) is highly compacted which limits root penetration and thereby nutrient and water uptake from deeper soil layers. Orup soil is one of the Swedish long-term soil fertility sites run since 1956.

Pedo-climatic zone

The climate is cold-temperate and humid. The zone is: Nemoral. Soils are sandy loams.

2. Cropping systems

The number of farms in Skåne was 9337 in 2010, with 1147 larger than 100 ha; 417 were milk producers, while 6233 had no animal production. Most common crops in 2014 were ley (temporary grass; 102 300 ha), winter wheat (99 500 ha), spring barley (72 400 ha), rapeseed (45 800 ha) and sugar beets (32 900 ha).

Cropping intensity

Different cropping intensities from no fertilization to high fertilization rates are applied at the Orup site. Both treatments with and without animal manure are run. Rates of manure are in relation to yields provided by the cropping system. The site is treated according to conventional agricultural practices of the region.

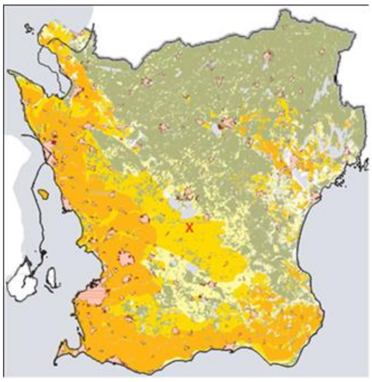

Fig. 1. The map of Skåne showing the Orup site marked by a red cross intended to be used for this case study.

Types of crops

Two 4-year rotations are applied:

- crop rotation with livestock: barley, ley, winter wheat and sugar beets
- crop rotation without livestock: barley, oil seed rape, winter wheat and sugar beet.

Management of soil, water, nutrients and pests

Soil tillage includes yearly mouldboard ploughing, cultivation, fertilization, manuring, chemical weed and pest treatment. Crops are rain-fed and no catch crops to combat N leaching are grown.

Soil improving cropping system and techniques currently used
Measures include crop rotation, use of animal manure, no removal of crop residues in non-manured plots, and regular lime application.

Problems that cause yield loss or increased costs
Soil compaction is a threat to crop production in agriculture, since it enhances harmful physical, chemical and biological processes, which lead to soil degradation. Driving heavy tractors and other machines that affects the subsoil during ploughing and harvesting is a major cause of subsoil compaction, which is not possible to adjust through tillage, but has a severe long-lasting impact on plant growth. This means that the problem is widespread in Europe. However, the problems may be even worse in Scandinavia, where soils are naturally compacted by land ice and the humid climate often means that rain events coincide with harvest. Schjønning et al. (2009) identified soil compaction as the greatest threat to agricultural productivity in Denmark.

Instead of using more inputs, we can increase crop yields by enabling use of a larger soil volume. To achieve this, conditions in the subsoil (layers below the topsoil) can be improved by mechanical loosening and long-term structure stabilisation through addition of waste materials such as paper mill waste, biochar, hydrothermally carbonised straw and composted wood bark. In addition to improving aggregate formation in subsoil, organic amendments increase the water holding capacity and can help to buffer conditions of drought.

One farm where we have observed severe problems with soil compaction is Orup (Fig. 1). This site belongs to our series of long-term field experiments (Kirchmann and Eriksson, 1993). Most of the problems with this soil is due to natural compaction, caused by the land ice thousands of years ago. Plants will hardly have any roots below 30 cm depth. This situation is common in this region and would most likely be possible to improve.

The Orup site is producing 20-40% lower yields than of comparable crops in the region. The primary reason is the inability of crops to penetrate the subsoil. Data in the table below illustrate prevailing soil physical conditions:

Soil depth (cm)	Bulk density (kg dm^{-3})
0-30	1.55
30-40	1.61
40-50	1.66
50-60	1.79
60-70	1.80
70-80	1.80
80-90	1.84
90-100	1.83

3. External drivers and factors

Institutional and political drivers
There are a number of political aims related to agriculture in Sweden. For example:

- to crop 20 % of the arable land according to organic farming practices;
- to take measures to reduce P leaching with 590 tons P from Swedish arable land to the Baltic Sea by 2020;
- to maintain and increase the biological diversity in the landscape through subsidies for animal grazing of non-arable land, etc.

Societal and bio-physical drivers
There are strong interest groups and commercial companies marketing organic food as a being superior to conventionally grown food. New dietary recommendations by the National Food Agency aim to reduce meat consumption. The size of farms continuously increases driven by low profitability. Demand for locally produced instead of imported fodder changes the proportions of certain crops in rotations. Demand for bioenergy often means straw removal followed by lower soil organic matter contents over time. Use of new crop varieties, for example sugar beet, enables farmers to increase yields drastically.

4. Multi-actor approach

Relevant end-users and stakeholders

The farmer and landowner and the Rural Economy and Agricultural Society in Skåne will administrate the field experiment. The following organisations, the Federation of Swedish Farmers (LRF), advisors at the County Administrative Board of Skåne and the Swedish Board of Agriculture will follow the study providing extension and being involved in policy making. The extension service of the the Rural Economy and Agricultural Society in Skåne (Hushållningssällskapet at Borgeby) will use the Orup site as a pilot example for this type of soil treatment. Other research projects may be added to the site for further detailed studies on identification of microbial community in subsoil and changes caused by loosening and organic amendments.

5. Past and on-going work

Past and on-going projects

The site has been and is used for a number of investigations: Effect of different fertilization rates on yields, impact of animal manure on soil properties, microbial biomass determination, P fractionation, changes in soil carbon contents in top- and upper subsoil, composition of micronutrients in crops.

Availability of long-term data

The data base (starting 1957) includes the following: Yield, pH, plant available P and K, C content in soil, concentrations of N, P and K in crops. Climatic data are available for modelling.

6. Key references

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Schjønning, P., Heckrath, G. & Christensen, B.T. (2009) *Threats to soil quality in Denmark: A review of existing knowledge in the context of the EU Soil Thematic Strategy*. DJF Report Plant Science No. 143, The Faculty of Agricultural Sciences, Aarhus University, Tjele, Denmark. URL: http://pure.agrsci.dk:8080/fbspretrieve/2933167/djfma143.pdf.pdf

STUDY SITE 14: Prague – Ruzyně, Czech Republic
Responsible partner: 26, Crop Research Institute (VURV)

1. General information

Geographical description
Site: Prague – Ruzyně latitude 50°05' N; longitude 14°20' E; altitude 345 m; area 110 ha
Climatic region: T2, annual precipitation 472 mm; annual average temp. 7.9°C
Soil: brown earth modal, clay-loam, loess on, partially on the Cretaceous clay slate with a higher content of coarse dust and a lower content of clay particles; Orthic Luvisol (IUSS/ISTRIC/FAO (2006); clay-loamy texture, pH (KCl) 7.0, pH (H2O) 7.8; SOC 1.4%;
The site is a beet production area; available nutrients (extracted by Mehlich III method): P – 62 mg kg-1; K - 171 mg kg-1; Ca - 3446 mg kg-1; Mg – 114 mg kg-1; CEC – 227.6 mmol kg-1).

Pedo-climatic zone
Continental climate, brown soil (Luvisol)

2. Cropping systems

Cropping intensity
Conventional (production area)
Traditional (crop rotation, different fertiliser levels…)
Organic (without fertilizers and pesticides, improving crop rotation)

Types of crop
1. Tillage trial: 50% winter whet, 25% winter oilseed rape, 25% peas; sequence: rape-wheat-rape-wheat-peas-wheat-peas-wheat
2. Fertilizer Long-term Trial: "Cereal Crop Rotation" (67% cereals, 11% root crops and 22% legumes in the crop rotation). The crop sequence was alfalfa, alfalfa, winter wheat, winter wheat, spring barley, potatoes, winter wheat, winter wheat and spring barley with alfalfa under-sowing.
3. Trial on Organic Farming: 33% legumes, 33% cereals, 33% buckwheat

Management of soil, water, nutrients and pests
There is no irrigation at this site.
1. Tillage trial: since 1995 three tillage practices: conventional tillage (CT = ploughing down to 22 cm), reduced tillage (RT = chisel ploughing of the surface soil layer to a depth of 10 cm), and no-tillage practices (NT = with crop residues left on the soil surface).
   All crop residues and side products are left on the field. Mineral fertilizers containing phosphorus (50 kg P_2O_5/ha, in Ammophos) and potassium (80 kg K_2O/ha in Korn-Kali) were applied on the soil surface every year after harvest. Nitrogen fertilizers are applied during spring vegetation. Nitrogen dose is given with view to previous crop, $N_{min.}$ content in soil, expected production yield and required quality. Conventional pesticides are applied as needed in a given year.
2. Fertilizer Long-term Trial: Deep ploughing (28 cm) is applied before seeding of each crop in the autumn. Pesticides are used only if necessary, and growth regulators have never been used. In the experiment nitrogen mineral fertilizers are applied in four different levels (40-80 kg N/ha), phosphorus and potassium ones at two levels (26 and 35 kg P ha−1; 90 and 124 kg K ha−1). Two organic fertilizers were also used, straw and pig slurry mixed with straw (pig slurry + straw). Pig slurry was applied in the autumn before planting the root crops. The straw of cereals and the residues of other crops are removed from the plots.
3. Trial on Organic Farming: no fertilisers, no pesticides, soil improving crops are used

Soil improving cropping system and techniques currently used
Soil improving operations and techniques used at study site:
- Conservation tillage such as reduced or no-tillage. Leaving crop residues (or its part) on the soil surface e.g. limits soil erosion and water evaporation. These soil treatments lead to elevation of soil organic carbon content in the surface layer, improve soil structure etc.

- Water infiltration and compaction of soil under different tillage has been measured in last years for estimation of risk of water erosion of soil.
- If it is possible, convenient crop rotation systems are used, which include legume and other soil improving crops. Byproducts (post-harvest residues) are almost leaving on the fields owing to nutrients and organic matter recovery for sustainable soil fertility.
- Pesticides used with view to pests and diseases appearance in given year, in minimum needed dose not according to long-term planned methodology.
- Tillage trial only: new developed fertilizers are used; optimal term, dose and application method is tested for maximum nutrient efficiency and minimal losses and environmental impact.

Problems that cause yield loss or increased costs
There is a risk of unexpected climatic extremes in given year (e.g. drought, thunderstorm with hail, heavy rains) those can limit yields. Using improper technique leads to soil compaction. Decrease liming and organic fertilization in recent years causes decrease SOC and deterioration of the soil structure. The consequence of these effects is limited water infiltration into the soil, which results in erosion, water run-off.

Figure 1: Long term experiments

3. External drivers and factors

Institutional and political drivers
- Act No 156/1998 Coll., on fertilisers (+ Execution Decrees)
- Act No 242/2000 Coll., on ecological farming
- Government Regulation No 262/2012 Coll., on vulnerable zones (Nitrate directive)
- Act No 334/1992 Coll., on agricultural fund protection

Societal drivers
Are there negative public views on "using of soil for non-food production (rape, maize - bio fuels)". Increasing public opposition elevates under oilseed rape. Pollen causes allergies, large quantities of pesticides used and the odour when rape freezes after winter bothers people. Despite this, yet there are no restrictions on oilseed rape in the CR.

Bio-physical drivers
Increasing frequency of droughts cause changes in the used varieties of crops, the intensity of tillage and nitrogen fertilization – application methods, doses, dates, fertilizer types.

4. Multi-actor approach

Relevant end-users and stakeholders
Farmers in agriculture practise & government bodies & education bodies (Universities, schools….) & advisory system.

Involvement stakeholders in study site
CRI has no subcontractor for this project solving. Cooperation with pilot farms during project solution will be realized. The results obtained at field trials are/will be verified in pilot plant experiments. These farms are not part of the research team present Project.

5. Past and on-going work

Past and on-going projects
Sustainable systems for growing crops to produce quality and safe food, feed and raw materials. Ministry of Agriculture of the Czech Republic, MZE0002700604, 2009-13.
Optimalisation of the nutrition and fertilisation of the sunflower with the aim to increase the yield and quality of production, Ministry of Agriculture of the Czech Republic, QH81271, 2008-2012
Utilization of long-term fertilizer experiments for the determination of risk elements entry from agroecosystems into the food chain, Ministry of Agriculture of the Czech Republic, QJ1210211, 2012-2016
An integrated approach to diversify the genetic base, improve stress resistance, agronomic management and nutritional/processing quality of minor cereal crops for human nutrition in Europe. 7th FP EU, 2016-2020

Availability of long-term data
1. Tillage trial: since 1995; three tillage practices; 27 plots with one nitrogen fertilization level applied in various fertilizers per one tillage
2. Fertilizer Long-term Trial: since 1956; 1056 plots; four level of nitrogen fertilization, two P and two K fertilization
3. Trial on Organic Farming: since 2006

Available data: meteorological data, soil analyses, crop yields and event. quality (esp. for winter wheat and other food production).

6. Key references

Hejcman, M., Kunzová, E., Šrek, P. (2012): Sustainability of winter wheat production over 50 years of crop rotation and N, P and K fertilizer application on illimerized luvisol in the Czech Republic Field Crops Research, 139: 30–38.

Šíp, V., Růžek, P., Chrpová, J., Vavera, R. & Kusá, H. 2009. The effect of tillage practice, input level and environment on the grain yield of winter wheat in the Czech Republic, Field Crops Research, 113: 131-137

Šíp, V., Vavera, R., Chrpová, J., Kusá, H., Růžek, P. 2013. Winter wheat yield and quality related to tillage practice, input level and environmental conditions. Soil and Tillage Research, 132: 77-85

Šrek P., Hejcman M., Kunzová E. (2010): Multivariate analysis of relationship between potato (Solanum tuberosum L.) yield, amount of applied elements, their concentrations in tubers and uptake in a long-term fertilizer experiment. Field Crop. Res. 118, 183–193.

STUDY SITE 15: Almeria, Spain

Responsible partner: 27, University of Almería (UAL)

1. General information

The study site is included in the province of Almería (South East Spain,)between coordinates 2° 11' 10" W and 2° 31' 10" W; and 37° 00' 04",7 N and 37° 10' 04",7 N. The climate is arid (Mediterranean South). Rainfall is very scarce, always inferior to 300 mm per year. ETo is in a range between 1,400 – 1,500 mm/year. Although the province is not very large (8774 km^2), we have within the study site two main areas where past and ongoing work of interest for the proposal is being (or has been) carried out (see Figure 1).

Area A is located in the Sorbas-Tabernas Basin which is one of the Neogene basins of the Betic Cordilleras situated in a crustal transcurrent shear zone. It is an intra-montane depression, bounded by the *Sierra de Filabres* to the North and the *Sierra Alhamilla* to the South and at the leeward side of the Nevada and Gador ranges, all of which are over 2000 m above sea level. The altitude ranges between 200 and 400 m.a.s.l. Soils in this area are developed on carbonated Tertiary parent materials, sometimes with high amounts of gypsum, or on Quaternary parent materials including sands, conglomerates or clays of fluvial origin. Dominant soils in this area belong to the Leptosol or Regosol Reference Group, although we can find Cambisols that tend to be exploited for olive cultivation. These soils are loamy to sandy loam in texture, with basic pH, low organic matter and nutrients content and shallow depth. We find soils with high amounts of soluble salts more soluble than gypsum. The stratigraphic series, the Tortonian-age Chozas formation that gave rise to the Tabernas badlands, is about 150-m thick and includes mudstone and some calcareous sandstone. The mudstone has been identified as calcareous and gypsiferous predominantly composed of 80% silt grains with the following mineralogical composition: muscovite 35%, paragonite 10%, minerals with a main peak at 1.4 nm (mainly chlorite and a small amount of smectite) 3%, quartz 9%, calcite 20% to 35%, dolomite 2% to 5% and gypsum 5% to 20%. The climate is semiarid thermo-Mediterranean with an average annual temperature of 17.8ºC and an average annual rainfall of 235 mm, which is among the driest areas in Europe. The pronounced regional semiarid climate in the SE Iberian Peninsula is determined by its geographical location, in the rainfall shadow of the main Betic ranges and the proximity of northern Africa. In the autumn, rainfall is associated with incoming fronts from the Mediterranean Sea, which sometimes results in storms and torrential rains. Most rainfall events are low magnitude and low intensity. The average minimum temperature is 4.1°C in the coldest month and an average maximum of 34.7°C in the hottest month. Daily amplitudes average 13.7°C in summer. Potential evaporation is around 4 to 5 times higher than annual precipitation.

Area B is located in the Cabo de Gata Natural Park. There the climate is semiarid warm Mediterranean. The mean annual temperature oscillates around 18-19ºC, and frosts are sporadic, occurring only on isolated days. Mean annual rainfall is approximately 220 mm per year, with prolonged summer droughts, strong inter- (larger than 30%) and intra-annual variations and 9 to 12 months in which precipitation is not sufficient to compensate for potential evapotranspiration. Annual potential evapotranspiration is around 1400 mm. Soils are mainly calcaric Regosols developed on a wide variety of carbonated parent materials, in different topographic positions with slopes ranging between 0% and 40%. These soils present basic pH, with loamy or coarser textures, low organic matter and nutrients content and shallow depth, except for the very scarce calcaric Fluvisols found as spots in the "Ramblas" around the study zone. We can also find soils affected by salts as a consequence of the xeric moisture regimen of the area.

Land uses include tree and annual crops cultivation, occasionally in protected structures (greenhouses and under mesh), pasturage (especially goat herds) and recreational activities (touristic uses, beaches in Cabo de Gata, and cinema in Tabernas area). Industry development is scarce and of composed by small enterprises. The exploitation of natural resources is regulated by the current zoning plan (PORN, 2008). Agriculture is one of the main activities, covering 26% of the park area. The abandonment of some agricultural areas and simultaneous intensification in certain others (i.e., water fed agricultural systems and greenhouses) are the main causes of degradation in the park.

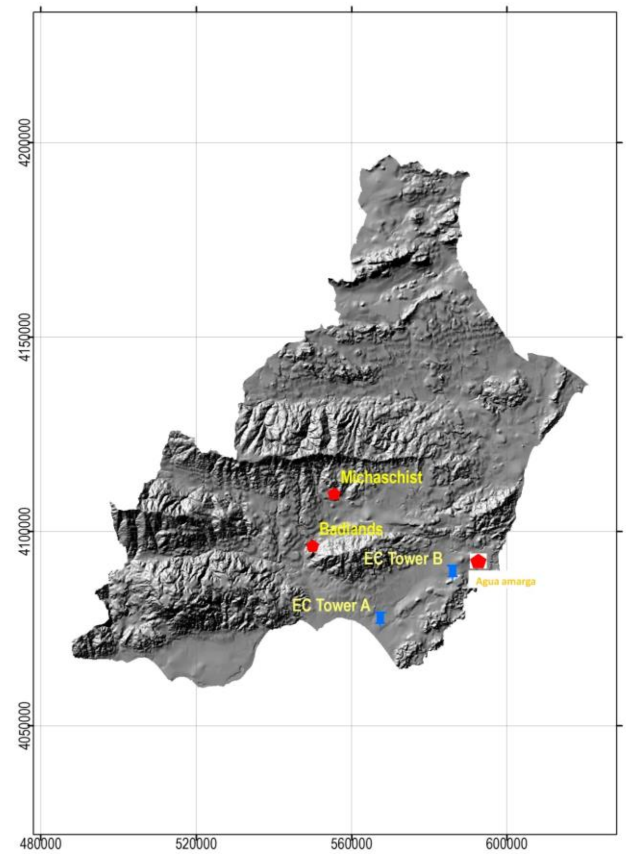

Figure 1. Almería map showing study sites and EC towers location.

Figure 2. Stone fruit orchards sited in Agua Amarga at bloom.

2. Cropping systems

Tree crops orchards of different species planted at varied densities can be found in the study area, being perhaps the most representative, olives (Area A) and almond and stone fruits (Area B). **In Area A** (Tabernas) we found conventional and also some organic olive orchards with a tree density labelled as intensive for this crop (200-300 trees/ha; density considered low instead for many other fruit trees). Modern new super high density orchards (1500-2500 trees/ha) with mechanized harvesting using adapted grape harvesters are in development in the area. In intensive orchards olive trees are vase trained while in super high density orchards usually central-leader training systems are used. **In Area B,** the most interesting new development is focused on intensive (600-800 trees/ha) very large orchards of low chilling stone fruits (peaches, nectarines, apricots, plums). Trees are commonly trained in a vase shape, with 4-5 main scaffolds where productive wood is formed (Figure 2).

Non-tillage and weed control with herbicides or reduced tillage is usually applied in most modern olive and stone fruit orchards in the study site. Most of these orchards are drip irrigated. Conventional fertilizers are normally used, mainly N (several applications per year) and K. Conventional or chemical control of pest and diseases isnormally used. Main pests and disease in olive orchards are olive fruit fly, prays, black scale, peacock spot, and verticillium wilt. Verticillium has no cure since no effective control on this soil fungus is available. Excessive irrigation and runoff contribute to the dispersion of this lethal disease. Temporal cover crops can be used instead of conventional tillage for soil improvement and for reducing erosion. Nonetheless, the very scarce rainfall in the area makes difficult for growers to adopt this management technique. In intensive stone fruit orchards of **Area B** the control of weed is achieved also by herbicides and reduced tillage in areas where infiltration problems occurs, and where gullies of certain depth appear. High soil compaction can also be a problem and is commonly resolved by owners by tillage. Watering is performed by drip irrigation too. Water needs are determined according to an estimation of crop evapotranspiration using climate data from nearby weather stations. Standard fertilization common in the area includes 110, 65 and 160 kg ha-1 year-1 of N, P2O5 and K2O, respectively. Deficiencies in microelements are solved by foliar fertilization. Biological and cultural methods are first used to control pests and diseases. When really needed, chemical control is also achieved, switching active ingredients. Main pests in stone fruit crops are aphids, tripses, mites and San Jose scale. Main diseases are powdery mildew, leaf curl and Phytophthora.

High content of salts of Tabernas area soil is a common cause of yield reduction. Excessive N fertilization contributes to this problem, increasing also the sensitivity to pests and diseases and crop costs. Scarce water resources and regulation limitation due to the protection of environment in orchards sited in the Natural Park Cabo de Gata-Nijar might reduce yield, and increase costs for stone fruit trees. Flower and fruit thinning represent the most important cost. Excessive watering has been occasionally linked with damages caused by soil fungus (Phytopthora in this case) suggesting an improvement can be achieved. Excessive nitrogen application also leads to higher damages caused soil and airborne fungi. An adequate control of nitrogen level avoids some yield losses and improves fruit quality and enhances postharvest.

3. External drivers and factors

Current UE strategies of agricultural and rural development policies contribute to put in action help lines for rural areas of the study site through the Program LIFE and FEADER Regulation. UE objectives include the implementation of different tools in the period 2014-2020 to support the adoption of beneficial practices for the conservation of climate and environment (the so called greening EU strategies). Among potential beneficiaries of those help lines we find organic farmers and growers of permanent crops such as olive and fruit trees. Special attention will be given too to farms totally or partially located in areas included in EU Directive 92/43, relative to natural habitats conservation, Directive 2000/60, linked to actions in the field of water protection, and Directive 2009/147, relative to the protection of wild birds.
Other Programs and Normative are established. At national level we should mention Red Natura 2000 plan that will implement the help lines established in 1305/2013 and 1306/2013 Regulations. In Andalusia, through the Program for Rural Development, these areas may find tools to sustain the economy of those areas. Two different types of actions and helplines deserve mentioning: modernisation of agricultural exploitations and animal husbandries, and Preservation of the nature and landscape in agricultural exploitations. Organic production of food in Andalusia is reinforced by regional normatives (besides Commission Regulation (EC) No 889/2008) aiming to supervise production and labelling of organic products.
Regarding societal drivers we must recognise that the characteristics of the crops of the study site confer to them of a multifunctional character due to their localization (often within and/or in the limits of natural areas protected by law). In these systems, excellent products very much appreciated by customers are being produced. Further development of agriculture in the area is extremely important since it represents the main economic activity and the first source of income for the families. This development is also essential since might be of help allowing fixing rural population to the site. Maintaining profitable agriculture in the area diminishes the risk of fire and help minimizing erosion when sustainable practices in the farms are achieved. The concept of multi-functionality for the agrarian systems represents the recognition of the capacity of rural areas to create an aggregate of goods and services of different kinds: economic, but also social and environmental.
The multi-functionality of the services provided by rural can be studied under two complementary orientations: the establishment of the list of goods and services being produced, and the demand that the society makes of them trying to identify the preferences of the Society. Combining both orientations, offer and demand, an integral analysis can be performed to orientate tools and instruments of intervention within EU agricultural politic in order to maximize the social welfare derived from the agricultural activities in the study site.
Climate change may contribute to the aridity of the zone; higher frequency of extreme episodes of rainfall and drought would make more vulnerable the environment, increasing erosion, already a very serious problem in the badlands of Tabernas. Global warming could make more difficult to satisfy chilling requirements of the crops, most of them with reduced need of winter chilling, however. Displacement of crop phenology to earlier bloom could increase the risks of frost, although warm winters in the study site suggests seldom occurrence of damages. Increasing temperatures during winter and spring will accelerate fruit ripening and harvest with positive effects on prices and profitability.

4. Multi-actor approach

The Department of Agriculture at the national level, and the Agriculture, Fishery and Rural Development Department at the regional level are the organisms in charge of promoting the politics of sustainable agricultural development in the study site. The Groups of Rural Development (GDR) implement that politic with tools at the ground level and are the more easily accessible interlocutors to farmers. In the study site, “Filabres-Alhamilla” and “Levante almeriense” GDRs act. The Deparment of Environment and Land Use is the responsible of enacting the politics preserving the sustainable development in protected areas as those included in the study site. Tabernas forms part of the Natural Landscape of Tabernas Desert, and Cabo de Gata enjoys a high level of protection due to its inclusion within a National Park. In the field of organic production the Association of Producers and Customers of Ecological Products, and the Counsel for Organic Production offer technical assistance to farmers. A number of organisms and private companies are of help in the control and certification of ecological production in Andalusia (Agrocolor, Certifood, Ecocert, etc.).

5. Past and on-going work

A long list of past and on-going projects were performed in the study site, most of them focusing on the progression of the erosive dynamics, and the success of corrective measures.

Mediterranean Desertification and Land Use (MEDALUS III) deserves special consideration. Thanks to the prolonged studies, long-term data and equipment to prolong the measurements are available, dating back from the 90's to the present. These long-term data included meteorological parameters, topographical and hydrological studies. The study of the geology and soils and vegetation changes too extensive to be included within the page limits here imposed are also available.

STUDY SITE 16: Brittany, France
Responsible partner: 28, FRAB

Study site 16 consists of 2 areas in Brittany, namely the Semnon catchment area the Oust-Ninian catchment. These areas are presented separately below.

Semnon catchment area
1. General information

Geographical description
Semnon catchment area is localized at the south of Ille-et-Vilaine department, in the eastern part of Brittany. It size is around 495 km2 and 26. 000 hectares of total cultivated area. Semnon river is 73 km long. The geology of the area is quite homogeneous. It consists of alternating 2 types of schists, between which are intercalated sandstone and sandstone foundations.
The Semnon catchment descends west to its confluence with the Vilaine river, where its altitude is about ten meters. Its maximum altitude is about 100 meters, in the south-eastern part.
The Semnon catchment is subject to an oceanic climate, with a gradient to a continental climate in the eastern part, with result in less continuous rains than in coastal areas.

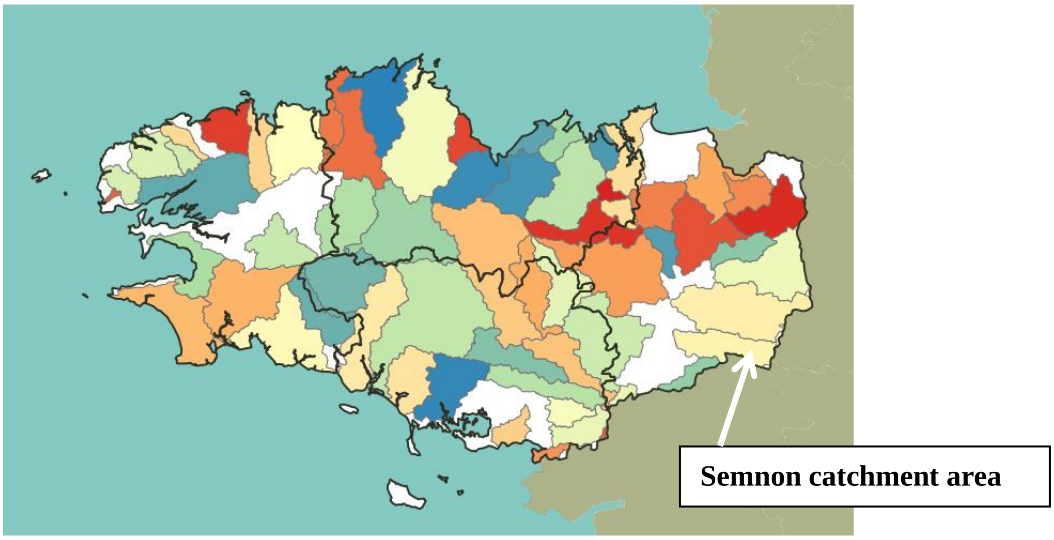

Figure 1: Location of the Semnon catchment area.

Pedo-climatic zone
Lusitanian/ Atlantic Central, Cambisol

2. Cropping systems

Cropping intensity
Semnon catchment area has 434 farms and it is mainly a dairy area. There are 18 organic farms on the area. FRAB and his local partner Agrobio35 are working on soils with more or less 12 farms in this area (organic and conventional)

Types of crop
Wheat, maize and grassland : the territory has mainly traditional dairy systems : grassland systems and maize based systems. Most of the farms of the territory grows cereals too. We can also find orchards.

Management of soil, water, nutrients and pests
There is no irrigation in this area. Management of soils and nutrients depends of the farms, whether they are in conventional or organic farming. GAB-FRAB network is trying to promote organic methods, as organic fertilisation, mechanical weeding, rotations…

Soil improving cropping system and techniques currently used
Biological pest management, green manure, organic fertilisers

Problems that cause yield loss or increased costs
Compaction, weeds, loss of soil fertility

3. External drivers and factors

Institutional and political drivers
In 1964, France, with the first water law, establishes a water management by catchment areas. This water management by catchment area is then reaffirmed by the European Framework Directive on "Water 2000" which requires all its member states in order to achieve good ecological status of waters by 2015. Catchment areas are coherent territories recognized by French and European laws.

Societal drivers
The western part of France (Brittany, Pays de la Loire, Normandie) is a traditional dairy area. Large dairy companies are located in this area. Organic farming and alternative growing methods are growing much for 10 years, driven by societal demand.

Bio-physical drivers
Annual climate hazards, due to climate change, are becoming stronger. This is a major problem for the cattle management, because food autonomy is threatened. Farms have to be more resilient to climate hazards. They are developing new approaches: innovative crops, new grass management methods…

4. Multi-actor approach

Relevant end-users and stakeholders
Agrobio3, Syndicat Intercommunal du Bassin du Semnon, Chambre d'Agriculture d'Ille et Vilaine, Conseil Général d'Ille et Vilaine, Conseil Régional de Bretagne

Involvement stakeholders in study site
Agrobio35 : local organic farmers groups, working on soils with groups of farmers
Syndicat Intercommunal du Bassin du Semnon : management of the catchment area, helping to "hire" willing farmers
Conseil Régional de Bretagne : supports progress initiatives on soil quality in that territory

5. Past and on-going work

Past and on-going projects
Agrobio35 is already working on soil quality in this study site with a group of 12 farmers, involved in Ecologically Efficient Agriculture (AEP). There are organic and conventional farmers in this group, all of them are interested about soil quality and management.

Availability of long-term data
Soil quality projects in this area begun in 2013-2014 and they will last 3 years. Soils analysis are done in fields of the willing farmers, with advices of experts. Agrobio35 is then animating exchanges between farmers in order to find solutions to improve soil quality in their fields.

Oust-Ninian catchment areas
1. General information

Geographical description
"Oust moyen" and "Ninian" catchment areas are localized at the north of Morbihan department, in the center of Brittany. They are part of the largest catchment area called "Oust".

Oust moyen size is around 390 km2 and 27. 000 hectares of total cultivated area. It counts 370km of rivers. Ninian size is around 340 km2 and 24. 000 hectares of total cultivated area. Is counts 280 km of water.
Altitude: From 225 m to 10 m more or less
Geology: the entire Oust catchment area is impermeable rock (55% schist and 30% sandstone)
Pedo-climatic zone
Lusitanian/ Atlantic Central, Cambisol

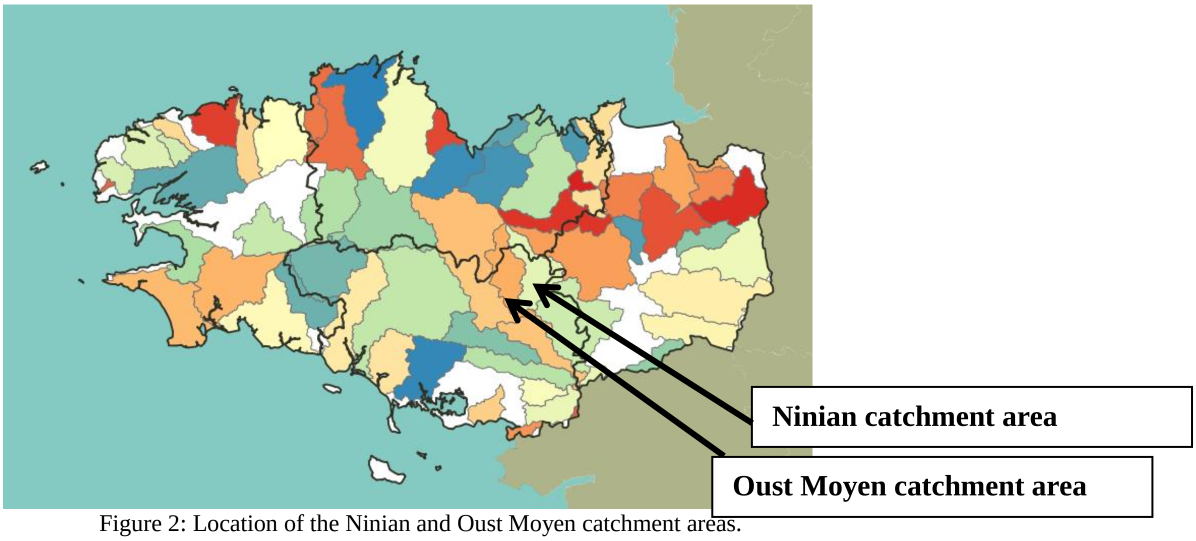

Figure 2: Location of the Ninian and Oust Moyen catchment areas.

2. Cropping systems

Cropping intensity
Oust and Ninian catchment areas have 1159 farms and it is mainly a dairy area. There are 38 organic farms on the area. FRAB and local partners Agrobio35 and GAB56 are working on soils with 10 farms in this area (organic and conventional).

Types of crop
Wheat, maize and grassland. The territory has mainly traditional dairy systems : grassland systems and maize based systems. Most of the farms of the territory grows cereals too. We can also find orchards.

Management of soil, water, nutrients and pests
There is no irrigation in this area. Management of soils and nutrients depends of the farms, whether they are in conventional or organic farming. GAB-FRAB network is trying to promote organic methods, as organic fertilisation, mechanical weeding, rotations.

Soil improving cropping system and techniques currently used
Biological pest management, green manure, organic fertilisers.

Problems that cause yield loss or increased costs
Compaction, weeds, loss of soil fertility.

3. External drivers and factors

Institutional and political drivers
In 1964, France, with the first water law, establishes a water management by catchment areas. This water management by catchment area is then reaffirmed by the European Framework Directive on “Water 2000” which requires all its member states in order to achieve good ecological status of waters by 2015. Catchment areas are coherent territories recognized by French and European laws.

Societal drivers

The western part of France (Brittany, Pays de la Loire, Normandie) is a traditional dairy area. Large dairy companies are located in this area. Organic farming and alternative growing methods are growing much for 10 years, driven by societal demand.

Bio-physical drivers

Annual climate hazards, due to climate change, are becoming stronger. This is a major problem for the cattle management, because food autonomy is threatened. Farms have to be more resilient to climate hazards and they are developing new approaches: innovative crops, new grass management methods…

4. Multi-actor approach

Relevant end-users and stakeholders

Agrobio35 and GAB56, Syndicat Mixte du Grand Bassin de l'Oust (more precisely Bassin Versant de l'Oust mioyen and Bassin Versant du Ninian-Léverin), Chambre d'Agriculture du Morbihan, Conseils Généraux d'Ille et Vilaine et Morbihan, Conseil Régional de Bretagne.

Involvement stakeholders in study site

Agrobio35 and GAB56 : local organic farmers groups, working on soils with groups of farmers
Syndicat Mixte du Grand Bassin de l'Oust: management of the catchment area, helping to "hire" willing farmers
Conseil Régional de Bretagne : supports progress initiatives on soil quality in that territory.

5. Past and on-going work

Past and on-going projects

Agrobio35 and GAB56 are already working on soil quality in this study site with a group of 10 farmers, involved in Ecologically Efficient Agriculture (AEP). There are organic and conventional farmers in this group, all of them are interested about soil quality and management.

Availability of long-term data

Soil quality projects in this area begun in 2013-2014 and they will last 3 years. Soils analysis are done in fields of the willing farmers, with advices of experts. Agrobio35 and GAB56 are then animating exchanges between farmers in order to find solutions to improve soil quality in their fields.