

## **Inventory of opportunities and bottlenecks in policy to facilitate the adoption of soil-improving techniques.**

**Authors:** Alicia McNeill, Harriet Bradley, Melanie Muro,  
Nicholas Merriman, Robert Pederson, Tugce Tugran,  
Zuzana Lukacova.

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Project coordinator:	Wageningen Environmental Research (WEnR)
EU project representative & coordinator of the project:	Dr. Rudi Hessel - ( <a href="mailto:rudi.hessel@wur.nl">rudi.hessel@wur.nl</a> ) +31 317 486 530
Project manager(s):	Erik van den Elsen ( <a href="mailto:erik.vandenelsen@wur.nl">erik.vandenelsen@wur.nl</a> ), Simone Verzandvoort ( <a href="mailto:simone.verzandvoort@wur.nl">simone.verzandvoort@wur.nl</a> ), Falentijn Assinck ( <a href="mailto:falentijn.assinck@wur.nl">falentijn.assinck@wur.nl</a> )

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Principle Author(s):	Alicia McNeill, Harriet Bradley, Melanie Muro, Nicholas Merriman, Robert Pederson, Tugce Tugran, Zuzana Lukacova.
Principle Author e-mail:	<a href="mailto:alicia.mcneill@milieu.be">alicia.mcneill@milieu.be</a>
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No.	Participant organisation name	Abbreviation	Country
1	Wageningen Environmental Research	WEnR	Netherlands
2	University of Newcastle upon Tyne	UNEW	United Kingdom
3	Katholieke Universiteit Leuven	KUL	Belgium
4	University of Gloucestershire	UoG	United Kingdom
5	University Hohenheim	UH	Germany
6	Research Institute for Knowledge Systems	RIKS	Netherlands
7	Technical University of Crete	TUC	Greece
8	Joint Research Centre	JRC	Italy
9	University of Bern	UNIBE	Switzerland
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11	Norwegian Institute of Bioeconomy Research	NIBIO	Norway
12	Bodemkundige Dienst van België	BDB	Belgium
13	Aarhus University	AU	Denmark
14	Game & Wildlife Conservation Trust	GWCT	United Kingdom
15	Teagasc	TEAGASC	Ireland
16	Soil Cares Research	SCR	Netherlands
17	Instituto Politecnico De Coimbra	IPC/ESAC	Spain
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22	University of Pannonia	UP	Hungary
23	Swedish University of Agricultural Sciences	SLU	Sweden
24	Agro Intelligence Aps.	AI	Denmark
25	Crop Research Institute	VURV	Czech Republic
26	University of Almeria	UAL	Spain
27	Fédération Régionale des Agrobiologistes de Bretagne	FRAB	France
28	Scienceview Media BV	SVM	Netherlands

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## **Authors**

Alicia McNeill, Harriet Bradley, Melanie Muro, Nicholas Merriman, Robert Pederson, Tugce Tugran, Zuzana Lukacova

## **Contributors**

Abdallah Alaoui, Anne Karine Boulet, Annemie Elsen, Antonio Berti, Aurelia Jud, Carola Pekrun, Chris Stoate, Damir Petrovic, Dimitrios Alexakis, Emilia Noel Ptak, Emilio Galdeano Gomez, Goulven Maréchal, Gunnar Börjesson, Hedwig van Delden, Ioannis Tsanis, Irina Calciu, Jannes Stolte, Jerzy Lipiec, Jim Egan, Jose Angel Aznar Sanchez, Julian Cuevas Gonzalez, Kamilla Skaalsveen, Kismányoky Tamás, Mia Tits, Moritz Hallama, Pavel Čermák, Sabina Potestio, Sofi Lloyd, Tamás Hermann, Tommy Dalgaard, Tóth Zoltán,

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## Abbreviations

AECM	Agricultural-Environment-Climate Measures
CAP	Common Agricultural Policy
CMO	Common Market Organisation
COP	Conference of the Parties
EAFRD	European Agricultural Fund for Rural Development
EAGF	European Agricultural Guarantee Fund
EAP	Environmental Action Programme
EFA	Environmental Focus Areas
ELD	Economics of Land Degradation
ENSA	European Network on Soil Awareness
EQS	Environmental Quality Standards Directive
ESBN	European Soil Bureau Network
ESF	European Soil Forum
ESPG	Environmentally Sensitive Permanent Grasslands
FAO	Food and Agriculture Organisation
FAS	Farm Advisory Service
FP7	7th Framework Programme for Research and Technological Development
FRMP	Flood Risk Management Plan
GAEC	Good Agricultural and Environmental Conditions
GMO	Genetically Modified Organism
GSP	Global Soil Partnership
IPM	Integrated Pest Management
IYS	International Year of Soils
LDN	Land-Degradation Neutrality
MRL	Maximum Residue Level
MS	EU Member States

N	Nitrogen
ND	Nitrates Directive
NVZ	Nitrate Vulnerable Zones
P	Phosphorous
PoM	Programme of Measures
PPP	Plant Production Products
RD	Rural Development
RDP	Rural Development Programme
RBMP	River Basin Management Plan
SDGs	United Nations Sustainable Development Goals
SICS	Soil Improving Cropping Systems
SMR	Statutory Management Requirement
SoCo	Sustainable Agriculture and Soil Conservation
SOM	Soil Organic Matter
SSD	Sewage Sludge Directive
SUPD	Sustainable Use of Pesticides Directive
TFEU	Treaty on the Functioning of the European Union
UAA	Utilised Agricultural Area
UNCCD	United Nations Convention to Combat Desertification
WFD	Water Framework Directive

## Executive summary

Soil is increasingly recognised as a crucial resource providing products such as feed, fibre, food and fuel as well as critical ecosystem services including water storage, filtration, and carbon sequestration. Soil offers a habitat for billions of organisms and is the foundation for our cities and towns. Despite its recognised importance in sustaining ecosystems functions, human life and economic activities, soil is being over-exploited, degraded and irreversibly lost due to inappropriate land management practices, industrial activities and land use changes that lead to soil sealing, contamination; erosion and loss of organic carbon.

Agriculture occupies a substantial proportion of European land and consequently contributes significantly to various forms of degradation. The uptake of innovations associated with potential benefits to soil quality, such as precision farming and conservation agriculture is slowly expanding across Europe. Yet, these are not adopted to their full potential and are in some cases even abandoned, raising the question of why support and adoption of these practices by European farmers is still considerably weak. Understanding common barriers to the adoption of soil improving practices is an important prerequisite for identifying and designing policy measures to encourage farmers to adopt effective soil conservation practices. A second important foundation for developing appropriate policies is an appreciation of the effectiveness of soil conservation policies in agriculture.

This report presents an inventory and analysis of bottlenecks and opportunities in sectoral and environmental policies to facilitate the adoption of Soil-Improving Cropping Systems (SICS). Using documentary reviews and interviews with policy-makers and stakeholders, we identify, describe and analyse relevant EU-level policies as well as national, regional and sub-regional policies in 16 European countries in support of the following research questions:

1. Which existing policies and policy instruments shape agricultural practices?
2. What are the intended mechanisms and impacts of existing policies, instruments and practices
3. To what extent do existing policies facilitate adoption of soil-improving practices?
4. Which factors shape success or failure of a policy instrument?

The findings of this study present the first step towards developing policy alternatives across various levels of governance with the aim of facilitating the uptake of SICS in particular, and of agricultural practices in general, which have demonstrated to be beneficial to soil quality.

### *1. Which existing policies and policy instruments shape agricultural practices?*

The protection, maintenance and improvement of soil quality relies on a number of sector and environmental policies that address different aspects of soil management. This study has identified a number of policies and their specific instruments that explicitly and implicitly impact on farming practices and management in relation to improving soil quality. At EU-level, these include:

- **Agricultural policies:** Greening measures, Cross-compliance and Rural Development Policy, under the broader framework of CAP, potentially impact farmers' adoption of cropping systems and several of the instruments have explicit links to maintaining or improving soil quality.
- **Water policies:** Agricultural management and practices impact on nutrients, water use and pollution, and maintaining or enhancing soil quality can impact or be impacted by all of these management areas.
- **Nature policies:** Instruments established by the Birds and Habitats Directives impact on farmers and their decisions in relation to management practices, mainly at a landscape level, but also in some cases on farmer's specific management practices such as cropping patterns, timing of tillage and crop rotation in relation to preserving wildlife.
- **The Sewage Sludge Directive** promotes the use of sewage sludge in agricultural areas by providing a legal framework to administer potential risks mainly due to sludge content of heavy metals that can accumulate in soil. The main way in which the SSD could influence agricultural practices relates to fertilisation and nutrient management.
- The **Sustainable Use of Pesticides Directive** is designed to achieve more sustainable use of pesticides by requiring MS to develop clear, measurable targets to reduce risks from pesticides. The SUPD affects farmer's decisions and practices relating to pest management and weed control, because MS are required to develop and in place National Action Plans to reduce pesticide use.
- The **Fertilisers Directive** mainly impacts on the market for fertilisers i.e. producers of fertilisers, however it indirectly impacts on farmers and their practices, because it affects the range of fertilisers that are accessible.

At country-level, the policy landscape largely mirrors that at EU-level with only a few countries having a specific legislative or policy instrument with soil protection as its primary objective.

## *2. What are the intended mechanisms and impacts of existing policies, instruments and practices*

Our analysis shows that, both at EU as well as country-level, SICS components are most frequently addressed by regulatory and economic instruments. Many of the identified regulatory policies use a mix of instruments, often including both mandatory and voluntary elements. This is illustrated by the country-level analysis where the policy landscape is largely characterised by legislation transposing EU policy or nationally-initiated regulations which in turn establish bans and targets as well as subsidy systems linked to the implementation of the CAP.

The economic instruments are those sanctioning or incentivising behaviour through market mechanisms. The CAP's greening measures or payments, for example, are an attempt to incentivise agricultural practices that go above and beyond standards and regulations covered under Cross-compliance. In addition, funding available under the Regional Development Programmes compensates farmers for transaction costs in relation to providing public goods or ecosystem services. The economic instruments under the Water Framework Directive which aim to establish pricing systems reflecting real economic costs, may motivate farmers to reduce their irrigation programmes, and plant crops more suited to the natural environment.

## *3. To what extent do existing policies facilitate adoption of soil-improving practices?*

The analysis shows that agricultural practices and by extension soil quality in Europe are shaped by different policy areas and instruments implemented at various scales of governance. Some instruments address soil improving agricultural techniques directly, most of them indirectly. The existing policy framework is largely characterised by regulatory and economic policy approaches, with more than 80% of all policies in the covered countries formulated at EU level. Since many of these Directives and Regulations are subject to implementation and, as such, further definition at national and regional scale, impacts are bound to vary across countries.

- Evaluation of the different CAP instruments, especially greening measures, is early in the process of implementation, and because of this difficult to evaluate. Concerns expressed by stakeholders over the impact of CAP on the environment and sustainable farming systems, include: the system of payments under the CAP may potentially encourage farmers to engage in practices that are hazardous for the environment in order to obtain or maximise their payments; CAP instruments may actually support current industrial farming practices rather than promote a transition to more sustainable agricultural systems; the established system of payments may create a sense of entitlement that creates resentment when rules for payments are changed.
- Studies examining the impact of water policy on agricultural management and

practices are equally scarce. Although relevant literature shows that the objectives of EU water policy are integrated into agricultural policy at the strategic level, the impact of this integration depends on the effective implementation of the agricultural policies. Some stakeholders have indicated that the ND has certainly changed the way manure is handled.

- Assessments of the Nature Directives show that outside Natura 2000 habitat sites, obligations set on farmers to protect threatened habitats, as well as species of Community importance, were often poorly defined, and the legislation was not enforced. It seems that even within Natura 2000 sites, management plans drawn up for each site have little impact on farmers' decisions.
- Member States have largely implemented stricter limits than those recommended by the Sewage Sludge Directive, but there is substantial variation between Member States, with a number of Member States using practically no sewage sludge in agriculture, preferring to incinerate it.
- Recent reviews of the SUPD show that on the one hand, MS have provided a high level of training and certification of professional users, distributors and advisors, carried out comprehensive information and awareness activities, implemented a range of measures to protect the aquatic environment from pesticide use and to reduce pesticide use in specific areas; and banned aerial spraying, with strict conditions on its use. On the other hand, the overall rate of compliance and an assessment of tangible results is missing in the absence of measurable targets in most national action plans.
- Evidence shows that many fertilisers sold under national legislation comply with the technical standards specified in the Fertilisers Regulation. However, there is no evidence supporting the argument that the Regulation has led to improvements regarding fertilisers' impacts on the environment, particularly regarding the presence of heavy metals in fertilisers, which may leach into soils.

#### *4. Which factors shape success or failure of a policy instrument?*

The documentary and analysis and stakeholder interviews point to the conclusion that the existing policy framework appropriately addresses the soil issues at stake. However, from an EU-level perspective, the evidence demonstrates that policy impact is largely defined by how these are implemented at national and regional level.

It is acknowledged that, whilst the CAP has the potential of delivering real impact, it is undermined by lack of proper implementation, control and sanctions or penalties for non-compliance. Reported research suggests that the financial incentives established by the CAP may be less effective than other types of instruments such as provision of information and advisory services, as they do not take into account nor can be tailored to other factors relating to farmer views and attitudes.

A recurring theme in our analysis is the need for better integration and policy coherence. Whilst commentators agree that the coherence of agricultural and environmental policies has improved over the past decades, it is evident that a coherent, well integrated policy framework with clear objectives, targeted policy measures, and a well-defined monitoring process is needed to promote a transition towards agriculture systems and practices which support the protection, maintenance and improvement of soil resources across Europe.

## About this report

This report presents an inventory and analysis of bottlenecks and opportunities in sectoral and environmental policies to facilitate the adoption of Soil-Improving Cropping Systems (SICS).<sup>1</sup> Using documentary reviews and interviews with policy-makers and stakeholders, we identify, describe and analyse relevant EU-level policies as well as national, regional and sub-regional policies in 16 European countries in support of the following research objectives:

- A. To identify existing policies, policy instruments and practices promoting soil quality, and particularly the adoption of soil-improving cropping systems.
- B. To assess the extent to which existing policies, policy instruments and practices promote the adoption of soil-improving cropping systems.
- C. To identify contextual factors, particularly institutional settings, influencing policy impact on farmer adoption.

The findings of this study present the first step towards developing policy alternatives across various levels of governance with the aim of facilitating the uptake of SICS in particular, and of agricultural practices in general, which have demonstrated to be beneficial to soil quality.

PART I of this report presents current knowledge on the role and impact of policy instruments with regard to adoption and implementation of soil improving cropping systems. Different policy approaches and instruments are explored, and the overarching question asked: under which conditions do policy instruments — or mix of policy instruments — encourage the adoption of SICS? This is followed by a description of the aims and key questions guiding this research as well as the research process and methods implemented at EU-level and in the Study Site areas.

PART II of this report looks at policy initiatives and objectives directly aimed at tackling soil degradation especially in agriculture, firstly at international level and then EU level, although the two levels are becoming increasingly interlinked. The scope is then narrowed further to examine several key pieces of EU legislation which have potential to directly impact the uptake of soil-improving cropping systems.

Part III of this report focuses on the policy review and analysis of national instruments relevant for shaping agricultural practices in 16 Study sites. Each study site is described in detail in a dedicated section and presents results of the policy analysis per site. The last section of Part

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<sup>1</sup> For a detailed definition and overview of practices see D2.1 – A review of soil improving cropping systems, available at : <https://www.soilcare-project.eu/downloads/public-documents/soilcare-reports/75-report-06-d2-1-a-review-of-soil-improving-cropping-systems-wenr-oene-oenema>

III provides a synthesis of the study sites' results based on the policy inventories as well as the analysis of shortcomings and opportunities on national level in 16 Study sites.

This report is accompanied by a policy inventory describing relevant EU-level as well as national and (sub-)regional policies and policy instruments which is available at <https://www.soilcare-project.eu/resources/deliverables>.

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## Part I

# Research context, objectives and strategy

Adoption of agricultural practices associated with potential benefits to soil quality is slowly expanding across Europe. Yet, innovations are not taken up to their full potential and are in some cases even abandoned, raising the question of why support and adoption of these practices by European farmers is still considerably weak. This first part of the report presents current knowledge on the role and impact of policy instruments with regard to adoption and implementation of soil improving cropping systems. This is followed by a description of the aims and key questions guiding this research as well as the research process and methods implemented at EU-level and in the study site areas.

## 1 Introduction

Soil is increasingly recognised as a crucial resource providing products such as feed, fibre, food and fuel as well as critical ecosystem services including water storage, filtration, and carbon sequestration. Soil offers a habitat for billions of organisms and is the foundation for human settlements. Despite its recognised importance in sustaining ecosystems functions, human life and economic activities, soil is being over-exploited, degraded and irreversibly lost due to inappropriate land management practices, industrial activities and land use changes that lead to soil sealing, contamination; erosion and loss of organic carbon (Gardi et al., 2012).

Recent figures show that over 25% of EU land is affected by soil erosion and an estimated 45% of soils in the EU have low levels of organic matter. Agriculture occupies a substantial proportion of European land and consequently plays an important role in combatting various forms of degradation (EEA 2016). Six of the soil degradation processes recognised by the European Commission's Soil Thematic Strategy (2006)<sup>2</sup> are closely linked to agriculture: erosion, organic carbon decline, soil biodiversity decline, compaction, contamination, and salinisation and sodification.

It is now widely accepted that conventional agriculture production, with its resource-intensive practices and associated detrimental impacts on biodiversity, soil and water quality, is generating a negative spiral of degradation, which in turn triggers the need for increased inputs and higher costs, eventually intensifying environmental impacts. Against this background, there is a growing consensus that agricultural practices in Europe need to change in order to remain both profitable and sustainable, a change of direction, which is also reflected in numerous policy initiatives at the European level over the last decade which either directly or indirectly promote a multitude of existing beneficial agricultural practices. For instance, the most recent reforms to the Common Agricultural policy in 2013 introduced a requirement to tie a proportion of direct payments to farmers to the implementation of a set of pre-defined agricultural practices aimed at preserving biodiversity, soil quality and the environment in general. With this shift comes increasing pressure on agricultural producers to change how they operate and adopt new techniques and practices, not only due to the described changes in policies, but also their own environmental concerns, private industry standards, and increasing consumer awareness.

The uptake of innovations associated with potential benefits to soil quality, such as precision farming and conservation agriculture is slowly expanding across Europe. Yet, these are not adopted to their full potential and are in some cases even abandoned, raising the question of why support and adoption of these practices by European farmers is still considerably weak. Understanding common barriers to the adoption of soil improving practices is an important

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<sup>2</sup> COM(2012)046 final: The implementation of the Soil Thematic Strategy and ongoing activities. Accessed at: <http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A52012DC0046>

prerequisite for identifying and designing policy measures to encourage farmers to adopt effective soil conservation practices. A second important foundation for developing appropriate policies is an appreciation of the effectiveness of soil conservation policies in agriculture.

The overall ambition of this work is to develop a better understanding of how policy measures should be designed to encourage farmers to adopt effective soil improving practices. More specifically, this task aims to analyse the role, benefits and shortcomings of policies, policy instruments and practices as drivers for the adoption of soil-improving cropping systems

This chapter briefly presents the concept of cropping systems, before reviewing the available knowledge on the role and impact of policy instruments on the adoption and implementation of these practices.

## 1.1 Soil Improving Cropping Systems

Soil improving cropping systems (SICS) are cropping systems that improve soil quality (and hence its functions), and that have positive impacts on the profitability and sustainability of cropping systems (see Box 1.1). The term is relatively new in academic literature, but include crops (crop types, crop rotations, cover crops, fallows, etc.), inputs and agro-management techniques. For the purposes of this study, the last two are considered together, as it is often difficult to separate them. Within each component, sub-components can be distinguished, with different soil improving properties.

*Box 1.1: A definition of soil quality<sup>3</sup>*

SICS are expected to improve soil quality and thereby profitability and sustainability. Soil quality is defined briefly as 'the capacity of the soil to function', which in cropping systems translates to 'the capacity of the soil to sustain high crop yields with minimal environmental impacts'. The crop yield potential is defined by:

- (i) the yield defining factors climate, carbon dioxide concentration, and genetic potential of the crop,
- (ii) the yield limiting factors water and nutrient availability, and
- (iii) the yield reducing factors pests, diseases, weeds and pollutants (including high concentrations salts). Hence, the concept of soil quality boils down here to its role in crop yield limiting and reducing factors.

Cropping systems and soil types vary significantly across Europe due to different environmental and socio-economic conditions, and as such, soil threats are often site or region specific. For example, salinization and desertification are greater risks in the Mediterranean than in northern Europe, while soil compaction is a greater risk in the intensive, mechanized

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<sup>3</sup> D2.1 – A review of soil improving cropping systems, available at : <https://www.soilcare-project.eu/downloads/public-documents/soilcare-reports/75-report-06-d2-1-a-review-of-soil-improving-cropping-systems-wenr-oene-oenema>

and large-scale cropping systems in western Europe and some part of central Europe than in the small-scale and less intensive cropping systems in, for example, Romania. These spatial variations would suggest that SICS, and indeed any combination of SICS would need to be tailored to the local context. However, it is possible to derive some general principles, mechanisms, guidelines and recommendations.

An ideal set of SICS would consist of a particular crop rotation and an 'integrated' combination of inputs and management techniques. The SoilCare project has identified a total of 8 major cropping systems based on EUROSTAT data, which are listed below along with other SICS. The cropping systems are all rotations with a minimum of three crops, with five including cereals, as cereals is by far the most dominant arable crop, and generally have a positive effect on soil quality when grown in rotation. The other three are rotations with horticultural crops, mixed crop – animal systems, and permanent cropping systems.

Table 1.1: List of promising general SICS<sup>3</sup>

Component	Expected impact
<b>Crop rotation</b>	Improves crop productivity, soil biodiversity and system sustainability; decreases need for pesticides and risk of erosion
<b>Green manures, cover crops, catch crops</b>	Improves SOM content, soil structure, soil biodiversity, nutrient use efficiency; decreases nutrient leaching, run-off, erosion
<b>Integrated nutrient management</b>	Improves crop productivity, soil nutrient status and resource use efficiency;
<b>Enhanced efficiency irrigation</b>	Improves crop productivity and resource use efficiency; minimizes risks of salinization and desertification
<b>Controlled drainage</b>	Improves crop productivity and resource use efficiency; minimizes the risk of waterlogging
<b>Reduced tillage</b>	Reduces energy cost and may enhance SOM content and soil structure; may increase the need for herbicides/ pesticides
<b>Integrated pest management</b>	Improves crop productivity and resource use efficiency; minimizes the loss of biodiversity.
<b>Smart weed control</b>	Improves crop productivity and resource use efficiency; may decrease the need for herbicides
<b>Smart residue management</b>	Reduces evaporation and soil temperature; may increase/decrease the succes of germination
<b>Controlled trafficking</b>	Reduces energy cost and the risk of soil compaction
<b>Integrated landscape management</b>	Improves biodiversty and cropping systems sustainability

## 1.2 Policy as a driver for Soil Improving Cropping Systems adoption

Farmer uptake is a key, if not the key, factor linked to the effectiveness of interventions to improve environmental quality in agriculture (Finn et al., 2007). This means that even the best intentions of policy makers will not make a difference to the environment, unless the famers are able and willing to adopt SICS. Various studies have acknowledged the lack of universal explanations for farmers' decisions to adopt on-farm conservation measures (e.g. OECD, 2001;

Knowler and Bradshaw, 2007; Gjertsen & Barrett, 2004). This reflects the fact that the effectiveness of policy instruments varies according to the context, which they are applied. Moreover, all policy options operate in a landscape of existing forms of intervention, both compulsory and voluntary. Under these complex circumstances, it is more appropriate to ask what the appropriate mix of compulsory and voluntary policy options is to promote adoption (OECD, 2001, 2012; Cocklin, Mautner and Dibden, 2007; Posthumus and Morris, 2010; Barnes et al., 2013; Mazerolle & Ransley, 2004). At the same time, policy design is only part of the reason farmers may not adopt SICS.

Measures to protect, maintain and improve soil quality are found in various regional, national and international policies. Policies can directly target soil quality or more indirectly have positive side effects on soils. While policy instruments can be complex and multi-faceted, they can be broadly grouped into the following four categories, according to the level of intervention or the restriction of choice that each entail<sup>4</sup>:

- Mandatory regulation;
- Economic instruments;
- Voluntary approaches;
- Educational-informational instruments.

The aim of the literature review is to understand the role and impact of policy instruments with regard to adoption and implementation of soil improving cropping systems. Different policy approaches and instruments are explored, and the overarching question asked: under which conditions do policy instruments — or mix of policy instruments — encourage the adoption of SICS?

To answer this, we draw on the wider literature about on-farm conservation measures. We explore empirical findings stemming from the mechanisms and impacts of different types of policy instruments as well as contextual factors found to support or hinder the uptake of agri-environmental practices. Rather than focusing solely on research on farmer-adoption of soil improving practices or cropping systems, we review a wider set of literature on agri-environmental schemes and conservation agriculture in general as well as specific practices, such as no tillage practices. There are two primary reasons for this: first, there are too many gaps in the adoption and regulation literature on the theme of soil conservation in agriculture for the drawing up of a comprehensive review of all policy approaches, and second, because of the parallels between the adoption of soil improving practices and on-farm conservation or agri-environmental schemes in general.

Soil degradation is not just an ecological problem it is also an institutional, social and economic problem, and therefore, soil degradation needs to be addressed and investigated from a

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<sup>4</sup> The typology of policy instruments is taken from Cocklin, Mautner and Dibden (2007), although similar categories are widely used in the study of public policy.

multidisciplinary perspective. Knowing how to best promote the uptake of soil-improving agricultural practices will require conducting systematic, cross-case comparisons of adoption and the multitude of factors shaping this process, and therefore, research needs to be guided by a common framework that takes the interdependencies between ecological and social systems into account. Such a framework should consider environmental conditions, farming practices impacting on soil conservation, different types of actors, policies, institutions and governance structures.

The key questions guiding the literature review are:

- Which types of policies, instruments and practices exist?
- How do the different policies, instruments and practices work in practice (mechanisms/impacts)?
- To what extent do policies facilitate adoption of soil-improving cropping systems (evidence)?
- Which are the factors shaping success or failure of a policy instrument?
- Which factors shape farmer adoption of soil-improving cropping systems?

The structure of this review follows the broad policy categories introduced previously: regulation, economic instruments, voluntary approaches, and education and informational instruments (see **Error! Reference source not found.**). Each section begins with a description of each type of policy approach, along with examples of specific policy instruments. The theoretical underpinning and debates relevant to the policy approach are then analysed, and empirical evidence from the literature about the operation of each policy instrument in practice is explored. The pros and cons of the instrument are identified and then the factors influencing the SICS adoption are introduced. Overall conclusions are presented, focusing on key lessons learned on effectiveness, and factors affecting policy impact.

In addition, the literature review includes a section (1.2.5) on the role of institutions and governance, an important factor recurrent in the reviewed literature. Although not a policy instrument, it is relevant because it influences the context in which decisions are made. Institutions and governance can therefore inform context-dependent policy design or be adjusted by policy makers as a way to facilitate long term change of practices.

*Table 1.2: Summary of policy approaches*

Policy approach	Premise
Regulatory instruments	Force farmers to adopt SICS
Economic instruments	Incentivise farmers to adopt SICS using subsidies and taxes etc.
Voluntary instruments	Encourage farmers to adopt SICS
Educational/information instruments	Educate farmers so they understand the importance of SICS

### 1.2.1 Regulatory instruments

Regulation can be defined in different ways, both broadly and narrowly. Here, we refer to 'direct regulation'<sup>5</sup>, conceived as all forms of mandatory standards or practices; those that eliminate choice. It is assumed that regulation will oblige individuals to act in a certain way, based on sufficient penalties for non-compliance (Nuffield Council on Bioethics, 2012).

Examples of the policy instruments in this category include: statutes, fines, zoning (FAO, 2001), discharge standards, licensing, technology/design requirements, bans or limits on inputs and outputs the banning of certain practices (Cocklin, Mautner and Dibden, 2007). At the level of the European Union, a range of existing policies have the potential to address all recognised soil degradation processes occurring in agriculture (Louwagie et al., 2011). Cross-compliance, including synergies with environmental directives, and rural development policy, are the main relevant instruments. However, not all policy measures are implemented in every Member State or region, nor are they implemented in the same way (see also Kutter et al. 2011).

There are competing theories relating to the role of regulation in promoting behavioural change<sup>6</sup>. A more traditional perspective sees direct regulation, or 'standard-setting' as a way to automatically restrict some behaviours and encourage others (Lodge & Wegrich, 2012). Other studies stress the importance of direct regulation for setting minimum standards (e.g. Gunningham, 2004). On the other hand, regulation can only impact SICS adoption if it is complied with and correctly implemented. Whether regulation affects SICS adoption or not depends on compliance, which, in turn, depends on the factors discussed below: farmer attitude, monitoring and enforcement, practicalities, synergies with other instruments, and social learning and social bonding.

#### *Effectiveness of direct regulation*

The empirical literature explores two overarching aspects concerning farmers' responses to direct regulation: firstly, their observed behaviour, and secondly, the attitudes and other factors that underpin this behaviour. The critiques are mainly based on three aspects: firstly, individuals do not necessarily comply with regulations, secondly, even where individuals comply on paper, they may practise behaviours that subvert the goals of the regulation, and thirdly direct regulations may only motivate individuals to comply with the minimum standard set, rather than improving beyond it (Lodge & Wegrich, 2012).

The available empirical evidence shows that regulation may be effective. Cocklin et al. (2007) show that farmers support the role of regulation for controlling "rogue" actors and setting minimum standards for environmental protection (see also Greiner & Gregg, 2011). Similarly, a survey of UK farmers found that the threat of prosecution for bad practices within agri-environmental schemes prompted farmers to change not only their practices but also their

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<sup>5</sup> Also referred to as 'classical' or 'command and control' regulation (e.g. Lodge & Wegrich, 2012).

<sup>6</sup> For a summary of the different perspectives, see Barnes et al., 2013

attitudes (Posthumus & Morris, 2010). A survey carried out in Finland, where agri-environmental schemes operate under a quasi-cross-compliance arrangement, shows that uptake is far higher at 75% compared to around 10% in other member states such as the Netherlands and Spain (Mettepenningen et al., 2013).

Conversely, several studies have found that direct regulation often fails to change behaviour (Cocklin, Mautner and Dibden, 2007), and that it encounters significant levels of resistance (Ravenborg and Guerrero, 1999; Macgregor and Warren, 2006; Barnes et al., 2009, cited in Barnes et al., 2013). For example, a study of the impact of policy instruments on forest management in Flanders, Belgium, found that less than 28% of private landowners were in compliance with the mandatory requirement to have an approved management plan for forested properties over 5 hectares (Serbruyns & Luysaert, 2006). Gachango et al. (2015) found that in general, farmers have a negative attitude towards regulatory nutrient reductions measures despite the fact that a relatively large number of them had adopted voluntary environmental measures.

Barnes et al. (2013) found that there was no difference in adoption rates of water quality management techniques between farmers living within (mandatory) and outside (voluntary) a 'Nitrate Vulnerable Zone' (NVZ) in Scotland. Farmers' preference was therefore for regulation to be used as a measure of last resort, and for it to be accompanied by education and training about its logic and implications. This suggests that regulation may be successful at setting minimum standards of behaviour and environmental protection, but for higher levels of protection other policy instruments may be required.

Although command and control approaches have increasingly been superseded in practice by more flexible approaches (Cocklin, Mautner and Dibden, 2007; Lodge and Wegrich, 2012), there is also increasing recognition of the risk that informal measures fail to reach those who have no intention of complying voluntarily (Gunningham & Johnstone, 1999). However, for regulation to be successful, the appropriate monitoring and enforcement measures must be in place, and farmers must be capable of implementing the regulation.

#### *Factors determining adoption of SICS*

Various literary sources identify factors that either block or promote the adoption of SICS using direct regulation. The distinction must be made between compliance (i.e. SICS are adopted) and attitude change (SICS are adopted, but given the opportunity, behaviour would revert to conventional farming practices). These factors examine the role of monitoring and enforcement, capacity, potential for exploitation, and social learning and social bonding.

Regulatory instruments need to be monitored and effective sanctions put in place for non-compliance in order to be successful in prompting adoption, (Nuffield Council on Bioethics, 2012). There is a body of literature examining how enforcement can impact whether a regulation can successfully prompt behavioural change. However, there is a debate over the type of enforcement that is most effective in promoting compliance, centring around the use

of 'legalistic' enforcement, versus 'cooperative' enforcement (May & Winter, 1999), or the 'punish or persuade' debate (Sarre & Johnstone, 2004). May & Winter (1999) found in their study of enforcement and compliance with environmental policies in Danish agriculture, that cooperative enforcement approaches are found to be more effective than excessively legal enforcement styles. On the other hand, the same study found that overly cooperative enforcement styles left enforcement open to capture by agricultural organisations.

Another factor impacting the potential for regulation to impact SICS are the potential practical implementation barriers. This is especially applicable to SICS because they are highly contextual, so a "one-size fits all" approach could be less effective in easing implementation barriers compared to a more flexible, context specific approach. The implementation of regulations need to be financially and technical feasible, otherwise they risk putting farmers out of business, or being met with non-compliance rather than adoption. Similarly, regulations need to be consistent with other regulations, at national and international level, so that individuals can comply (e.g. OECD, 2001).

Attitude (as opposed to technological or other capacity) is often found to be a major contributing factor to non-compliant behaviour. Several studies have found farmer attitudes towards regulation to be extremely negative. Cocklin et al. (2007) report a largely negative response towards regulation amongst farmers in Australia, which could be driving resistance to adoption. Breaking down attitudes further, Barnes et al. (2013) generally found that farmers' attitudes towards direct regulation are mainly characterised by: 1) an aversion to responsibility (Hayman and Alston, 1999; McDermaid, 2005; Nguyen et al., 2006; Popp and Rodriguez, 2007), and 2) a lack of knowledge about the regulations' purpose (Bosch et al., 1995; Widdison et al., 2004; Nimmo Smith et al., 2007; Sang and Birnie, 2008 cited in Barnes et al., 2013). In any case, individuals who are more predisposed to resist a regulation require great levels of coercion and prescriptiveness than compliant ones (Lodge & Wegrich, 2012).

Even when farmers technically comply, regulations have been associated with negative behaviours such as exploiting loopholes and game-playing (see Barnes et al., 2013). In a survey of UK farmers on the introduction of compulsory set-aside measures, the authors report instances where farmers adapted implementation to suit their own purposes, even amongst farmer who are generally sympathetic to conservation measures (Walford 2002).

In the worst cases, it is theorised that as regulations do not necessarily change attitudes, they can lead to deviant behaviours amongst those who are opposed to them, meaning that they do not implement them in the intended way (Walford, 2002). This could have a lot of pertinence for the agricultural sector as farmers are traditionally seen as a group who are sceptical of government regulations (Cocklin, Mautner and Dibden, 2007).

Similarly, compulsory measures often fail to encourage long term behavioural change. A survey of arable farmers' responses to the introduction in 1992 of compulsory set aside measures under the CAP found that 95% stated that they would return land to production if

the restrictions were lifted (Robinson & Lind, 1999, cited in (Walford, 2002). Such evidence stresses that once regulation is in place, it is hard to dismantle it, which may potentially lead to a vicious cycle of more regulation (Barnes et al., 2013).

### 1.2.2 Economic Instruments

Economic or 'market' instruments act to correct market failure caused by negative externalities. Such negative externalities exist as conservation agriculture which do not always lead to financial gain<sup>7</sup>. As with regulatory instruments, there are different conceptions of what constitutes an economic policy instrument. This review employs the distinctions used in Cocklin et al. (2007), where economic instruments are those designed to address some form of pricing signal, affecting which practices are easily adoptable or not from a financial standpoint. These can include negative or positive incentives (Pannell, 2008), and different levels of restriction on choices, depending on the level of incentive. Some economic instruments have the added advantage of generating public revenue, which in turn can be used for environmentally-friendly investments (TEEB, 2009).

Examples include taxes and subsidies, tradable entitlements, auction systems, incentives, and payments. Existing examples in EU agricultural policy include direct payments (area-based subsidies) under Pillar I of the CAP conditional on compliance with environmental standards with financial sanctions for non-compliance through deductions of area-based payments, grants for agri-environmental schemes under Pillar II of the CAP, and experiments with competitive bidding (Mettepenningen et al., 2013).

#### *Effectiveness of economic instruments*

Economic instruments are based on Rational-Choice theory, which posits that individuals are 'rational' actors who respond to price signals and will therefore adopt practices where the private benefits outweigh the costs (e.g. Boardman et al., 2003, cited in de Graaf et al., 2010; Pannell, 2008). Therefore, from this perspective, economic instruments can be used to 'internalise' negative environmental consequences or 'externalities', so that less desirable practices incur higher personal costs and more desirable practices become comparatively cheaper or financially attractive (see box 1.2 for a more detailed explanation).

The steady loss of soil is closely tied to its economic invisibility, as the resource is degraded without understanding the value of what is being lost (TEEB, 2009). Economic instruments are a way of making people aware of the cost. In addition, research suggests that monetary incentives provide farmers with the economic security to adopt long-term behavioural changes, highlighting the strategic benefits of economic instruments (Pannell, 2008). It is often necessary to have financial incentives or compensation for the adoption of practices for which farmers incur costs or which impose constraints on their behaviour. Taxes, for example on

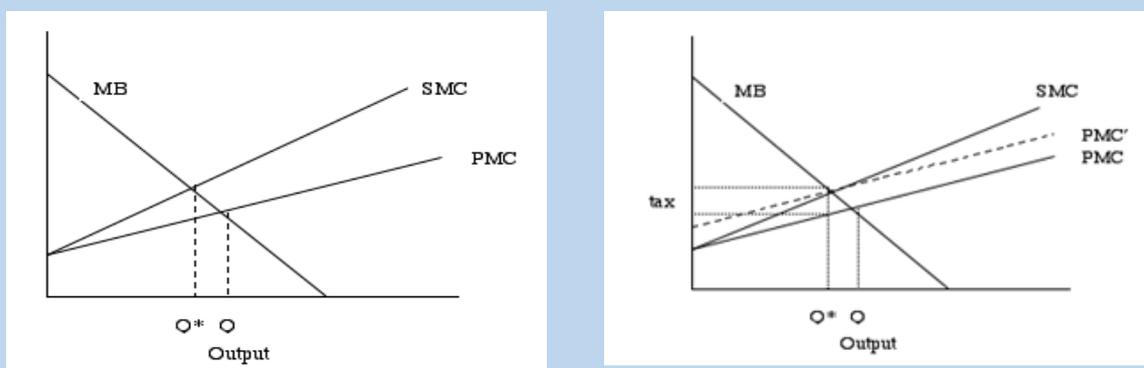
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<sup>7</sup> See FAO (2001) for more information on the deficit between conservation agriculture and financial gain.

pesticide use, are seen as being flexible, can be progressively implemented (giving farmers time to adjust their production decisions), do not impose any particular practice, and involves fewer management costs than other instruments (Aubertot et al., 2005, cited in Femenia & Letort, 2014).

*Box 1.2: Visualising market failure*

Market failure occurs when social costs are not taken into consideration. The figure below shows Marginal Benefit (MB) with respect to Social Marginal Costs (SMC) and Private Marginal Costs (PMC). If negative externalities are not taken into account, the optimal output for farmers is Q (Quantity), which is above the social optimum  $Q^*$ . However, if a tax is introduced (see figure below), the optimal outcome shifts from Q to  $Q^*$ , and thus the market failure is mitigated.



Source: Geoff Lewis, 'Externalities' Lecture: PUBL 303/ECON307, Victoria University Wellington, 27 July 2011

Despite this, there is substantial evidence of cases where the farmers' adoption of conservation related measures has been low despite there being adequate financial incentives. Duesberg et al. (2014) found, for example, that a majority of farmers surveyed will not make their decision to plant trees on their land based on profit maximisation goals, thus offering only such financial incentives will not be effective. Indeed, Greiner & Gregg (2011) found that farmers in northern Australia had very high levels of conservation and lifestyle motivations and were motivated less by financial and economic incentives. As pointed out by Rode et al. (2015), the use of economic incentives can either undermine or reinforce people's intrinsic motivations, with more evidence found for the former than the latter. This would suggest that incentivising behaviour change using economic rewards would lead to fewer SICS being adopted than using incentives related to moral commitment towards nature conservation. Rode et al. stress that such intrinsic motivations must be understood before economic incentives are introduced to avoid any detrimental long-term effects.

In addition to this, various scholars refer to "perverse incentives", such as high uptake in marginalised, 'least favoured areas' (Posthumus & Morris, 2010); or farmers receiving payments for set-aside on land where the application of chemical inputs was already prohibited, for example near water courses (Walford, 2002), or applying for subsidies for

practices they were going to implement anyway (Serbruyns & Luysaert, 2006). Such inefficiencies can be detrimental to the overall effectiveness of the economic instruments – such instruments often carry high administrative and transaction costs, including for monitoring, compliance and prosecution (TEEB, 2009). As such, if economic instruments are to be used, they need to generate more benefits than costs.

### *Factors determining adoption of SICS*

Financial support can help overcome large initial investments and transition costs, or where adoption is (possibly) unprofitable for the farmer, (FAO, 2001, Kassam et al., 2014). Ridier et al. (2012) found that the greater the sunk costs, the more likely farmers will continue using SICS over time. However, they also note that the greater the sunk costs, the more reluctant farmers will be to engage in costly innovative practices, which would suggest that policy makers have only one chance to get things right with regard to policy design. Financial support is also a way of retiring marginal land and reducing farming intensity (Cocklin et al., 2007). In turn, making practices financially affordable or profitable can make farmers more receptive to—or increase the impact of—other policy tools such as extension services (Pannell, 2008). For example, Pannell (2008) argues that extension services will only accelerate adoption where practices do not incur costs, therefore in these cases it should be combined with other instruments.

The type of economic instrument used is also vital when determining if it will increase the adoption of SICS. Skevas et al. (2012) found that when looking at economic instruments to curb pesticide use, taxes based on toxicity did not lead to a substitution of high- with low-toxicity pesticides. Similarly, subsidies on low-toxicity were not found to affect the use of high-toxicity products. They did find, however, that pesticide quotas were more likely at reducing pesticide use and environmental spill over.

Large-scale farmers may be better placed to respond to tax breaks than small (Walford, 2002; Cocklin et al., 2007). But large, commercially oriented farmers (especially arable) may also require larger economic incentives to switch from intensive production, due to higher economies of scale from food production than environmental services (Gailhard & Bojnec, 2015).

Ridier et al. (2012) found that market trends will affect the adoption of SICS. As the price for certain crops (for example, those with long innovative rotation) rises, more farmers will grow those crops, regardless of whether it is a SICS or not. Bossange et al. (2016) also found that the cost of farming was one of the key reasons farmers would not adopt SICS – farmers interviewed said they could not afford to have long rotation crops. Economic instruments would be one way to artificially drive these prices up.

Another key factor influencing SICS adoption is farmer attitude. While this does not play such a large role as it does in other policy tools, research conducted by Cocklin et al., (2007) showed that trust in the continuity of schemes was an important aspect of any land stewardship

scheme, and that frustration with frequent changes in policies was a barrier to future adoption.<sup>8</sup> In addition, the success of economic instruments may also be impacted by how risk-adverse the farmer is. As pointed out by Ridier et al. (2012), SICS are perceived by farmers as risk increasing because of the uncertainty regarding the expected yield of the new practices. A higher economic incentive would therefore be needed before such a risk-adverse farmer would adopt SICS.

As in the previous section on regulation, available knowledge suggests that the policy mix might impact on the success of economic instruments. Various studies have found that a combination of regulation and financial incentives is needed to promote adoption (Posthumus & Morris, 2010; Ring et al., 2010; Barnes et al., 2013; OECD, 2012; Gunningham, 2004; Sarre, in Johnstone & Sarre, 2004, p.5), with the mix being adapted to specific circumstances.

### 1.2.3 Voluntary instruments

Voluntary approaches allow individuals to choose whether they take part or not. A farmer's decision to utilise such voluntary instruments may be intrinsically linked with other policy instruments, for example, the decision may be based on requirements under a regulation or a financial incentive. This section examines the various voluntary instruments and their effectiveness but should not be considered in isolation from the previous sections.

Voluntary approaches encompass a wide range of individual instruments including self-regulation, covenant agreements<sup>9</sup> and specific programmes (Cocklin et al., 2007). In the EU, the clearest example of voluntary approaches relevant to the adoption of SICS are the specific programs under Pillar II of the CAP, along with other specific EU environmental programs that farmers can take part in, such as Natura 2000 and LIFE funding. While it is less widespread, the discussion of other forms of voluntary instruments such as self-regulation and covenant agreements is also relevant to the question of the uptake of SICS by farmers.

Voluntary approaches have the potential to overcome the disadvantage with regulatory approaches which either not being complied with or only encouraging minimum standards of behaviour necessary to comply with the regulation (Gunningham, 2004). They are also an opportunity to increase adoption by accommodating the particular capacities and constraints facing different farmers or farming groups (depending on how flexible their provisions are). Self-regulation, for example, is posited a way to reduce the compliance costs of command and control regulation, by placing rule-making power in the hands of the regulated sector (Lodge and Wegrich, 2012, p. 102). As another example, covenants can encourage adoption and compliance because they are agreed to by the landholder, making the ownership more bottom-up. Despite this, some academics and practitioners are wary of the effectiveness of

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<sup>8</sup> The impact of trust on SICS adoption will be addressed in more detail in the research carried out under WP3 of the SoilCare project.

<sup>9</sup> A covenant involves an agreement voluntarily entered into but legally binding, which restricts the use of the land in question to agreed uses (Kabii & Horwitz, 2006)

voluntary instruments. A major criticism of self-regulatory tools is that they risk encouraging weak standards by giving the regulated operator too much say (Lodge and Wegrich, 2012).

### *Effectiveness of voluntary instruments*

One of the major theories applied to study the adoption of voluntary schemes is the theory of reasoned action and planned behaviour, which defines the relationship between attitudes and actions (e.g. Baumgart-Getz et al., 2012; Wauters, 2008, cited in de Graaf et al., 2010; Gailhard & Bojnec, 2015; Mettepenningen et al., 2013). According to the theory, background characteristics such as socio-economic and individual variables inform individuals' attitude towards a practice, their perceived and actual experience with performing a certain activity, and their perception of social norms. For example, farmers who expect to leave their farm to a family member are expected to be more likely to conserve soil fertility (Ervin & Ervin, 1982, cited in Baumgart-Getz, Stalker and Floress, 2012). These characteristics therefore influence the intention and adoption of a practice. (Ajzen & Fishbein, 2005, cited in Mettepenningen et al., 2013). This emphasis on planned behaviours and intentions is notably missing from traditional economic models.

Despite this, other studies attribute the uptake of voluntary schemes to utility maximisation – an economic theory that means a farmer would adopt a voluntary practice only if they see rewards (financial or otherwise). For example, Gailhard & Bojnec (2015) apply a profit-maximising model to a study of participation in agri-environmental schemes in Slovenia. This model assumes that farmers make decisions based on profit (or utility) maximisation and considers all the factors that would affect profit (or utility) maximisation, such as farm size or type (Gailhard and Bojnec, 2015). In addition, farmers with a higher income are hypothesised to be more likely to invest in best management practices due to increased capacity (Prokopy et al., 2008; Baumgart-Getz, Stalker and Floress, 2012). These perspectives place less emphasis on farmer attitude, although some scholars do incorporate attitude into their measurement of utility gained from a certain action.

In relation to the adoption of voluntary programs within agriculture, the theoretical concept of social capital has been deployed to investigate the social networks that farmers belong to and their role in spreading information about a practice and providing role models or generating norms of participation. Although the concept developed by Bourdieu defies any agreed upon definition, and is often vaguely explained in the literature, is here taken to mean: "networks together with shared norms, values and understandings that facilitate co-operation within or among groups" (Keeley, 2007, p. 102). Further, it can relate to either 'bonding' social capital, between individuals, and 'bridging' social capital, between groups or wider networks (de Krom, 2017). Increased levels of social capital should be linked to higher adoption rates because social capital increase awareness of schemes and reduces transaction costs (for example through access to group resources) (de Krom, 2017). On the other hand, it can also have negative effects due to the obligations within a network (Mathijs, 2003).

### *Factors determining adoption of SICS*

There is a well-developed literature on factors influencing the adoption of specific programs especially on agri-environmental schemes under Pillar II of the CAP, and of other voluntary agri-environmental measures such as in forestry and water management. The literature highlights a range of factors affecting the adoption. These can be broadly categorized into demographic, socio-economic and institutional variables on the one hand, and attitudinal and identity-based characteristics on the other.

Empirical evidence regarding the use of voluntary programmes to stimulate adoption of specific practices includes both evidence of actual uptake and analysis of the variables associated with adoption of such programs. Regarding the former, there is some, but limited, evidence of high participation in voluntary programs. This mostly appears to relate to specific contexts, for example in a study of olive grove farmers in the Southern Spanish provinces of Granada and Jaén, 99% of farmers had adopted a soil improving practice, in particular the adoption of non-tillage (Calatrava, Franco and González, 2007). This could be related to the existence and awareness of soil erosion as a particular problem amongst olive grove farmers which has been linked to uptake (Villanueva et al., 2015). Similarly, there is evidence that the voluntary-based Environmental Farm Plan in Ontario was met with comparatively higher levels of compliance than traditional regulatory approaches (FAO, 2001).

Financial incentives are seen as an important factor in the adoption of voluntary schemes or practices (e.g. Posthumus & Morris, 2010). The mechanisms involved largely relate to those outlined in the preceding section and are therefore not further elaborated in this section. However, the impact of various socio-economic variables on uptake, and specific conservation related programs by farmers has been extensively researched. Those highlighted as important are: labour supply in rural markets, farmer age, farm size, nature of tenure, farm profitability, legacy, farmer and technological capacity (see, for example, Knowler & Bradshaw, 2007). To take a more specific example, Gachango et al. (2015), found that the adoption of one or more voluntary agri-environmental technologies is highly related to farm size, when they studied nutrient reduction technology use in Denmark. The findings of this study corresponded to other adoption studies, which found larger farms are more likely to adopt technologies and schemes that may leave part of the farms out of production (Hodge & Reader, 2010; Ma et al., 2012).

However, different studies have yielded different results, which could be due to methodological differences, or the fact that the studies are based on different regions which could affect the results due to other non-controlled for factors. For example, Atari et al. (2009) found that age and formal education were not associated with participation in the Nova Scotia farm environmental plan, whereas several other studies associated younger farmers with increased adoption (Villanueva et al., 2015; Calatrava Leyva et al., 2007; Walford, 2002; Polman & Slangen, 2008) and higher levels of education (Villanueva et al., 2015).

Research into the impact of farm size on participation in voluntary schemes has also yielded mixed results. Polman & Slangen (2008), found that size, farm legacy and farm intensity had no effect on participation in agri-environmental schemes. However, Villannueva et al. (2015) found that larger farms were among the group with the highest uptake of agri-environmental schemes on olive groves in southern Spain, due to higher economies of scale and lower transaction costs. On the other hand, other studies have found that large, especially arable farms, are less likely to partake in agri-environmental schemes due to the higher relative profitability of growing crops (Gailhard and Bojnec, 2015). The same study of farmers in Slovenia found that higher land productivity is associated with participation for small farms. There is therefore likely to be an interaction between different factors conditioning the adoption of voluntary agri-environmental measures, which has not received a comprehensive analysis.

Concerning the other factors highlighted above, most studies tend to find that farm profitability is associated with increased adoption (Calatrava, Franco and González, 2007; Atari et al., 2009). This tallies with evidence that the majority of farmers do not base their decisions primarily on profitability, but that financial stability allows farmers to invest in new practices or take on their risks (Atari et al., 2009; Duesberg, Dhuháin and O'Connor, 2014). The type of farm also appears to have an impact: uptake of voluntary schemes has been found to be higher amongst farmers in marginal areas (Walford, 2002; Posthumus and Morris, 2010). Tenure also appears to affect adoption, for example farmers renting land are less likely to invest soil conservation or in good practices such as conservation agriculture (Walford, 2002; Kabii and Horwitz, 2006; Baumgart-Getz, Stalker and Floress, 2012; Sklenicka et al., 2015).

These studies had highlighted the importance of schemes being designed to take into account farm and farmer characteristics. However, on the basis of existing research, it is as yet inconclusive as to the precise nature of the relationship between these factors and the likelihood of adoption, if indeed a universal relationship exists.

Beyond farm and farmer characteristics or socio-economic variables, is the importance of attitude to decisions to adopt pro-environmental practices (e.g. Barnes et al., 2013; Cocklin et al., 2007; Wauters et al., 2008 cited in De Graaf et al., 2010; Sutherland et al., 2011; Willock et al., 1999; Thompson et al., 2015) or 'farmer identity' (Sulemana et al., 2014). Indeed, this has been seen as an overarching category conditioning the relationship between socio-economic and demographic factors and adoption (Kabii & Horwitz, 2006). In the field of soil management in particular, Wauters et al., (2008) found attitude to be the most important factor explaining the adoption of soil conservation practices in Belgium.

However, some studies have uncovered how the importance of attitude depends on what the attitude is referring to. Some have highlighted the importance of farmer attitudes towards specific best management practices, rather than the environment in general (Azjen, 1985, cited in Baumgart-Getz et al., 2012), whereas others have cited the relationship between environmental awareness and increased adoption (Wilson & Hart 2000; Wynn et al., 2001;

Beedell & Rehman 2000; cited in Mettepenningen et al., 2013). Prokopy et al. (2008) also find that awareness of a practice in general will increase adoption, but that awareness of the consequences of an action has no significant effect.

Attitude can also relate to a farmers' perception of risk and uncertainty, which has been found to be an important influence on adoption decisions (Sattler & Nagel, 2010, cited in de Graff et al., 2010; Greiner & Gregg, 2011; Prokopy et al., 2008) especially regarding markets for new products such as organic produce (Walford, 2002). However, this could potentially relate more to financial risks, as Atari et al. (2009) found that minimizing potential environmental risk was the lowest ranked reason amongst farmers for their participation in the Nova Scotia Environmental Farm Plan.

Finally, studies generally find that social capital plays an important role in explaining behaviour and behavioural change. Social capital has also been linked in areas beyond agriculture to behavioural change regarding natural resource management (Pretty & Ward, 2001; Mathijs, 2003; Prokopy et al., 2008; cited in Barnes et al., 2013). In terms of agriculture, different studies have suggested slightly different relationships between different forms of social capital and adoption. In particular, Kassam et al. (2014) and Baumgart-Getz et al. (2012) highlight the role of farmers' organisations as being positively related to the adoption of conservation agriculture, whereas Polman & Slangen (2008) found that farmers' participation in non-agricultural networks had a positive influence on adoption whereas participation in agricultural networks had a negative influence.

Despite the existence of many voluntary programs available to farmers for conservation measures, several studies show low uptake of voluntary schemes, even when financial incentives are high enough (e.g. Wauters et al., 2010; Duesberg et al., 2014; Ganchango et al., 2015). For example, in the US one study found that only around half of farmers surveyed participated in conservation programs (Smith, Peterson and Leatherman, 2007) and in Denmark 90% of farmers were still practicing conventional farming in 2014 despite the introduction of measures under the Green Growth Agreement, such as government-funded perennial crop production and organic production. An afforestation scheme on agricultural land in Ireland between 1996 and 2009 only resulted in half the target area being planted (Duesberg, Dhubháin and O'Connor, 2014). Various explanations for this have been offered, including the variables linked to adoption discussed above.

*Box 1.3: Example: uptake of covenant agreements*

Kabii & Horwitz (2006) analyse the conditions that lead landowners to enter into covenant agreements. They highlight key factors such as: demographic characteristics of landholders, land tenure, knowledge and awareness, financial situation, perceptions of risks and benefits (financial and other), and the overarching role of attitudes and values (Kabii & Horwitz, 2006). These appear to overlap with the factors linked to the adoption of specific programs. A farmer-led covenant agreement to combat soil erosion was also entered into in Limburg in the Netherlands, in 2000 and then in 2003. Monitoring of the fulfillment of the covenant

remains incomplete, however contrary to the expectations of a negotiated agreement, not all stakeholders have implemented the erosion control measures (Spaan et al., 2010). This implies that as with other forms of regulation, the impact on adoption of self-regulation is also subject to other conditioning factors and should be designed to try and minimized constraints to adoption (Gunningham, in Johnstone and Sarre, 2004).

Low uptake may be affected by attitude towards a specific scheme or agri-environmental schemes in general. As Barnes et al. (2013) assert, those with embedded apathy or resistance would not comply with voluntary instruments. However there appears to be a lack of comprehensive research on the interaction effects between variables that can explain these low adoption figures. There is also a lack of research into non-adoption of voluntary soil conservation practices in particular.

Another criticism relating to voluntary schemes is the issue of whether, contrary to their theoretical potential to encourage higher levels of the targeted behaviour, they may in practice only promote minimum standards. There is some evidence of farmers submitting unproductive land that would not be used anyway for schemes, in order to receive the financial benefits or other incentives attached, for example for set-aside schemes (Gailhard & Bojnec, 2015; Walford, 2002; Hart & Wilson, 2000, cited in Walford, 2002). Therefore, voluntary schemes can be vulnerable like regulation to 'game-playing' behaviours. For this reason, the design of such programs should pay careful consideration to the various incentives offered, and also adapt this to the audience targeted in terms of their attitudes and socio-economic characteristics. Here it may also be important to think about the issue of 'crowding out' intrinsic motivations with financial incentives, as discussed above. At the same time, the low uptake of many schemes suggests that more knowledge is needed on how to reach outside of those who uptake willingly based on favourable attitudes and capacity.

#### **1.2.4 Education and Information**

Educational and informational tools are policy instruments or components of policy instruments which provide or develop some form of formal exchange of information or knowledge, or training. They can also be tools which facilitate the channels for the dissemination and exchange of such information or education. Some examples of instruments that provide information or education include<sup>10</sup>:

- training, information provision,
- peer-to-peer learning,
- eco-labelling and certification,
- naming and faming/shaming,
- workshops, exchange schemes, and

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<sup>10</sup> For further information see Taylor et al., 2013

- research and development.

There are many sub-types within these categories, for example providing information can include: simple information of policies and measures, providing information services specifically geared to behavioural or attitude change, or education and training programmes. Real policy examples include the work of the European Innovation Partnership for agricultural productivity and sustainability (EIP-AGRI) and the Farm Advisory Systems measure under the Rural Development Regulation of the CAP (see Section 4). Other information instruments may indirectly impact on information or education, such as strengthening social networks or institutions that work as channels for information provision.

*Box 1.4: Defining awareness*

Awareness can be broken down into the following categories:

**Cause:** simple awareness of how actions impact environmental quality

**Knowledge:** understanding (in general terms or facts) how environmental quality is affected

**Consequences:** knowing what the consequences of degraded systems are

**Action:** knowledge of programmes then can assist the mitigation of the problems

Source: Adapted from Prokopy et al., 2008

*Effectiveness of education and information instruments*

Education and information have the potential to serve various purposes in terms of influencing adoption. In terms of providing direct information or education, there are two main functions. Firstly, these tools may be a prerequisite for the successful use of regulation and economic instruments (Serbruyns & Luyssaert, 2006). At the most basic level, information tools are useful for bring individuals' attention to policies, mechanisms, or schemes that they were previously unaware of (e.g. Bakker & Trip, 2013; FAO, 2001; Posthumus & Morris, 2010). They can also reduce the costs of adoption for farmers, warning farmers of costly mistakes and encouraging good practices vis-à-vis implementation (see e.g. FAO, 2001; Pannell, 2008).

Secondly, education and information tools can also be used to change attitudes and perceptions, for example explaining the reasons for a policy or programme or changing a farmer's perception of their personal interest. Promoting intrinsic values, such as benevolence and universalism in particular, is linked in the literature to pro-environmental behaviour (Brown & Kasser, 2005; Greiner & Gregg, 2011), as long as they are tailored to different farmer attitudes (Barnes et al., 2013).

In terms of indirectly strengthening channels for information or education, there is increasing interest on the role that social capital plays in encouraging adoption. For instance, this would include which networks a farmer belongs to and what position they occupy within the rural community. In the case of conservation agriculture, social capital through trust between farmers has been cited as one of the necessary conditions for the adoption of conservation agriculture (Kassam et al., 2014). This can be delivered for example through strengthening

farmers' organisations and encouraging peer-to-peer learning rather than through advisers (ibid.).

### *Factors determining adoption of SICS*

Research on adoption of conservation measures also highlights the importance of education for both awareness raising and changing farmers' attitudes (e.g. Greiner et al., 2009, cited in Greiner & Gregg, 2011; Polman & Slangen, 2008; Kassam et al., 2014). Despite this, different types of information appear to have different levels of effectiveness. Prokopy et al., (2008) review studies on best management practice and found that, in general, increased farmer awareness will lead to adoption, but that this depends on the type of awareness, although they did especially find that education never had a negative influence on the adoption of soil management best practices<sup>11</sup>. Awareness of consequences of an action did not significantly affect adoption (Prokopy et al., 2008, cited in Barnes et al., 2013). In general, increased environmental awareness has been found to promote adoption of agri-environmental schemes in the EU (Wynn et al., 2001; Beedell & Rehman, 2000, cited in Mettepenningen et al., 2013).

There is also evidence that different types of farmers may have different informational needs. For example, Gailhard & Bojnec (2015) found that smaller farms needed increased information in order to reduce their transaction costs. This suggests that ideally different levels and types of information should be provided according to different farm and farmer characteristics.

### **1.2.5 The role of institutions and governance**

Rather than being a specific policy instrument, institutions and governance refers to the wider landscape in which policy instruments operate. This applies to the allocation of property rights, social networks (creating the conditions for collective action), and how policies are arrived at (e.g. top down or bottom-up). It is also linked to support and capacity-building, such as through research and knowledge generation; demonstration projects/knowledge diffusion; network building and joint problem solving (Taylor et al., 2013). As institutions and governance relate to the creation of an enabling environment, the remainder of this section looks at research related to their role. An analysis of the institutional and governance contexts that facilitate adoption is thus undertaken.

New institutional economics looks at how institutions and the 'the rules of the game' affect incentives in economic transactions (see Gehnet et al., 2014; Williamson, 2000). More specifically, it considers the impact of institutional aspects such as rules of collective action, property right enforcement, availability of financing tools and information impact on transaction costs, uncertainty and risk. This branch of theory therefore draws attention to the

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<sup>11</sup> Although interestingly enough, they did find that it had a negative effect on nutrient management, pest management, and water management practices (among others). Education was found to have insignificant impact in a number of studies, in total 22 studies, compared to 15 who found positive impacts.

wider institutional factors that play a role in individuals' decision-making. For example, the work of Ostrom (1990) draws attention to the role of institutions such as reputation for the management of common resources. If a policy aims at enhancing collective action to achieve an environmental objective, then it will have to ensure enforcement mechanisms such as reputational costs are in place. Similarly, access to finance will play a role in whether adopting a behaviour is too risky or not (see e.g. Gehnet et al., 2014).

Property rights are another institutional factor that affect the ability to adopt a practice. From the perspective of economic theory, if other incentives or private net benefits are high enough, then an individual will adopt a practice regardless of property rights (Pannell, 2008). The government can play a role in reallocating property rights or issuing flexible property rights such as tradeable pollution permits (Pannell, 2008).

There has also been some work on the institutional design of projects themselves. A notable example is the study by Mettepenningen et al. (2013), which looks at the design aspects of agri-environmental schemes that affect their uptake. This includes: scope (which level the program is implemented at i.e. coordinated landscape level, or individual farms), the level of stakeholder participation in design ('top-down' versus 'bottom-up' approaches), the assistance provided in implementation, flexibility in implementation and the mode of payment. Therefore, this refers to an aspect of the governance and design of specific schemes, which have been discussed in preceding sections.

Institutions and governance are receiving increasing attention in the literature on the adoption of sustainable natural resource management practices. As mentioned, Mettepenningen et al., (2013) found that the institutional organization of AESs is an important factor determining participation rates. Similarly, the study by Getnet et al., (2014) found that the success of economic tools was hampered by the lack of institutions for farmers for risk reduction and incentive creation. Similarly, Kassam et al. (2014) concluded that institutions are an important condition for the adoption of conservation agriculture. They emphasised the need for dynamic supportive institutional capacity, which they characterise as self-organising innovation networks with diverse providers.

In terms of property rights, studies have found that farmers are averse to schemes which they perceive to pose a risk to their property rights (Cocklin et al., 2007). Issues with the definition of property rights have also been cited as one of the reasons for the difficulties implementing economic instruments (ibid.). The distribution and enforcement of property rights can therefore play a role in delineating the rights and responsibilities of farmers towards adoption (OECD, 2001). This implies that policy design should take into account whether property rights are individually or collectively owned by the target audience, or whether a farm or area of land in question is tenant or owner-occupied (see discussion on tenure above), and what role the state has in enforcing or affecting those rights.

Polman & Slangen (2008) investigated the institutional design of contracts. They find that farmers are less likely to enter into contracts which they perceive as weak, or if they have a low level of trust in government. Likewise, in a study of managing land for biodiversity outcomes in Australia, building knowledge, engagement and trust with landholders was considered important (Mitchell et al., 2016). Therefore, strengthening these aspects could be a factor to consider in attempting to increase adoption rates.

Several studies investigating elements of institutional design have also highlighted social capital as an aspect of institutional design which is linked to increased adoption (e.g Polman & Slangen, 2008). Government support building of social capital as part of the Landcare project in Australia was an important factor promoting adoption (Sobels et al., 2001, cited in FAO, 2001). A more in-depth discussion of the role of social capital has been undertaken in previous sections.

### 1.3 Conclusions

This literature review has drawn together theory and evidence from a variety of fields which sheds light on policy instruments and factors linked to the adoption of conservation measures on farms. The wider category of conservation measures rather than soil improving practices or cropping systems was chosen due to the gap in the adoption and regulation literature on the theme of soil conservation in agriculture. However, studies that exist on this topic have also been presented. Moreover, inferences can be drawn from the literature examined for the adoption of soil improving practices themselves, as they share many vital characteristics of agri-environmental schemes in general, perhaps with the exception that soil improving practices are likely to represent more of a clear financial benefit to farmers in the long term than other environmental practices such as minimising downstream water pollution.

The empirical evidence in the literature suggest that direct regulation has a role to play in providing minimum standards for conservation, but that there is opposition amongst many farmers to inflexible regulation which can lead to non-compliance or subversive behaviours. Therefore, regulation is effective for encouraging adoption on paper, but if farmers have a reason to resist it then the manner of adoption may be a weaker form. Regulatory instruments are often embedded in a complex policy landscape, involving other policy instruments that do not eliminate or restrict individual choice, which means that a decision to adopt SICS can often not be attributed to a single policy instrument. It also means there is potential to utilise these opportunities for synergy and to consider how to design the most effective policy package possible. Education, particularly, can play a role in changing farmers' perceptions of a regulation by highlighting the need for a specific piece of regulation. This could help to make practices accepted before they come into force which in turn might encourage long-term compliance and acceptance of a regulation.

Economic incentives can be a powerful tool with which to change farmer behaviour and improve SICS adoption. They offer more flexibility than regulatory instruments, both for the

authorities and the farmer, and may provide farmers with the means to implement the change in cropping system. Whilst a minimum level of economic support may be necessary for the adoption of practices which incur financial or other costs, they are not usually sufficient in themselves to prompt adoption, and risk impinging on intrinsic motivation which may be linked to more long term behavioural change. In the long term, the impact of financial incentives on farmer attitudes should be considered in the design of economic instruments. This includes the level at which incentives are set, the level of flexibility offered, and the interaction and combination with other types of policy instruments, in particular those addressing farmer attitudes.

The literature highlights the favourable attitude of farmers towards voluntary measures, which is an important condition for their adoption. However, the low levels of uptake for most programs studied compared to targets or expectations calls into question their effectiveness at promoting adoption in the absence of other instruments. The literature reviewed illustrates the multitude of factors that can condition the success or otherwise of voluntary approaches in changing farmers' behaviour. First, there is significant evidence of farmers' attitude being a key factor determining adoption, over and above financial incentives. Research suggests that for voluntary approaches to succeed, incentives, including financial need to be high enough to allow participation, but not so high that they 'crowd out' other motivations. Another of the main findings is that voluntary approaches need to allow sufficient flexibility in terms of behaviours or practices, so that they can be adopted in different ways suited to different contexts, for example, this should take into account the availability of rural labour supply, socio-economic contexts, attitudes towards risk, technological capacities and financial capacity. Several studies have found that the level of social capital of a farmer appears to affect their willingness to adopt, in particular the networks that they belong to and the role that they play in the community. Therefore, policies that invest in these types of institutional factors may have a higher long-term chance of success.

Farmers articulate a preference for informational and educational tools. Research shows that farm and farmer characteristics play a role in the impact of informational tools. In particular, if a tradition for innovating exists amongst farmers they are more likely to be receptive to information and education about new technologies. A farmer's attitude towards the environment also clearly conditions the influence that information and education will have on their decision to adopt. In addition, the literature reviewed suggests that the type of information and method through which it is conveyed also has an important bearing on how successfully it can promote uptake of the desired practice(s). Findings show that education is likely to encourage positive attitudes towards a policy, which can facilitate—although not necessarily ensure— adoption. Moreover, these tools are regarded as a slow method for encouraging adoption and are likely to work best if combined with other policy instruments.

Frequently cited prerequisites for policy impact include i) economic viability, ii) physical viability, iii) level of acceptance, and iv) coherence with other standards that farmers need to

comply by, v) attitudinal change, and vi) a supportive institutional environment. This list, however, might be significantly broader and varied, depending on the specific context. Finally, a recurring theme highlighted throughout the literature is the need for pairing different types of policy instruments in order to achieve maximum impact. Rather than asking which type of instrument is appropriate for which situation, it might be more meaningful to question what the most suitable policy mix might be for a given problem.

**Error! Reference source not found.** summarises policy instruments, intended objectives and mechanisms for the four broad policy categories reviewed and identifies factors promoting and limiting policy impact found in the literature. For each instrument, we provide an example of a relevant existing policy instrument at EU-level. As this synthesis demonstrates, there is already a wealth of knowledge available on the benefits and drawbacks associated with different categories and types of policy instruments. Yet, assessments which analyse the shortcomings and opportunities of the current policy framework at EU-level and across Europe are only starting to emerge (e.g. Vrebos et al., 2017; Paleari, 2017). Against this background, the research presented here aims to analyse role, benefits and shortcomings of existing policies and policy instruments in Europe as drivers for the adoption of soil-improving cropping systems.

Table 1.3: Summary of policy instruments, objectives and mechanisms as well as factors impacting on their success and failure compiled from the literature

Policy approach	Instrument	Objective	Mechanism	Examples	Success factors	Failure factors
<b>Regulation</b>	Standard setting	Establish universal standards of conservation/ adoption	Coercion (incl. sanctions) May force behaviour change when unlikely to occur otherwise Minimum standards can be established Perception of a level playing field	Cross compliance under CAP Pillar I	<ul style="list-style-type: none"> <li>• Effective sanctions</li> <li>• Target audience desires to comply/ agrees with restriction</li> <li>• Technology capacity to comply</li> <li>• Financial capacity to comply</li> <li>• Social networks and social learning: peers in compliance</li> <li>• Combination with other tools: sufficient financial compensation; education about reasons for regulation and its implications; strengthening 'good' social capital</li> <li>• Enforcement is appropriate (institutionally, culturally) and does not create resentment or capture</li> <li>• Measures prompt changes in attitudes – e.g. understanding of the impacts of a measure</li> <li>• Practices are already adopted or accepted before regulation comes into force</li> <li>• Consistent with other regulatory obligations</li> </ul>	<ul style="list-style-type: none"> <li>• Resistance due to existing attitude: non-compliance/ game-playing/ adaptation to existing practices/ not moving beyond minimum standards</li> <li>• Resistance to being coerced: non-compliance/ game-playing/ adaptation to existing practices/ not moving beyond minimum standards</li> <li>• Failure to change attitudes over long term: adoption may cease when rules no longer apply</li> <li>• Technology inability to comply</li> <li>• Financial inability to comply</li> <li>• Social networks and social learning: peers not in compliance</li> <li>• Inappropriate enforcement</li> </ul>
	Bans or limits on inputs	Eliminate use of certain inputs: universal adoption	Coercion Sanctions for non-compliance	Banning of pesticides under the Pesticides Regulation (Regulation EC No. 1107/2009)		
	Zoning	Restrict land uses to specified practices	Coercion Sanctions for non-compliance	Natura 2000, Designation of National Parks, Nitrate Vulnerable Zones		
<b>Economic</b>	Subsidies	May adoption beneficial to a larger number of farmers without	Make good practices cheaper to adopt Help overcome large initial investments Reduce transaction costs	CAP Pillar I subsidies	<ul style="list-style-type: none"> <li>• Subsidies must be sufficient for enough farmers to make an overall net benefit</li> <li>• Subsidies make good practices more profitable than primary productivity</li> </ul>	<ul style="list-style-type: none"> <li>• Target audience are not motivated by financial incentives</li> <li>• Lack of trust in continuity of support</li> </ul>

Policy approach	Instrument	Objective	Mechanism	Examples	Success factors	Failure factors
		harming profitability	Ability to make long term changes if maintained Overcome attitudinal barriers <sup>12</sup>		<ul style="list-style-type: none"> <li>• Knowledge of subsidies through awareness raising</li> <li>• Trust in the continuity of support (can be linked to trust in institutions)</li> <li>• Farmers' are relatively risk-accepting if long-term gains unknown</li> <li>• Non-financial barriers are able to be financially compensated</li> <li>• Technically feasible</li> <li>• Farm size or profitability: larger farms more responsive to tax breaks</li> </ul>	<ul style="list-style-type: none"> <li>• Farmers are risk averse where financial impact is unknown</li> <li>• Significant non-financial barriers to adoption exist e.g. lack of motivation.</li> <li>• Non-financial barriers are not able to be financially compensated</li> <li>• Environmental or intrinsic motivations are 'crowded out' affecting quality and longevity of adoption.</li> <li>• Farm size or profitability: larger, commercially oriented farms may have higher economies of scale from food production than environmental services</li> <li>• Auctions: strategic bidding in consecutive rounds creates potential for some who are willing to adopt to be left out or undermines scheme effectiveness.</li> </ul>
	Grants	Encourage adoption beyond minimum standards	Financial incentives – reduce risk of changing practices; help overcome large initial investments Reduce transaction costs	CAP Pillar II Rural Development Programmes		
	Taxes	Reduce occurrence of bad practices	Make bad practices or inputs more expensive to adopt Increase transaction costs	Energy and resource taxes in agriculture		
	Auctions for conservation funding	Make conservation affordable; winner will be most committed to implementing	Funding is based on what farmers can afford or are willing to accept, removing financial barriers to adoption			
<b>Voluntary</b>	Specific programs	Increase adoption and compliance, including beyond	Flexibility on whether to adopt and which practices will encourage adoption: suited to farm and	Agri-environmental schemes (CAP Pillar II), Natura 2000-and LIFE-	<ul style="list-style-type: none"> <li>• Schemes do not involve a financial loss to the farmer</li> <li>• Awareness and recognition of environmental or soil issues as a problem</li> </ul>	<ul style="list-style-type: none"> <li>• It is more profitable for a farmer to use the land for primary production</li> <li>• Groups who have no intention of complying not reached</li> </ul>

<sup>12</sup> N.B. this is debated as there is also evidence of economic incentives crowding out environmental or intrinsic motives

Policy approach	Instrument	Objective	Mechanism	Examples	Success factors	Failure factors
		minimum standards; those who face other barriers to adoption are not penalised	farmer capacity and characteristics. It will also encourage adoption beyond minimum standards by promoting intrinsic motivations	funded schemes	<ul style="list-style-type: none"> <li>• Transaction costs are sufficiently low</li> <li>• Adequate technical capacity including suitable land on which to implement measures (e.g. more marginal, less productive soils); tenure is sufficiently stable for schemes to be worthwhile implementing</li> </ul>	<ul style="list-style-type: none"> <li>• Lack of awareness of programmes</li> <li>• Financial barriers to uptake: incentives are too low, farmer cannot afford to implement the measure, or production is more profitable</li> </ul>
	Self-regulation: Covenants	Increased adoption and compliance, including beyond minimum standards	Landholders agree to measures in advance based on what is practical viability and personal motivation	Farmer-led covenant in Limburg, NL, to combat soil erosion	<ul style="list-style-type: none"> <li>• Environmental attitude or motivation is positive (e.g. of best management practices and/or the environment more generally)</li> <li>• Sufficient flexibility to adapt schemes to different contexts</li> <li>• Role models exist in the community to encourage other farmers to adopt practices</li> <li>• Farmers willing to take risks associated with new practices</li> <li>• Positive social capital: farmers are part of networks which spread awareness of schemes and which can reduce transaction costs (e.g. through access to group resources)</li> <li>• Stakeholders (farmers and non-farmers) are involved in design</li> </ul>	<ul style="list-style-type: none"> <li>• Excessive economic focus 'crowds out' intrinsic motivation</li> <li>• Technical or transactional barriers to uptake – such as topographical, machinery related (e.g. a farmer does not have enough stores to diversify his crop types), rural labour supply; tenure too short to make schemes worth implementing</li> <li>• Psychological barriers to uptake: lack of environmental or other motivation, risk aversion</li> <li>• Negative social capital: farmers are part of networks which promote a negative view of schemes</li> <li>• Penalties are too high: dissuade farmers from participating</li> </ul>

Policy approach	Instrument	Objective	Mechanism	Examples	Success factors	Failure factors
<b>Education and information</b>	Training programs; Extension services; Eco-labelling and certification; Research and Development	Increased adoption and compliance, including beyond minimum standards	Awareness as a first step to adoption; Addressing attitudes and motivations; Building positive social capital; Increasing technical capacity and know-how; Reducing transaction costs	Farm Advisory Services under CAP Pillar II; Farmer Exchange Schemes e.g. Nuffield farm scholarships; LEADER programme Pillar II of the CAP	<ul style="list-style-type: none"> <li>Information is provided free of charge</li> <li>Providers of information or training are perceived as independent (e.g. for some farmers this is state rather than private providers, or peer-to-peer learning rather than through advisers)</li> <li>Financial and technical capacity to act on information or training</li> <li>Type of information and awareness training (e.g. whether awareness of the consequences of an action prompts uptake)</li> <li>Positive social capital: farmers are part of networks which spread awareness of schemes and which can reduce transaction costs (e.g. through access to group resources)</li> <li>Tradition for innovating amongst farmers</li> </ul>	<ul style="list-style-type: none"> <li>Information is provided privately</li> <li>Information and training is provided off farm</li> <li>Information is not free</li> <li>Financial and technical barriers to acting on information or training</li> <li>Psychological barriers to acting based on information</li> <li>Information is only linked to economic incentives: risk of 'crowding out' intrinsic motivations over long term</li> <li>Negative social capital: farmers are part of networks which do not encourage environmentally friendly farming methods</li> <li>Information, training or R&amp;D is unsuitable to farm context</li> </ul>

## 2 Research objectives, methods and scope

The overall ambition of this work is to develop a better understanding of how policy measures should be designed to encourage farmers to adopt effective soil improving practices. More specifically, this task aims to analyse the role, benefits and shortcomings of policies and policy instruments in Europe as drivers for the adoption of soil-improving cropping systems by systematically collecting evidence of the mechanisms and impacts of policies currently shaping agricultural practice in Europe. In support of this aim, the following objectives were defined:

- A. To identify existing policies and policy instruments at EU-level as well as national and (sub)regional level in selected European countries promoting soil quality, and particularly the adoption of soil-improving cropping systems
- B. To assess the extent to which existing policies, policy instruments and practices promote the adoption of soil-improving cropping systems.
- C. To identify contextual factors, particularly institutional settings, influencing policy impact on farmer adoption.

To operationalise these objectives, a set of key research questions has been defined, described in Table 2.1 below.

*Table 2.1: Research objectives and questions*

Research objectives	Research questions
A. To identify existing policies and policy instruments at EU-level as well as national and (sub)regional level in selected European countries promoting soil quality, and particularly the adoption of soil-improving cropping systems	<ol style="list-style-type: none"> <li>1. Which existing policies, instruments and practices shape agricultural practices?</li> <li>2. What are the intended mechanisms and impacts of existing policies, instruments and practices</li> </ol>
B. To assess the extent to which existing policies, policy instruments and practices promote the adoption of soil-improving cropping systems.	<ol style="list-style-type: none"> <li>3. To what extent do existing policies facilitate adoption of soil-improving practices?</li> </ol>
C. To identify contextual factors, particularly institutional settings, influencing policy impact on farmer adoption.	<ol style="list-style-type: none"> <li>4. Which factors shape success or failure of a policy instrument?</li> </ol>

### 2.1 Definitions and scope of analysis

This work focuses on identifying and analysing existing policies and policy instruments and their potential to promote soil quality, and particularly the adoption of soil-improving cropping systems, where:

**Policy**, loosely defined, is “officially accepted set of rules or ideas about what should be

done<sup>13</sup> or “a system of courses of action with a common long-term objective (or objectives) formulated by governmental entities or its representatives”.<sup>14</sup> For the purposes of this study, the analysis will broadly distinguish between the following categories proposed by Cocklin, Mautner and Dibden (2007):

- Regulatory instruments
- Planning instruments
- Economic instruments
- Information-/ education-based instruments

Policy mapping and analysis is conducted at three **levels of governance**:

1. EU-level
2. National level
3. Regional or sub-regional level

Across these levels, we distinguished between **two types of policies based on where they originate from**:

1. EU-level policies, and national, regional and sub-regional policies in the 16 study site countries which are linked to or partially linked to EU-level policy, and
2. National, regional and sub-regional policies in the study site countries which are not linked to EU-level policy.

Within each category, a list of **specific instruments and interventions** can be defined (see Table 2.2).

*Table 2.2: Types and functions of policy instruments*

<b>Policy category</b>	<b>Instruments</b>	<b>Functions</b>
Regulatory instruments	National, state/regional, local laws and ordinances Targets Standards Bans Permits/quotas Planning/zoning	Imposing obligations, prohibitions or restrictions. Introducing standards.
Planning instruments	Action programmes Strategies	Orienting policy-making.

<sup>13</sup> <http://learnersdictionary.com/definition/policy>

<sup>14</sup> <https://www.thefreedictionary.com/policy>

Policy category	Instruments	Functions
	Communications (e.g. green papers, white papers, roadmaps)	
Economic instruments	Pricing, such as tariffs, taxes and charges and tradable allowances Subsidies Risk liability schemes Green public procurement Voluntary agreements	Sanctioning or rewarding behaviour through market mechanisms.
Information/education instruments	Information campaigns Labelling Stakeholder and public participation Training Advisory services	Stimulating changes in preferences and behaviour of the public. Generating information for policy formulation and evaluation.

## 2.2 Research strategy and methods

The research adopted a sequential research strategy, with data collection and analysis conducted first at EU level, followed by data collection in the 16 European countries where the 16 SoilCare study sites are located<sup>15</sup>. Figure 2.1 Research design illustrates the overall study design and methods, which were designed to answer specific research questions, although it is acknowledged that these questions are interrelated. Together, findings provide a more comprehensive analysis of the multi-faceted nature of policy impact on the adoption of agricultural practices and a degree of confirmation and completeness which would not have been achieved with one approach alone.

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<sup>15</sup> We use the term 'study site countries' to allow us to refer to both EU and non-EU Member States participating in the site-level activities.

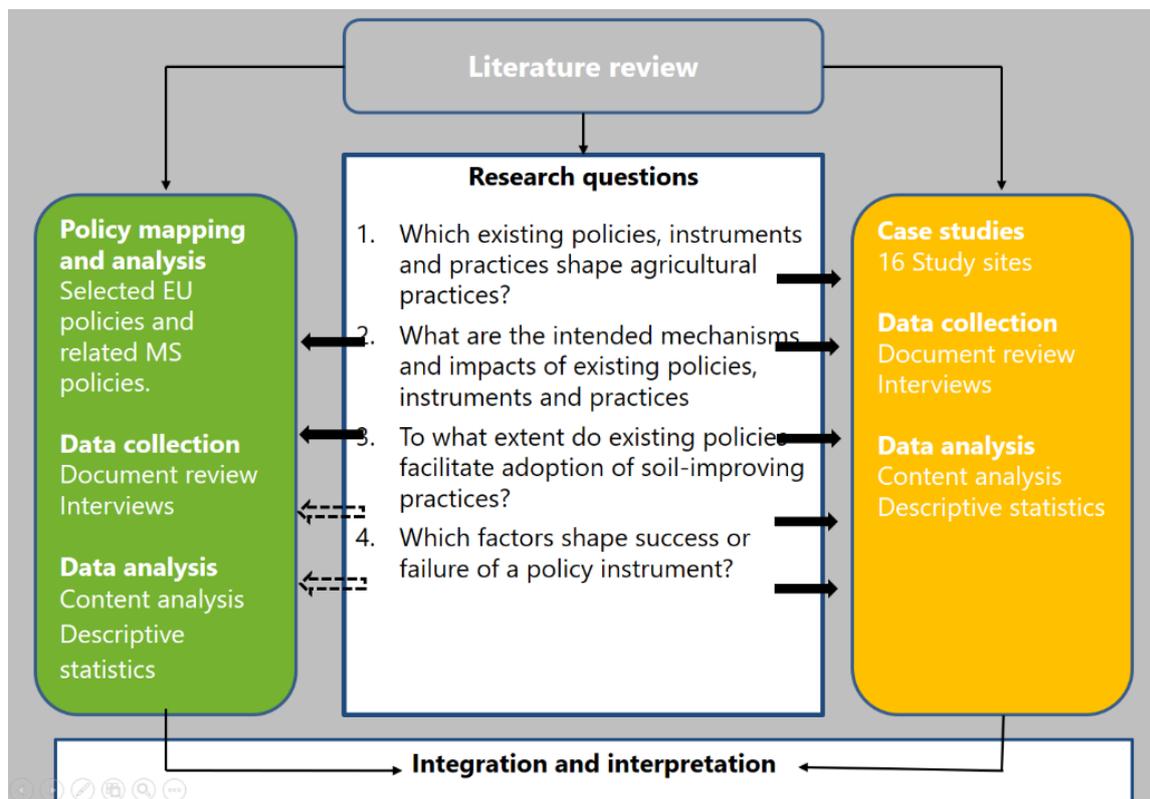


Figure 2.1 Research design

In each of these research streams, the work was carried out in the same sequence of steps, including the following steps:

1. Policy mapping and screening
2. Desk-based analysis of selected policies and instruments
3. Interviews with selected policy-makers
4. Data analysis and integration.

Section 2.2.1 details the research process at EU-level and Section 2.2.2 illustrates how activities were adapted to and implemented in the study site areas.

### 2.2.1 EU-level policy mapping and analysis

Under Step 1, we screened the pool of European strategies, policies and instruments to identify those (at minimum indirectly) related to soil protection.<sup>16</sup> The long list of EU-level policies and

<sup>16</sup> The initial phase of this work greatly benefitted from the WP Leader's involvement in the project *Updated Inventory and Assessment of Soil Protection Policy Instruments in EU Member States*, carried out for DG Environment in 2015 and 16. Final report available at: [http://ec.europa.eu/environment/soil/pdf/Soil\\_inventory\\_report.pdf](http://ec.europa.eu/environment/soil/pdf/Soil_inventory_report.pdf)

instruments included in the scoping exercise can be found in Appendix I. The initial selection was limited to strategies, policies and instruments with at least an indirect link to soil with the main source of information being the original text of the EU strategy, policy or instrument.

Identified policies were clustered into sectoral/environmental areas and then described using the following attributes:

- Name of policy, and link to the official document;
- Governance level;
- Policy category;
- Instruments;
- Notes/comments.

We then applied a set of selection criteria in order to select policies for in-depth analysis:

- Policy addresses soil quality in aims, objectives, instruments -> explicit, implicit, no;
- Policy addresses agricultural practices in aims, objectives, instruments -> explicit, implicit, no;
- Policy end-user/recipient -> policy-maker at EU, national, regional, local level, farmer;

The scoping exercise resulted in an EU-level policy inventory which is available at the project's website at <https://www.soilcare-project.eu/resources/deliverables>.

Having identified those policies with the (potentially) highest impact on agricultural practices, we then conducted an in-depth policy analysis drawing from, a wide range of Commission documents, research reports and the academic literature. The desk-based research was complemented by interviews with EU-level policy-makers and stakeholders.

We conducted 12 interviews in collaboration with WP6 (integrated assessment modelling and scenarios) (see Annex IV). The aim of the EU-level interviews was to gain a deeper understanding of the impact of various EU-level policies on agricultural practices which complemented the desk-based in-depth analysis of EU-level policies, as well as to scope the main uncertainties for the future of Europe and provide input into the development of the Integrated Assessment Model (IAM). The interviews aimed to elicit information on the mechanisms through which agricultural and other policies impact on the practices farmers adopt, i.e. how they work and why. This included questions on the shortcomings of the policies in terms of farmer adoption, and gaps in the EU-level policy framework for encouraging soil conserving/improving agricultural practices as well as the interactions between the different policies, looking at trade-offs and synergies.

Given the above, the type of interviewees considered most appropriate were EU-level policy

experts and strategic thinkers.<sup>17</sup> This included those involved in the policy-making process and strategic development such as officials from the EU institutions, as well as policy experts from NGOs, as well as EU-level farmer associations and other relevant interest groups. The aim was for the sample to match the scope of the policy analysis, i.e. to cover experts in the agricultural and other policy areas being analysed and involved those who have a broader perspective on the future of Europe to understand plausible future developments that might impact on the need, adoption or effectiveness of policies.

A semi-structured interview guide was developed and included questions addressing the following topics (see Annex II):

- The role of and relationships between agricultural practices and soil quality/degradation, including good and bad practices;
- The current EU-level policy framework shape and the impact of various policies on soil-improving agricultural practices, particularly farmer behaviour;
- Successes and challenges of the current EU-level policy framework with regards to promoting soil-improving agricultural practices;
- The extent to which the current policy framework facilitates or hinders the adoption of soil-improving agricultural practices and cropping systems;
- Contextual factors which influence the impact of policy.;
- Links, complementarity and conflicts between individual policies/policy areas;
- Policy gaps, needs for future initiatives, promising future policies or policy options.<sup>18</sup>

### 2.2.2 Policy mapping and analysis in study site countries

The study site-level work followed the same three-step process as the EU-level research (see Annex III). As for the EU-level policy analysis, all policies potentially impacting on the adoption of Soil improving cropping systems in the study sites were identified and briefly described in study site-specific policy inventories. The aim of this step was to provide a broad overview of soil-related national and regional policies as a basis for selecting the most relevant policies for in-depth analysis. To compile the draft inventory, the following guidelines were followed:

- A study site country-level mapping of policies should focus on national, regional or sub-regional policies that are linked to the pre-selected EU policies;

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<sup>17</sup> Those who are concerned with or work with long-term strategies on the future of (rural) Europe,

<sup>18</sup> Additional questions posed by WP6 focused on the drivers of change and their uncertainties, the role of and potential gaps in decision support techniques (data, models, expertise).

- At the regional and sub-regional level, the analysis should concentrate on policies that shape agricultural practices in the study sites only; we are not looking to cover all regions;
- At the initial inventory stage, the scoping exercise should not focus on policies that are specific to the study site countries (i.e. not linked to EU policy) but may include them if information is easily available.

Therefore, the focus was on those instruments which were either transposing the relevant EU legislation at national or regional level. Each policy was then described using a pre-defined set of attributes such as date of adoption, governance scale, type of instrument, link to cropping system (components) etc.<sup>19</sup>

The aim of the in-depth analysis was to describe and analyse those national and regional policies and respective instruments which were identified as the most relevant for the adoption of SICS in the study site through the compilation of the policy inventories. In order to carry out this task, the analytical template developed for and tested at EU-level was applied. Based on this analysis, Study Site Researchers then conducted interviews with policy-makers and stakeholders. These should include both national and regional level policy-makers, with emphasis on the latter. Ideally, selected policy-makers should have a good understanding of and practical experience with policy implementation, for example through working in an agency responsible for implementing Rural Development Programms. Interviews followed the structure as the ones conducted at EU-level (see Annex III).

The results presented here for the country-level analysis draws from the data gathered during the policy mapping. The in-depth analysis and interview data will feed into the next step of the research process, namely the drafting of policy alternatives.

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<sup>19</sup> The policy inventory is available at: <https://www.soilcare-project.eu/resources/deliverables>

## PART II Analysis of EU policies and their potential for promoting SICS adoption

Soil degradation has long been recognised as a problem both at EU and international levels, yet policy responses remain fragmented, with more emphasis on awareness raising than on hard and fast policies to change soil practices. PART II of this report looks at policy initiatives and objectives directly aimed at tackling soil degradation especially in agriculture, firstly at international level and then EU level, although the two levels are becoming increasingly interlinked. The scope is then narrowed further to examine several key pieces of EU legislation which have potential to directly impact the uptake of soil-improving cropping systems.

### 3 International and European soil policy

#### 3.1 United Nations Soil Policy and International Initiatives

The Rio+20 review<sup>20</sup> showed that globally land and soil degradation is extensive, and that fertile soils are being rapidly depleted, compromising agricultural productivity (Keestra et al., 2016) Estimates from 2015 produced by the Economics of Land Degradation (ELD, 2015, see below) initiative, showed that worldwide, 52% of agricultural land is moderately or severely affected by land and soil degradation.<sup>21</sup>

The UN has been the most significant international body addressing the issue, and the main source of influence on EU soil policy from the international sphere. Soil degradation was addressed in several of the recommendations of the 1972 UN Conference on the Human Environment<sup>22</sup>, however, the first legally binding UN agreement concerning soil was the 1994 UN Convention to Combat Desertification. This section introduces these initiatives, as well as the 2015 Sustainable Development Goals, the initiatives undertaken by FAO, and the various awareness-raising campaigns.

##### 3.1.1 UN Convention to Combat Desertification

The UN Convention to Combat Desertification (UNCCD), adopted in 1994, was one of the three Conventions that resulted from the 1992 UN Conference on Environment and Development (also known as the 'Rio Earth Summit'). It was the first legally binding UN international agreement relevant to soil.<sup>23</sup>

The aim of the UNCCD is to prevent or reverse issues of drought, soil productivity and living conditions in the world's drylands.<sup>24</sup> Parties to the Convention can declare themselves 'affected' countries, which then requires them to implement national, regional and sub-regional action programmes for reversing land degradation.<sup>25</sup> Governments are specifically responsible for creating an enabling environment in which bottom-up approaches can be prioritised.<sup>26</sup> The EU is a party to the UNCCD (since 1998<sup>27</sup>) and all EU Member States are also individually either accession countries or ratified parties.<sup>28</sup> 12 EU Member States, all located in

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<sup>20</sup> In 2012, 20 years after the UN 'Rio Earth Summit', the participating countries met to review progress on the 3 Conventions that came out of the Summit: the UNCCD, the UNFCCC and the UNCBD.

<sup>21</sup> COM(2012) Report on the Implementation of the STS

<sup>22</sup> <http://www.un-documents.net/aconf48-14r1.pdf>

<sup>23</sup> <http://www2.unccd.int/convention/about-convention>

<sup>24</sup> UNCCD, Convention text, available at: [http://www2.unccd.int/sites/default/files/relevant-links/2017-01/UNCCD\\_Convention\\_ENG\\_0.pdf](http://www2.unccd.int/sites/default/files/relevant-links/2017-01/UNCCD_Convention_ENG_0.pdf)

<sup>25</sup> <http://www2.unccd.int/convention/about-convention>

<sup>26</sup> <http://www2.unccd.int/sites/default/files/relevant-links/2017-01/An%20explanatory%20leaflet.pdf>

<sup>27</sup> <http://www.unccd.int/Documents/Ratification%20list%20Dec2016.pdf>

<sup>28</sup> <http://www.unccd.int/Documents/Ratification%20list%20Dec2016.pdf>

Central and Eastern Europe, currently have 'affected country status'<sup>29</sup>, and therefore must prepare Regional and National Action programmes identifying contributing factors and measures to combat desertification. The EU stated in 2012 that it was considering whether to declare itself as an 'affected' party given that several EU Member States are affected by desertification.<sup>30</sup>

Progress on the UNCCD was reviewed at the 2012 UN Conference on Sustainable Development ('Rio+20'). The review showed that some progress had been made on land and soil degradation but that it is still a global problem and that fertile soils are still being rapidly depleted (Keestra et al., 2016).

The outcome document of the Rio+20 conference, 'The Future We Want', includes a section on 'Desertification, land degradation and drought'. It recognises the global problem of land degradation, the importance of soil management to sustainable development, and the need to take urgent action to reverse land degradation. It set a target of achieving a land-degradation-neutral world. In the context of the UNCCD, the document also included a pledge to support and strengthen—including financially—the implementation of the UNCCD and its ten-year strategic plan (2008-2018).<sup>31</sup> It also called for the development of scientific indicators, scientific research and sharing of information relevant to land degradation. The target of land-degradation-neutrality (LDN) was taken up as one of the UN Sustainable Development Goals in 2015, making this target legally binding to all signatories (see following section).

The UNCCD first proposed the concept of Zero Net Land Degradation in 2009 (FAO & ITPS, 2015), and the 12th Conference of the Parties (COP) to the UNCCD adopted national voluntary target setting for LDN in 2015. It defined LDN as 'state whereby the amount and quality of land resources necessary to support ecosystem functions and services and enhance food security remain stable or increase within specified temporal and spatial scales and ecosystems'. It adopted three indicators for measuring progress towards LDN: trends in land cover, trends in land productivity or functioning of the land, and trends in carbon stock above and below ground.<sup>32</sup>

### *Economics of Land Degradation initiative*

The Economics of Land Degradation (ELD) was co-founded by the UNCCD Secretariat, the European Commission<sup>33</sup> and the German Ministry for Economic Cooperation and

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<sup>29</sup> Bulgaria, Cyprus, Hungary, Italy, Greece, Latvia, Malta, Portugal, Romania, Slovak Republic, Slovenia and Spain

<sup>30</sup> COM(2012) Report - implementation Soil Thematic Strategy

<sup>31</sup> UNGA, 2012, 'The future we want', Resolution adopted by the General Assembly on 27 July 2012, 66th Session, Agenda Item 19, A/RES/66/288, p. 40

<sup>32</sup> IUCN, Technical Brief, Land Degradation Neutrality

<sup>33</sup> The European Commission remains one of its core donors <http://www.eld-initiative.org/index.php?id=30>

Development in 2012. It functions as a scientific research, knowledge-exchange and discussion platform about how to address land degradation, including analysis of its socio-economic causes. The ELD has carried out various case studies across the globe, including in Europe<sup>34</sup>, looking at different sustainable land management scenarios in the context of cost-benefit analyses. They are mostly scientific studies, but in Spain, Portugal and Germany business case studies have also been carried out.<sup>35</sup>

The first report of the ELD was published in 2015, a special report aimed at policy and decision makers, covering both the economic value of sustainable land management and available policy options, including barriers to overcoming action, although this report did not mention specific practices associated with sustainable land management.<sup>36</sup> Other reports were also published in the same series, including one entitled 'The Value of Land', which offered examples from around the world of best-practice sustainable land management techniques and economic policy instruments.

### *The 2030 Agenda for Sustainable Development and the Sustainable Development Goals*

The UN Sustainable Development Goals (SDGs) are contained in the official '2030 Agenda for Sustainable Development', which were agreed by the UN General Assembly in September 2015 and took effect in January 2016.<sup>37</sup> They comprise 17 goals and 169 targets to be achieved by 2030, which are designed to eradicate poverty and achieve sustainable development 'in its three dimensions—economic, social and environmental'.<sup>38</sup> They incorporated the Rio+20 target of land-degradation neutrality (SDG 15). The EU has committed to the legally binding targets on land degradation set out in the SDGs<sup>39</sup>.

Whilst none of the SDGs specifically mention cropping systems, there are 2 SDGs that relate explicitly to soil and agricultural policy (2 and 15). SDG 2 is to: 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture'. Target 2.4 is to 'ensure sustainable food production systems and implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters and that progressively improve land and soil quality' (emphasis added). Although this does not specify which agricultural practices or cropping systems this might entail, it is implicit that it

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<sup>34</sup> 8 case studies in Spain, 4 in the UK, 3 in Portugal, 2 in Germany, 2 in Greece, 1 in Switzerland, 1 in Sweden and 1 in Hungary

<sup>35</sup> See, 'ELD Case Studies', accessed 26 May 2015, <http://www.eld-initiative.org/index.php?id=70>

<sup>36</sup> ELD Initiative, 2015, *Report for policy and decision makers: Reaping economic and environmental benefits from sustainable land management*, Available from [www.eld-initiative.org](http://www.eld-initiative.org).

<sup>37</sup> [http://www.un.org/ga/search/view\\_doc.asp?symbol=A/RES/70/1&Lang=E](http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E)

<sup>38</sup> [http://www.un.org/ga/search/view\\_doc.asp?symbol=A/RES/70/1&Lang=E](http://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E)

<sup>39</sup> <http://www.consilium.europa.eu/en/policies/unga/>

will support ones which are soil-improving. SDG 2 is due to be reviewed by a high-level political forum in July 2017.<sup>40</sup>

SDG number 15 is to 'Protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss' (emphasis added). Target 15.3 sets the goal of restoring degraded land and soil, combating desertification and striving to achieve a land-degradation-neutral world, by 2030. As with SDG2, there is no mention of specific agricultural practices or cropping systems that could help to achieve this goal, but again it is implicit that it will encompass agricultural soils and therefore soil-improving agricultural practices.

In addition, soils are addressed as a cross-cutting issue in other SDGs, relating to themes such as health, water, and biodiversity, although these are generally focused on avoiding soil contamination and pollution (see Table 3.1) (Keestra et al., 2016).

Table 3.1: References to soil and agriculture in the SDGs

SDG	Reference to agriculture	Direct reference to soil
2	Promote sustainable agriculture	
2.4	Implement resilient agricultural practices that increase productivity and production, that help maintain ecosystems, that strengthen capacity for adaptation to climate change, extreme weather, drought, flooding and other disasters	Implement 'resilient agricultural practices' that 'progressively improve land and soil quality'
15	Protect, restore and promote sustainable use of terrestrial ecosystems	Combat desertification, and halt and reverse land degradation
15.3		Restore degraded land and soil, combating desertification and striving to achieve a land-degradation-neutral world, by 2030

The EU is a permanent observer at the UN General Assembly and played an active role throughout the development of the SDGs.<sup>41</sup> The Commission has stated its intention to 'maximise its contribution' to the SDGs in the Commission's ten priorities outlined in 2014.<sup>42</sup> The Commission has published a series of documents outlining how they envisage implementing the SDGs. The most relevant being the Communication on 'Next Steps for a Sustainable European future'<sup>43</sup>, and an accompanying Staff Working Document on European

<sup>40</sup> <https://sustainabledevelopment.un.org/hlpf>

<sup>41</sup> [http://ec.europa.eu/environment/sustainable-development/SDGs/implementation/index\\_en.htm](http://ec.europa.eu/environment/sustainable-development/SDGs/implementation/index_en.htm)

<sup>42</sup> [https://ec.europa.eu/agriculture/consultations/cap-modernising/2017\\_en](https://ec.europa.eu/agriculture/consultations/cap-modernising/2017_en)

<sup>43</sup> COM(2016) 739 final, Communication: Next steps for a sustainable European future, available at: [https://ec.europa.eu/europeaid/sites/devco/files/communication-next-steps-sustainable-europe-20161122\\_en.pdf](https://ec.europa.eu/europeaid/sites/devco/files/communication-next-steps-sustainable-europe-20161122_en.pdf)

actions supporting the 2030 Agenda and the SDGs<sup>44</sup>. Box 3.1 below summarises the key messages of these documents.

*Box 3.1: Implementing the SDGs at European level*

**Commission Communication: Next Steps for a Sustainable European future**

This Communication sets out how the Commission plans to Implement the 2030 Agenda for Sustainable Development. It outlines the EU's commitment to integrating the SDGs into the European policy framework, and the synergies between the goals of the SDGs and the Commission's current ten priorities.<sup>45</sup> It specifically mentions the vital role of agriculture 'in any sustainable future', and its intrinsic link to various environmental resources including soil. Linked to this, the Commission commits to maximising the contribution of the CAP to the Commission's ten priorities and the SDGs, including in the context of the simplification and modernisation of the CAP.<sup>46</sup> This implies that the current reform of the CAP for the post-2020 period will include more soil-related targets in order to maximise its contribution to meeting the SDGs. The Communication also states that tracking of environmental objectives, including the agricultural resource base in accordance with SDG 15, will be strengthened through the Environmental Implementation Review.<sup>47</sup>

**Staff Working Document on 'Key European action supporting the 2030 Agenda and the SDGs'**

This document sets out the current and future actions that will allow it to meet the SDGs. On SDG 15, action relevant to soil is: the EU's engagement with the UN's voluntary Global Soil Partnership (see below), action as a party to the UNCCD including the commitment to achieve a land-degradation-neutral world. It also notes the CAP objective of ensuring the sustainable management of natural resources. Specific measures are mentioned that can 'have a positive impact' which relate to agricultural practices and soil, including: support to organic farming and the establishment of agroforestry systems.<sup>48</sup> Other actions and policies are mentioned that have an indirect impact on soil and agriculture, such as biodiversity and water policy.

<sup>44</sup> [https://ec.europa.eu/europeaid/sites/devco/files/swd-key-european-actions-2030-agenda-sdgs-390-20161122\\_en.pdf](https://ec.europa.eu/europeaid/sites/devco/files/swd-key-european-actions-2030-agenda-sdgs-390-20161122_en.pdf)

<sup>45</sup> The 10 priorities are set out in the following document: [https://ec.europa.eu/commission/sites/beta-political/files/juncker-political-guidelines-speech\\_en.pdf](https://ec.europa.eu/commission/sites/beta-political/files/juncker-political-guidelines-speech_en.pdf)

<sup>46</sup> COM(2016) 739 final, Communication: Next steps for a sustainable European future, p.9.

<sup>47</sup> A review of the implementation of EU environmental law and policy in EU Member States that occurs every 2 years, see: [http://ec.europa.eu/environment/eir/index\\_en.htm](http://ec.europa.eu/environment/eir/index_en.htm)

<sup>48</sup> [https://ec.europa.eu/europeaid/sites/devco/files/swd-key-european-actions-2030-agenda-sdgs-390-20161122\\_en.pdf](https://ec.europa.eu/europeaid/sites/devco/files/swd-key-european-actions-2030-agenda-sdgs-390-20161122_en.pdf)

### 3.1.2 The Food and Agricultural Organization (FAO) World Soil Charter and the Global Soil Partnership

The Food and Agricultural Organization (FAO) has played an active role in the governance of international soil policy since the 1980s. Its contributions have mainly been linked to scientific research and publications, awareness-raising activities and coordinating action on soil through partnerships and networks.

The original World Soil Charter was adopted by the FAO in 1982 and revised in 2015. It sets out key principles relating to soil functions, threats and sustainable management, as well as guidance for action towards sustainable soil management. It outlines that the 'overarching goal for all parties is to ensure that soils are managed sustainably and that degraded soils are rehabilitated or restored.' It is the only document reviewed as part of this work which provides a definition of sustainable soil management:

*"Soil management is sustainable if the supporting, provisioning, regulating, and cultural services provided by soil are maintained or enhanced without significantly impairing either the soil functions that enable those services or biodiversity. The balance between the supporting and provisioning services for plant production and the regulating services the soil provides for water quality and availability and for atmospheric greenhouse gas composition is a particular concern." (ibid; p.4)*

The Charter does not mention specific management techniques, but it does guide governments to pursue means to 'overcome obstacles to the adoption of sustainable soil management associated with land tenure, the rights of users, access to financial services and educational programmes'.<sup>49</sup> It also states that governments should support and develop initiatives to aid adoption of sustainable soil management, support research programmes, contribute to national and global soil information, monitor sustainable soil management, and 'explicitly consider the role of soil management practices in planning for adaptation to and mitigation of climate change and maintaining biodiversity'.<sup>50</sup>

The task of updating the World Soil Charter falls to the Global Soil Partnership (GSP), established in 2012. This is a voluntary, non-legally binding partnership and functions as a global platform for stakeholders to discuss and address global soil issues, mandated to improve the governance and promote the sustainable management of soils, including through awareness-raising<sup>51</sup>.

In 2013 the Intergovernmental Technical Panel on Soils was established as the scientific advisory body of the GSP. It has helped develop the action plans for implementing the five pillars of the GSP (FAO & ITPS, 2015; Montanarella, 2014). It is also responsible for producing

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<sup>49</sup> FAO, 2015, Revised World Soil Charter, p. 6

<sup>50</sup> FAO, 2015, Revised World Soil Charter, pp. 6-7

<sup>51</sup> FAO, 2012, appendix F, Terms of Reference of the Global Soil Partnership available at: <http://www.fao.org/docrep/meeting/027/mf558e.pdf>

the Status of World Soil Resources, a report delivered in December 2014 to mark the beginning of the International Year of Soils, looking at the threats to soils and ways to combat soil degradation. It specified a number of agricultural practices relevant to addressing the various soil threats.

In 2017 the FAO published Voluntary Guidelines for Sustainable Soil Management to complement the World Soil Charter by elaborating ways to translate its principles into practice for policy makers and farmers and other stakeholders. It sets out specific agricultural management practices designed to address each soil threat of which many overlap with the SICS identified by the SoilCare project.

The European Union played an active role in initiating the Global Soil Partnership, and European Commission representatives endorsed it at the Rio+20 Summit (Camarsa et al., 2014). In 2013 the European Soil Partnership was established by the GSP as the Regional Soil Partnership for Europe, and its Secretariat is hosted by the European Commission's Joint Research Centre. Its aim is to coordinate soil related networks and activities and also to contribute to the European chapter of the Status of World Soil Resources report.<sup>52</sup> It aims to federate all the stakeholders and institutions in Europe willing to adopt the principles of the World Soil Charter, to give guidance on goals and priorities tailored to specific regions, and to develop relevant activities in those regions.<sup>53</sup>

### 3.2 EU policy on soil

The degradation of agricultural soils is a major problem in Europe (e.g. Gardi et al., 2012) and has significantly worsened over the last decade (Paleari, 2017). Key causes include human-induced factors, notably unsustainable land management practices along with external environmental pressures, including climate change. (Orgiazzi et al., 2016). The main threats to agricultural soils are from loss of soil organic matter, wind and water erosion, compaction, soil biodiversity decline, desertification, salinisation and acidification (e.g. Gardi et al., 2012).

In the EU, policies recognise that soil is an essential element to life on earth<sup>54</sup>, and various initiatives have been taken by various EU bodies over the years. The Council of Europe's 1972 Soil Charter (revised in 2003) represents the first major effort at addressing soil degradation issues. The EU ratified the UN Convention to Combat Desertification in 1998, and the following year the European Soil Forum (initiated by the Commission and certain EU Member States) was established with the aim of developing and sharing knowledge on soil protection issues and linking the scientific and technical arenas with policymakers.<sup>55</sup> It issued the 'Bonn

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<sup>52</sup> <http://www.fao.org/global-soil-partnership/regional-partnerships/europe/en/>

<sup>53</sup> <http://esdac.jrc.ec.europa.eu/networkcooperations/european-soil-partnership>

<sup>54</sup> See e.g. the Soil Thematic Strategy, the Proposal for a Soil Directive

<sup>55</sup> EC, 2006, Impact Assessment Soil Thematic Strategy

Memorandum' in 1998, which underlined the importance of keeping soil degradation at sustainable levels, and to strengthen administrative capacity in Member States and applicant countries to carry out this requirement.<sup>56</sup> There is limited information available on what became of the ESF, although it appears that it may have been subsumed under the Commission's European Soil Bureau Network (see below).

Despite these early initiatives, the 2006 Soil Thematic Strategy represented the start of a renewed approach to combat soil degradation. Other initiatives include that 7th Environmental Action Programme (EAP), which aims to have land sustainably managed and soil adequately protected by 2020<sup>57</sup>, and the Roadmap to a Resource Efficient Europe, which aims to have soil sustainably managed by 2050<sup>58</sup>.

More recently, the EU has worked to raise awareness of the issue, including organising and promoting various activities for World Soil Days. The European Commission was also engaged in the activities to mark the International Year of Soils, commissioning a scoping study in 2014 to see what awareness-raising activities and events could be organised to mark the 'International Year of Soils' (IYS). DG Environment organised the EU Soil stakeholders' conference as a contribution of the European Commission to the World Soil Day 2016 aiming at raising awareness on the importance of soils and the ecosystem services that they deliver.

### 3.2.1 Environmental Action Programmes

The 6<sup>th</sup> EAP (2002 to 2012) set the objective of 'promotion of a sustainable use of the soil, with particular attention to preventing erosion, deterioration, contamination and desertification'.<sup>59</sup> It formally mandated the European Commission to develop a Soil Thematic Strategy as a 'priority action', 'addressing the prevention of, *inter alia*, pollution, erosion, desertification, land degradation, land-take and hydrogeological risks taking into account regional diversity, including specificities of mountain and arid areas'.

The following 7th EAP (2012 to 2020), set more detailed targets. One of its key three objectives is the protection, conservation and enhancement of natural capital. To achieve this, the EAP sets a number of targets to be achieved by 2020, one of which relates directly to agricultural soil: ensuring that land is managed sustainably and soil is adequately protected, requiring in particular 'increasing efforts to reduce soil erosion and increase soil organic matter,' and enhancing 'the integration of land use aspects into coordinated decision-making involving all relevant levels of government, supported by the adoption of targets on soil and on land as a

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<sup>56</sup> EEA, 2001, Proposal for a European soil monitoring and assessment framework, p. 14, accessed 26 May 2017, <http://edz.bib.uni-mannheim.de/daten/edz-bn/eua/01/tech61.pdf>

<sup>57</sup> The 7<sup>th</sup> Environmental Action Programme: Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet'

<sup>58</sup> COM(2011) 571: The Roadmap to a Resource Efficient Europe

<sup>59</sup> DECISION No 1600/2002/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 22 July 2002 laying down the Sixth Community Environment Action Programme.

resource, and land planning objectives'. Moreover, it calls for Member States to 'reflect as soon as possible on how soil quality issues could be addressed using a target and proportionate risk-based approach within a binding legal framework', and for targets to be set for sustainable land use and soil.<sup>60</sup>

### 3.2.2 Roadmap to a Resource Efficient Europe

These soil-related targets of the EAP were subsequently integrated into the Commission's wider sustainability policy strategy through the 'Roadmap to a Resource Efficient Europe' (2011)<sup>61</sup>, which outlines the areas where action is needed to make Europe's economy sustainable by 2050. Its overarching vision is that by 2050 all resources are sustainably managed, including land and soil. Specifically, one of its 'milestone' targets includes the reduction of soil erosion and the increase on soil organic matter. The accompanying Staff Working Paper (Part II) to the Roadmap proposed 2 further milestones relating to soil erosion and soil organic matter:

- 1) By 2020, the area of land in the EU that is subject to soil erosion of more than 10 tonnes per hectare per year should be reduced by at least 25%, and
- 2) By 2020 soil organic matter levels do not decrease overall and increase for soils currently with less than 3.5% organic matter.

The Roadmap also committed to establishing a European Innovation Partnership in 2011 on agricultural productivity and sustainability 'aiming, inter alia, at securing soil functionality at a satisfactory level (by 2020)', which has now been established under the acronym "EIP-AGRI".<sup>62</sup> Other actions to be taken by the Commission include:

- Developing scientific knowledge, with a communication on land use by 2014;<sup>63</sup>
- Member States to 'Implement the actions needed for reducing erosion and increasing soil organic matter;
- Other targets relating to soil management practices, such as on the use of agricultural inputs (especially phosphorus).

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<sup>60</sup> Decision No 1386/2013/EU of the European Parliament and of the Council of 20 November 2013 on a General Union Environment Action Programme to 2020 'Living well, within the limits of our planet'

<sup>61</sup> SEC(2011) 1067 final, COMMISSION STAFF WORKING PAPER, Analysis associated with the Roadmap to a Resource Efficient Europe, Part II, p.79

<sup>62</sup> COM(2011) 571 final, COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS, Roadmap to a Resource Efficient Europe

<sup>63</sup> Delayed until 2015<sup>63</sup>, however an internet search found no evidence that this was done.

### 3.2.3 Soil Thematic Strategy

A proposal for a Soil Thematic Strategy (hereafter, the Strategy) was drafted in 2002<sup>64</sup>, and, following the 6<sup>th</sup> EAP, the Commission adopted the Strategy in 2006. This was the first time the Commission addressed soil protection 'for its own sake'.<sup>65</sup> The Commission justified the need for such a strategy by the lack of any overarching, 'coherent soil protection policy' at EU level.<sup>66</sup> It also recognised that despite some existing policies and measures relating to soil protection, soil degradation in the EU is still occurring. In the absence of legislation, the Soil Thematic Strategy continues to form the cornerstone of EU level policy on soil.

The Strategy aims to protect soil and ensure its sustainable use, guided by the principles of preventing further soil degradation and preserving soil functions, and restoring degraded soils.<sup>67</sup> It highlighted eight main threats to soils in the EU: erosion, organic matter decline, contamination, salinisation, compaction, soil biodiversity loss, sealing, landslides and flooding. To achieve this, the Strategy sets out four key pillars: 1) Framework legislation, 2) Integration of soil protection in other policies, 3) Research, and 4) Raising public awareness.

While the Strategy recognises that unsustainable agricultural practices contribute to soil degradation, it also highlights the role that agriculture can play mitigating the issue. It specifies agricultural practices which can address various soil threats, including loss of soil organic matter and landslides.

Some concrete policy actions relevant to agricultural practices and cropping systems are also laid out in the Strategy. In particular, the Commission committed *inter alia* to review the Sewage Sludge Directive<sup>68</sup>, to closely monitor if the need to protect soil is adequately reflected in the CAP's Rural Development Plans for 2007-2013 and beyond, to check the contribution made by the good agricultural and environmental conditions in the CAP regulation to soil protection, and to assess potential synergies between soil protection and sustainable use measures in the river basin management plans under the Water Framework Directive.

There are also more general references in the Strategy to actions that encompass agricultural practices and cropping systems. For example, it specifies that action must be taken on soil use

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<sup>64</sup> Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions - Towards a Thematic Strategy for Soil Protection /\* COM/2002/0179 final \*/

<sup>65</sup> [http://ec.europa.eu/environment/soil/making\\_en.htm](http://ec.europa.eu/environment/soil/making_en.htm)

<sup>66</sup> Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions - Towards a Thematic Strategy for Soil Protection /\* COM/2002/0179 final \*/

<sup>67</sup> COM(2006)231 final COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS Thematic Strategy for Soil Protection.

<sup>68</sup> 'To ensure that maximum benefit is reaped from the reintroduction of nutrients while further limiting the release of dangerous substances into the soil'.

and management practices which contribute to soil degradation or exploit its functions. Finally, the Strategy also highlights the implications for food safety of the contamination of soil, which could have implications for certain agricultural practices such as the spreading of sewage sludge.

The Implementation Report (2012) on the Soil Thematic Strategy reviewed progress on its four pillars. It showed that the Strategy has impacted other policy initiatives, most notably with regard to the CAP, with the introduction of a new Good Agricultural and Environmental Conditions (GAEC) on organic matter protection, including a ban on stubble burning (GAEC 6). Improved soil management and enhanced carbon sequestration in agriculture was also introduced into the new Rural Development Regulation. Under cohesion policy, EU macro-regional strategies were also amended to include some actions on soil protection (such as the use of solid waste).

Perhaps the most significant action has been taken on the third pillar of the Strategy—research. Various organisations have long been carrying out research on soil, including that done by the European Soil Bureau Network (ESBN), established in 1996, to ‘collect, harmonise, organise and distribute soil information for Europe’<sup>69</sup>, however, there has been a notable increase since the Strategy. The Seventh Framework Programme (2007-2013) (FP7) included research into soil as part of its ‘Environment’ and ‘Food, Agriculture and biotechnology’ priority areas, including research into ‘soil fertility, improved crops and production systems in all their diversity, including organic farming, quality production schemes and monitoring and assessment of the impact of GMOs’. Horizon 2020 (2014-2020) also covers research relating to soil fertility and carbon content, sustainable agriculture and forestry, including ‘delivering more sustainable and productive agriculture’, although it does not specifically mention certain agricultural practices or systems. In practice, by 2012 FP7 was funding around 25 soil-related projects covering a range of topics<sup>70</sup>, and there are various under Horizon2020, including Landmark and SoilCare.

Other research initiatives include the creation of the European Soil Data Centre (ESDAC) in 2007, a centralised portal for European Soil Data. The same year, the European Parliament requested that the Commission conduct a study on Sustainable Agriculture and Soil Conservation (SoCo), which carried out its assessment of soil degradation based on the threats outlined in the Strategy.<sup>71</sup> Finally, the European Environment Agency has produced various reports on soil degradation and EU soil policy, such as a 2016 report on ‘The direct and indirect

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<sup>69</sup> The ESBN has a working group on Public Awareness and Educational Initiatives for Soil [http://eusoils.jrc.ec.europa.eu/esbn/Esb\\_n\\_overview.html](http://eusoils.jrc.ec.europa.eu/esbn/Esb_n_overview.html)

<sup>70</sup> Including those related to agricultural management practices such as CATCH-C ([http://cordis.europa.eu/project/rcn/101670\\_en.html](http://cordis.europa.eu/project/rcn/101670_en.html)), and RECARE (<http://www.recare-project.eu/project-information>).

<sup>71</sup> <http://esdac.jrc.ec.europa.eu/projects/soco-soil-conservation>

impacts of EU policies on Land' and the most recent Status of the Environment Reports (2015), which covers soil functions, threats and policies to address these.

There have also been various awareness-raising activities (Pillar 4 of the Strategy). Notably, the ESNB established a working group on Public Awareness and Educational Initiatives for Soil, known as the European Network on Soil Awareness (ENSA). Other activities include dissemination of the Soil Atlas of Europe (of which 10,000 copies were distributed in 2013), and the Soil Biodiversity Atlas (of which 30,000 copies were distributed in 2013).<sup>72</sup> There have also been various public events, conferences and leaflets and brochures to promote awareness of the issue.<sup>73</sup>

### 3.2.4 The Proposed Soil Framework Directive

the first pillar of the Soil Thematic Strategy pillar was to establish framework legislation building on existing national and European level measure<sup>74</sup>. The Commission published a proposal for the Soil Framework directive in 2006, justified by the lack of 'specific Community legislation on soil protection'.<sup>75</sup> It established provisions for protecting soil and its functions, measures for the prevention of soil degradation processes and mitigation of its effects, the restoration of degraded soils and integration in other sectoral policies.<sup>76</sup>

The Proposal did not prescribe or adopt measures relating to specific agricultural practices or cropping systems, rather Member States would propose measures that address soil degradation and/or its risk. However, the Annex set out lists of specific parameters<sup>77</sup> (referred to as "elements") to be considered when Member States identify areas at risk from the following soil threats: erosion, organic matter decline, salinization, compaction and landslides.

The proposed Directive also included some general aims and measures that would have impacted agricultural practices and/or cropping systems. For example, it proposed that land users must take precautionary action when their use of the land could be expected to significantly hamper soil functions. This could affect for example, farming practices or cropping systems which would have negative impacts on soil organic matter or soil erosion. The Directive also proposed to introduce measures to combat the introduction of dangerous

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<sup>72</sup> [http://esdac.jrc.ec.europa.eu/Awareness/Documents/ENSA2013/Jones\\_Activities\\_ECJRC.pdf](http://esdac.jrc.ec.europa.eu/Awareness/Documents/ENSA2013/Jones_Activities_ECJRC.pdf)

<sup>73</sup> COM(2012): Report on the Implementation of the STS

<sup>74</sup> in particular: the CAP, Nitrates Directive, Water Framework Directive and Floods Directive

<sup>75</sup> COM(2006) 232 final, Proposal for a DIRECTIVE OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL establishing a framework for the protection of soil and amending.

<sup>76</sup> Ibid.

<sup>77</sup> 'Common Elements for the Identification of Areas at Risk of Erosion': Soil typological unit (soil type), Occurrence/density of existing landslides, bedrock, topography, land cover, land use (including land management, farming systems and forestry), climate, seismic risk

substances into the soil which could hamper soil functions<sup>78</sup> and pose a risk to humans or the environment, which may have had implications for the application of chemical inputs and manure management such as the spreading of sewage sludge. Finally, the proposed Directive also required that measures to address soil degradation must be integrated into other sectoral policies (which also forms the Second Pillar of the Soil Thematic Strategy), including agriculture.

The Directive was passed in the European Parliament in November 2007, but was blocked in the Council in March 2010.<sup>79</sup> A minority of Member States (UK, Germany, France, the Netherlands and Austria<sup>80</sup>) blocked the proposal on the grounds of subsidiarity, excessive cost and administrative burden.<sup>81</sup> It is reported that the UK objected in particular to the requirement for landowners to provide a soil status report when selling land, due to costs and liability implications.<sup>82</sup> Opposition to the Directive also came from farmers, farmer associations and industry over additional legislative controls on soil protection, which could have also influenced the opposition of the Member States in question.<sup>83</sup> It was formally withdrawn by the Commission in May 2014<sup>84</sup>. Following the withdrawal, a number of strategic documents outlining ambitious soil targets, to facilitate this work an expert group composed of the Commission and Member States to address the soil-related targets of the 7<sup>th</sup> EAP, including the need to reflect on binding legislation was established. Since then, no formal efforts to revive it have been announced, despite calls from some environmental NGOs.<sup>85</sup> It appears that there are still diverse views amongst Member States as to the adoption of a new legislative proposal, including those opposed to the original Directive, such as Austria and the Netherlands (Palear, 2017).

### 3.3 Conclusions

EU action to address the issue is widely perceived as inadequate to tackle the threats to soil quality and meet the EU's own objectives in the area. Notably, soil policy remains fragmented,

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<sup>78</sup> Identified as: biomass production, storing, filtering and transforming nutrients and water, hosting the biodiversity pool, acting as a platform for most human activities, providing raw materials, acting as a carbon pool and storing the geological and archaeological heritage.

<sup>79</sup> COM(2012) Report on the Implementation of the STS

<sup>80</sup> Council of the European Union (2007) Press release, 2842nd Council meeting, Environment, p.8; <http://www.nfuonline.com/archived-content/more-news/soil-framework-directive-withdrawn/>; <https://euobserver.com/environment/29686>

<sup>81</sup> COM(2012) Report on the Implementation of the STS

<sup>82</sup> <http://blogs.lexisnexis.co.uk/purposebuilt/why-was-the-soil-framework-directive-withdrawn/>

<sup>83</sup> See e.g. <http://www.nfuonline.com/archived-content/more-news/soil-framework-directive-withdrawn/>; <https://www.theguardian.com/environment/georgemonbiot/2014/jun/05/the-farming-lobby-has-wrecked-efforts-to-defend-our-soil>; <http://www.copa-cogeca.be/Download.ashx?ID=1226451&fmt=pdf>

<sup>84</sup> [http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0521\(01\)&from=EN](http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014XC0521(01)&from=EN)

<sup>85</sup> <http://www.eeb.org/index.cfm/news-events/news/withdrawn-access-to-justice-and-soil-directives-must-be-replaced/>

with no specific legislation to address the issue in its own right, largely due to the objections of certain Member States in the European Council. Nevertheless, there are still a range of 'softer' policy initiatives and non-binding (but ambitious targets) which have been increasing over the past decade or so, both at EU and international level, with the two levels becoming increasingly linked.

The vast array of research initiatives into soil quality suggests that this topic is high on the Commission's agenda, perhaps because soil degradation remains a serious and ever-increasing problem in Europe. In addition, it must be noted that this is one of the ways the Commission is already empowered to act, making it a much easier task than implementing binding legislation which relies on the approval and agreement of Member States.

Since the withdrawal of the proposed Soil Framework Directive, there has been no public indication of the intention to revive the proposal, and the discussions appear to still be being hampered by opposition from certain Member States, either on the grounds of subsidiarity or in response to opposition from major farming organisations.

Further, despite all the policy initiatives, soil degradation continues to increase both at the EU and the international level, implying that current efforts are not sufficient to adequately address the problem. A key problem could be low uptake by farmers of the practices that are endorsed. This could be a result of poor or lacking policies, along with other socio-economic and environmental factors that impact on farmers' practices.

Despite this lack of any legislation targeting the protection, maintenance and improvement of soil at EU-level, an array of sectoral and environmental policies that may shape the impact of agricultural practices on soil quality exist, such as *inter alia* the Common Agricultural Policy, the Water Framework Directive or the Nitrates Directive which will be presented and analysed in more detail in the subsequent sections.

## 4 Agricultural policies

The Common Agricultural Policy (CAP) is considered one of the oldest, and most well integrated EU policies and for substantial share (approx. 38%) EU budget. The CAP has gone through successive reform processes during the past 50 years, but the legal basis of the policy as defined by objectives in art 39 of Treaty on the Functioning of the European Union (TFEU)<sup>86</sup> has remained unchanged:

- to increase agricultural productivity by promoting technical progress and by ensuring the rational development of agricultural production and the optimum utilisation of the factors of production, in particular labour;
- thus to ensure a fair standard of living for the agricultural community, in particular by increasing the individual earnings of persons engaged in agriculture;
- to stabilise markets;
- to assure the availability of supplies; and
- to ensure that supplies reach consumers at reasonable prices.

Reforms in recent years have had an increased focus on ensuring the competitiveness of European agriculture and providing public goods relating mainly to the environment, and more recently ecosystem services and climate change mitigation. Following the 2013 reform, the current CAP is composed of 4 regulations commonly referred to as direct payments regulation<sup>87</sup>, rural development regulation<sup>88</sup>, horizontal regulation<sup>89</sup> and Common Market Organisation (CMO) regulation<sup>90</sup>.

The focus of this section will be on instruments under CAP that implicitly and explicitly impact on soil quality and soil improving cropping systems. Through our mapping exercise we have

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<sup>86</sup> CONSOLIDATED VERSION OF THE TREATY ON THE FUNCTIONING OF THE EUROPEAN UNION No 2016/C 202/01

<sup>87</sup> REGULATION (EU) No 1307/2013 of the European Parliament and of the Council of 17 December 2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009

<sup>88</sup> REGULATION (EU) No 1305/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 december 2013 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD) and repealing Council Regulation (EC) No 1698/2005

<sup>89</sup> REGULATION (EU) No 1306/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 December 2013 on the financing, management and monitoring of the common agricultural policy and repealing Council Regulations (EEC) No 352/78, (EC) No 165/94, (EC) No 2799/98, (EC) No 814/2000, (EC) No 1290/2005 and (EC) No 485/2008

<sup>90</sup> REGULATION (EU) No 1308/2013 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 17 December 2013 establishing a common organisation of the markets in agricultural products and repealing Council Regulations (EEC) No 922/72, (EEC) No 234/79, (EC) No 1037/2001 and (EC) No 1234/2007

identified the following policy areas and instruments under CAP with implicitly or explicitly impact on soil quality and cropping systems:

- Pillar 1 greening payments which are intended to go beyond the baseline of cross-compliance<sup>91</sup>. Greening payments have 3 elements: crop diversity, ecological focus areas and permanent grassland;
- Cross-compliance includes standards relating to good environmental and agricultural conditions that specifically target soil i.e. adequate cover of soil to prevent erosion and practices that increase soil organic matter;
- Rural Development Policy encompasses a wide range of thematic focus areas and measures with potential impact on soil quality and SICS.

In addition, the potential links to other policy areas will also be explained and explored i.e. cross-compliance and water policy.

#### **4.1 Main objectives**

The overarching aims of CAP are described above as defined by the TFEU. The specific objectives of the current CAP, following the 2013 reform process are:

- to maintain a viable food production
- to ensure the sustainable management of resources and climate change
- to work towards a balanced territorial development

In this report, the CAP instruments that are linked to soil quality and soil improving cropping systems are clearly related to the objective of sustainable management of resources and climate change, more specifically the provision of environmental public goods and the pursuit of climate change mitigation and adaptation as described below in the following sections.

#### **4.2 CAP instruments**

The CAP, is structured as two 'Pillars':

- Pillar 1 is funded by the European Agricultural Guarantee Fund (EAGF) and provides payments to farmers (including the Pillar 1 greening measure based on the area of land farmed.) Pillar 1 also includes market measures such as public intervention and risk management and insurance schemes;

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<sup>91</sup> Cross-compliance is an important tool for integrating environmental requirements into the Common Agricultural Policy. Cross-compliance ensures that support granted under the Common Agricultural Policy is conditional on delivering public goods in relation to environment, climate change and good agricultural condition of land, public, animal and plant health, and animal welfare defined by Statutory Mandatory Requirements (SMR) and Good Agricultural and Environmental Conditions (GAEC).

- Pillar 2, co-financed by the European Agricultural Fund for Rural Development (EAFRD) supports Member States' and regions' Rural Development Programmes (RDPs) with a wide range of measures to address environmental, social, and economic priorities in the agricultural and forestry sectors, and rural communities more broadly; and
- Horizontal elements of the CAP, applicable to both Pillars, include cross-compliance rules and a requirement for Member State to provide a Farm Advisory Service (FAS)

The following sections outline the specific elements of these instruments and their impact on agricultural practices and soil.

#### 4.2.1 Greening measures

Greening measures are made up of three elements: Ecological Focus Areas (EFA), crop diversification, and maintenance of permanent grassland. Member States have a certain degree of flexibility to define the rules applicable to crop diversification (e.g., the list of crops permitted) and EFAs (types of EFAs adapted to national/regional circumstance). In practical terms, this means that greening measures or payments incentivise certain agricultural practices by providing additional payments to farmers for specific actions.

Greening measures are intended to support action to adopt and maintain agricultural practices that help meet environment and climate goals with the realization that market prices do not reflect the effort involved in providing these services. Member States must allocate 30 % of their national ceilings<sup>92</sup> for greening measures in addition to the basic payment, for obligatory practices to be followed by farmers. Practices should take the form of simple, general, non-contractual and annual actions that go beyond cross compliance and are linked to agriculture (EU 1307/2013, Article 47).

##### *Ecological Focus areas*

The main aim of Ecological Focus Areas (EFA) is to promote biodiversity in agricultural holdings through a variety of measures or agricultural practices. Although the main objective is promoting and preserving biodiversity, it is also recognised that EFAs can provide other ecosystem services. EFAs cover a broad range of features, including ones that affect biodiversity both directly and indirectly, however EFAs can also influence adoption of agricultural practices that explicitly linked to soil quality.

The practices that are eligible are defined by Direct Payments Regulation (EU 1307/2013 article 46) are as follows:

- a) land lying fallow;

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<sup>92</sup> National ceilings refer to the maximum amount available for each MS for financing the direct payments schemes, this is intended to give MS flexibility in managing funds and optimizing the use of available funds. National ceilings are set in Annex II to the Basic Act (Regulation 1307/2013).

- b) terraces;
- c) landscape features, including such features adjacent to the arable land of the holding which, by way of derogation (EU 1307/2013 Article 43(1)) may include landscape features that are not included in the eligible area in accordance (EU) No 1306/2013 Article 76(2);
- d) buffer strips, including buffer strips covered by permanent grassland, provided that these are distinct from adjacent eligible agricultural area;
- e) hectares of agro-forestry that receive, or have received, support under Article 44 of Regulation (EC) No 1698/2005 and/or Article 23 of Regulation (EU) No 1305/2013;
- f) strips of eligible hectares along forest edges;
- g) areas with short rotation coppice with no use of mineral fertiliser and/or plant protection products;
- h) afforested areas (referred to in point (b)(ii) of Article 32(2) EU 1307/2013);
- i) areas with catch crops, or green cover established by the planting and germination of seeds (subject to the application of weighting factors referred to in EU 1307/2013 article 46(3));
- j) areas with nitrogen-fixing crops.

Under this greening measure, holdings of arable land covering more than 15 hectares, farmers shall ensure that at least 5% of arable land is EFAs. This percentage will be increased to 7% subject to a legislative act of European Parliament and Council conditional on evaluation of EFAs. Member States have a certain degree of flexibility to decide on which EFAs to include, adapted to local circumstances and practices.

### *Crop Diversification*

The aim of crop diversification is to discourage the practice of intensive monocultures e.g. growing one crop intensively on the same parcel of land for repetitive seasons. This requirement applies only to farms with more than 10 hectares of arable land. Those with up to 30 hectares of arable land have to grow at least two different crops on their arable land, and farmers with more than 30 hectares of arable land have to grow at least three crops. In both cases the main crop cannot cover more than 75% of the arable land. The obligations relating to crop diversification should be applied in a way that takes into account the difficulty for smaller farms to diversify, while continuing to make progress towards enhanced environmental benefit, and in particular the improvement of soil quality (EU 1307/2013 Recital 41). Exceptions can be made for farms that already fulfil the objectives of crop diversification as a result of being covered to a significant extent by grassland or fallow land, for specialised farms rotating their parcels each year or for farms that because of their geographical localisation would have excessive difficulties in introducing a third crop. The crop diversification requirement targets improvement of soil quality as indicated in the regulation, but in practice the soil protection benefits will depend on the way in which individual farmers implement the diversification requirements i.e. if crop diversification is part of a broader crop rotation programme.

### *Permanent Grassland*

Permanent grassland mainly targets maintaining the agriculture area of permanent grasslands in relation to utilized agricultural area (UAA) because of environmental benefits, in particular carbon sequestration. Under the permanent grassland requirement, MS are required to designate environmentally sensitive permanent grasslands (ESPG) in areas covered by Birds and Habitats Directives, including peat and wetlands situated in these areas, and which need strict protection in order to meet the objectives of those Directives.

Member States may, in order to ensure the protection of environmentally valuable permanent grasslands designate other sensitive areas situated outside the areas covered by the Birds and Habitats Directives<sup>93</sup> including permanent grasslands on carbon-rich soils.

The measure impacts on agricultural practices and land management because it restricts conversion of permanent grasslands to arable crops and ploughing permanent grassland situated in areas designated by Member States in sensitive areas or those covered by the Birds and Habitats Directives.

#### **4.2.2 Cross Compliance**

Farmers receiving direct payments under Pillar 1 and area-based payments under Pillar 2 must comply with cross-compliance requirements across the whole farm holding, or risk losing part of their CAP payments. The rules on cross-compliance consist of the statutory management requirements (SMR) and standards for good agricultural and environmental condition (GAEC) of land established at national level relating to the following areas:

- environment, climate change and good agricultural condition of land;
- public, animal and plant health; and
- animal welfare.

Table 4.1 below provides an overview of cross-compliance requirements that impact on soil quality from Annex II of Horizontal Regulation<sup>94</sup>.

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<sup>93</sup> Directives 2009/147/EC and 92/43/EEC

<sup>94</sup> REGULATION (EU) No 1307/2013 of the European Parliament and of the Council of 17 December 2013 establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No 637/2008 and Council Regulation (EC) No 73/2009

Table 4.1: Conditions and requirements under Cross-Compliance that impact on soil

Main Issue	Conditions and requirements
Water	<b>SMR 1</b> Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources. Article 4 sets out establishing codes of good agricultural practice, advisory services to facilitate the application of good agricultural practices and requires MS to submit the details of their codes of agricultural practices. Article 5 requires MS to establish action programmes in respect of designated vulnerable zones (DVZ) <sup>95</sup>
	<b>GAEC 1</b> Establishment of buffer strips along water courses
	<b>GAEC 2</b> Where use of water for irrigation is subject to authorisation, compliance with authorisation procedures
	<b>GAEC 3</b> Protection of ground water against pollution: prohibition of direct discharge into groundwater and measures to prevent indirect pollution of groundwater through discharge on the ground and percolation through the soil of dangerous substances, as listed in the Annex to the Directive 80/68/EEC in its version in force on the last day of its validity, as far as it relates to agricultural activity
Soil and Carbon Stock	<b>GAEC 4</b> Minimum soil cover
	<b>GAEC 5</b> Minimum land management reflecting site specific conditions to limit erosion
	<b>GAEC 6</b> Maintenance of soil organic matter level through appropriate practices including ban on burning arable stubble, except for plant health reasons
Biodiversity	<b>SMR 2</b> Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds. Article 3 require MS to take requisite measures to preserve maintain and re-establish sufficient diversity and habitats; and in this regard, maintain the upkeep and management of habitats inside and outside protected zones. Article 4 requires MS to apply special conservation measures of habitats to ensure species survival and reproduction; adequate protection of breeding, moulting and wintering areas for migratory species; and take steps to avoid the pollution or deterioration of habitats or any disturbances affecting birds and their habitats.
	<b>SMR 3</b> Council Directive 92/43/EEC of 21 May 1992 on the conservation on natural habitats and of wild flora and fauna Article 6 requires MS to establish conservation measures and management plans for natural habitats in Annex 1 and species in annex 2 of the Directive. MS are required to take appropriate steps to avoid the deterioration of natural habitats of species as well as disturbance of species in these areas <sup>96</sup> .
Landscape, minimum level of maintenance	<b>GAEC 7</b> Retention of landscape features, including where appropriate, hedges, ponds, ditches, trees in line, in group or isolated, field margins and terraces, and including a ban on cutting hedges and trees during the bird breeding and rearing season and, as an option, measures for avoiding invasive plant species

<sup>95</sup> This is described in more detail in Section 5.

<sup>96</sup> More detailed description of the Nature Directives (SMR 2 and 3) is provided in Section 6.

### 4.2.3 Rural Development Policy

EU rural development policy forms Pillar 2 of the CAP. The overall aim of rural development policy is to promote sustainable rural development in a way that contributes to the development of a more territorially and environmentally balanced, climate-friendly and resilient, competitive and innovative agricultural sector and of rural areas overall.

Rural Development Policy specifies six priority areas at EU level that Rural Development Programmes (RDPs) must address<sup>97</sup>. Compared to the measures described in the previous sections, measures under Rural Development Policy are primarily voluntary, with some exceptions i.e. Leader and advisory services. All Member States must prepare a seven-year Rural Development Programme subject to European Commission approval at either national or regional level; there are currently 118 RDPs for the current programming period 2014 – 2020.

The Regulation on support for Rural Development (EU 1305/2013 art. 5) defines six EU level priorities. Within each priority there are several focus areas for a total of 18 focus areas (see table below for priorities and focus areas).

*Table 4.2: Summary of priorities and focus areas under Rural Development Policy*

Priorities	Focus Areas
1. Fostering knowledge transfer and innovation in agriculture, forestry, and rural areas	(a) fostering innovation, cooperation, and the development of the knowledge base in rural areas (b) strengthening the links between agriculture, food production and forestry and research and innovation, including improved environmental management and performance (c) fostering lifelong learning and vocational training in the agricultural and forestry sectors
2. Enhancing farm viability and competitiveness of all types of agriculture in all regions and promoting innovative farm technologies and the sustainable management of forests	(a) improving the economic performance of all farms and facilitating farm restructuring and modernization, notably with a view to increasing market participation and orientation as well as agricultural diversification (b) facilitating the entry of adequately skilled farmers into the agricultural sector and, in particular, generational renewal
3. Promoting food chain organization, including processing and marketing of agriculture products, animal welfare and risk management in agriculture	(a) improving competitiveness of primary producers by better integrating them into the agri-food chain through quality schemes, adding value to agricultural products, promotion in local markets and short supply circuit, producer

<sup>97</sup> MS RDPs must address minimum 4 of 6 priorities.

Priorities	Focus Areas
	groups and organisations and inter-branch organisations (b) supporting farm risk prevention and management
4. Restoring preserving and enhancing ecosystems relating to agriculture and forestry	(a) restoring, preserving and enhancing biodiversity, including in Natura 2000 areas and in areas facing natural or other specific constraints and high nature value farming, as well as the state of European landscapes (b) improving water management, including fertilizer and pesticide management (c) preventing soil erosion and improving soil management
5. Promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in the agriculture, food and forestry sectors	(a) increasing the efficiency of water use by agriculture (b) increasing the efficiency in energy use in agriculture and food processing (c) facilitating the supply and use of renewable sources of energy, of by products, wastes and residues and of other non-food raw material for the purposes of the bioeconomy (d) reducing greenhouse gas and ammonia emissions from agriculture (e) fostering carbon conservation and sequestration in agriculture and forestry
6. Promoting social inclusion, poverty reduction and economic development in rural areas	(a) facilitating diversification, creation and development of small enterprises, as well as job creation (b) fostering local development in rural areas (c) enhancing the accessibility, use and quality of information and communication technologies (ICT) in rural areas

The link to agricultural practices that improve soil quality is potentially substantial because two focus areas specifically target soil:

- **Focus area 4C** preventing soil erosion and improving soil management; and
- **Focus area 5E** fostering carbon conservation and sequestration in agriculture and forestry.

Rural Development Regulation provides an indicative list of 19 RDP measures that Member States can use to address the priorities set out by Member States/Regions. Of the 19 measures listed, only agri-environment-climate measure and LEADER are obligatory, while the others are voluntary (see **Error! Reference source not found.** below).

Under their RDPs, Member States/Regions can then provide for sub-measures/operations

tailored to specific local needs or priorities. At least 30 % of the EAFRD contribution to each RDP must be reserved for specific measures relevant to climate change mitigation and adaptation and the environment. The RDP measures judged to have most potential for soil protection are listed below.

Table 4.3: Specific measures and potential impact on agricultural practices and management

RDP Measures	Potential impacts on agricultural practices
<b>M1: Knowledge transfer and information actions (Optional).</b>	(Compulsory) Measure can potentially support vocational training, demonstration activities, information provision necessary to promote agricultural management for SICS through exchanges and visits
<b>M2: Advisory services, farm management and farm relief services</b>	(Mandatory) Measure is obligatory and funds part of the cost of the CAP Farm Advisory System (FAS) which Member States must provide, covering the following: cross compliance; Pillar 1 greening requirements; RDP measures to improve economic performance; obligations under the WFD; requirements for integrated pest management; farm safety; advice for first-time farmers. Could support optional additional advisory services to improve soil quality and provide advice on management of soils and SICS improve the economic and environmental performance as well as climate friendliness and resilience of their holding or enterprise; can also support training of advisors.
<b>M4: Investments in physical assets</b>	Optional: can support tangible and intangible investments aimed at improved performance and sustainability of farms, this could include drainage system, investment in precision agriculture technology to support SICS.
<b>M5: Restoring agricultural production potential damaged by natural disasters and introduction of appropriate prevention</b>	Optional: can support investments in preventive actions to reduce consequences of probable natural disasters and adverse climatic events as well as investments to restore agricultural land damaged by such disasters and events. Elements that restore soil and prevent erosion can potentially be included in this measure.
<b>M6: Farm and business and development</b>	Optional: investment support and other payments aimed at young farmers, small farms and setting up non-agricultural businesses.
<b>M7: Basic services and village renewal</b>	Optional: a wide range of support including investment in small-scale renewable energy, increasing environmental performance and awareness, drawing up protection and management plans for Natura 2000 and other high nature of value areas, and studies/investments associated with upgrading rural landscape. This measure can potentially be used for small-scale biorefineries to produce organic fertilisers.
<b>M10: Agri-environment-climate</b>	Compulsory: this is the only measure that must be made available throughout the Member State's or region's territory, in accordance with national, regional or local specific needs and priorities. It offers farmers and other land managers multi-annual contracts for agricultural practices that make a positive contribution to the

RDP Measures	Potential impacts on agricultural practices
	environment and climate. The baseline above which payments are calculated includes CAP cross compliance requirements, and there are strict rules to avoid double funding of actions that are Pillar 1 greening options, such as EFA buffer strips, areas with catch crops or green cover.
<b>M11: Organic Farming</b>	Optional: offers annual payments through multi-annual contracts for conversion to and/or maintenance of organic farming practicing and methods. Organic farming and practice i.e. crop rotation and use of organic fertilisers can play a role in improving soil quality.
<b>M12: Natura 2000 and Water Framework Directive payments</b>	Optional: basic compensatory payments applying to an area where there are restrictions on land management related to farm-level requirements under the WFD river basin management plans or under Natura 2000 designations on agricultural and forest areas.
<b>M13: Areas facing Natural Constraints (ANC) payments</b>	Optional: basic payments for farmers in mountain areas and in other areas where there are natural constraints on agricultural production. This measure can be potentially used for soil improvement, especially preventative measures against erosion, but is perhaps less applicable to arable crops.
<b>M16: Cooperation</b>	Optional: support for a wide range of cooperative activities by different actors and sectors, new clusters and networks; supports the establishment of operational groups linked to the work of the European Innovation Partnership for agricultural productivity and sustainability (EIP-AGRI). The work of EIP-AGRI has made suggestions for several operation groups focusing on improving soil organic matter and work relating to Integrated Pest Management (IPM).

The agri-environment-climate measure (M10) is of particular importance because it allows Member States to support implementation of appropriate soil management requirements through multi-annual contracts with individual farmers. This measure may also be used by Member States to define 'equivalent practices' to meet Pillar 1 greening requirements, instead of those set out in the Pillar 1 legislation. Moreover, the support for non-productive investments is crucial for the successful implementation of certain agri-environment-climate commitments.

Member States are allocated funding based on national envelopes. EAFRD is co-financed by MS and/or regional authorities, in contrast to Pillar 1 of the CAP, which is wholly financed by the EAGF.

### 4.3 Relationships to and impacts on cropping systems

The policy instruments described in the previous section were all selected for this analysis because they have potential links to agricultural practices that improve soil. In this section the links between the instrument and soil will be described as well as how they potentially influence farmers' adoption of certain agricultural practices.

### 4.3.1 Potential impacts on cropping systems

#### *Greening Measures*

Greening measures specifically address and in effect regulate cropping systems by providing incentives to adopt the requirements defined by the regulation. Under greening measures or payments MS are required to reserve 30% of their national ceilings for direct payments to grant an annual payment, in addition to the basic payment for compulsory practices to be followed by farmers addressing, as a priority, both climate and environment policy goals. The annual payment of 30% in addition to basic payments is an attempt to incentivize agricultural practices that go above and beyond standards and regulations covered under cross-compliance. Whether farmers view this as incentive to adopt practices with climate and environment goals or view it as a penalty for not doing things differently will be an interesting question to explore as the measures are evaluated.

The requirements under greening measures, although they are perhaps more specifically targeting biodiversity, are explicitly linked to soil quality. EFAs target components of cropping systems such as buffer strips and green cover. The permanent grassland component focuses on carbon sequestration and restricts conversion of permanent grassland to arable crops, and re-conversion to grassland can be required of individual farmers. This clearly impacts on farmers behaviour but will have very little impact on cropping systems described in this project, because conversion of permanent grasslands to arable crops would be restricted. The third greening requirement, crop diversification requires holdings over 10 hectares to have more than one crop, so this in theory will influence farmers cropping system decisions i.e. moving from intensive mono-culture practices to crop diversity and rotation. In reality though, initial calculations show that this will only affect a very small portion of the utilized agricultural area in Europe and its impact on soil will be highly dependent on how farmers choose to implement (Hart, 2015).

#### *Cross-compliance*

Cross-compliance specifically targets soil and carbon stock through 3 GAECs. From a theoretical perspective cross compliance should be an effective tool for promoting agricultural practices that maintain environmental standards, in this case soil quality. The threat of non-compliance and reduction of area-based payments should in theory be an effective tool for implementing regulations and standards. Cross-compliance is also effectively linked to the Farm Advisory Service (FAS) as cross-compliance is one of the measures MS are obligated to cover. This policy can have specific impacts on adoption of cropping systems i.e. maintaining green cover or measures that prevent erosion such as no- or low-tillage systems but does not explicitly address cropping systems.

#### *Rural Development*

As described in the previous section, there are several aspects of RD policy that could have

substantial impact on adoption of cropping systems. Two priorities and focus areas defined by the policy specifically address soil quality. RD funding for the most part compensates farmers for transaction costs in relation to providing public goods or ecosystem services. RD funding can potentially impact on adoption of cropping system components by reducing the transaction costs of adopting practices that in the short term have higher associated costs. Funding available under EARDF can also be used for tangible and intangible investments for agri-environmental climate objectives, including components of cropping systems.

#### 4.3.2 Empirical evidence

A number of the policies and instruments described above, especially greening measures or payments have not been thoroughly evaluated as of yet, with the exception of EFAs. Greening measures or payments were part of the 2013 reform package, and full implementation of these measures was not operational until 2015. Because of the controversy<sup>98</sup> surrounding the EFAs during the political negotiation of CAP, the proposal included a requirement that EFAs be evaluated by 2017. Full evaluation of the CAP is expected to take place in 2017/2018 and feed into discussions on the post 2020 CAP.

In 2015, 8 million ha of land was declared as EFA, which accounted for 13% of the arable land falling under the obligation and 10% after applying the weighting factors (percentages may differ at farm level). This is significantly above the regulatory requirement of 5% at farm level. In 2016 the figures were 15% and 10% respectively, with a slight increase of 130 000 ha. The evaluation showed that, the range of EFA types varied significantly between Member States. The data shows that Member States preferred areas with nitrogen-fixing crops, land lying fallow and landscape features over hectares of agroforestry, strips of eligible hectares along forest edges and terraces<sup>99</sup>. In this context, it is likely that farmers making a simpler choice, favouring “cultivation” EFAs such as nitrogen fixing crops, wind cover, catch-crops instead of EFAs like landscape features<sup>100</sup>, and that in contrast to other greening measures EFAs were not already in practice<sup>101</sup>

The above proportion of EFA at EU level remained quite stable in 2016, although with variation across Member States: areas under land lying fallow, landscape features and buffer strips decreased, while those under catch crops and nitrogen-fixing crops increased. The report from the Commission to the European Parliament reviewing the first year of implementation shows the following:

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<sup>98</sup> The controversy was mainly related to giving too much flexibility to MS in defining appropriate EFAs and mixes of EFAs watering down the original aims and objectives of EFAs.

<sup>99</sup>COM (2017) 152 final REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL on the implementation of the ecological focus area obligation under the green direct payment scheme

<sup>100</sup> European Commission Official. Interviewed by: Pederson, R.

<sup>101</sup> NGO Official, Interviewed by: Bradley, H.

- the data on EFA types shows in 2015 that land lying fallow declared as EFA accounted for 34% of the total fallow areas reported in Eurostat statistics for the Member States concerned. Such total areas decreased by 24% from 2000 to 2014 but increased slightly in 2015.
- EU leguminous crops areas by increased by 20% since 2013. Nitrogen-fixing crops declared as EFA, which were chosen by all Member States except Denmark, covered 49% of such areas in 2015<sup>102</sup>

The two other requirements under greening measures or payments, have not been thoroughly evaluated, however initial internal evaluation by the Commission<sup>103</sup> give some indications on the effectiveness of these measures:

- the effect of the crop diversification obligation, the application of which is determined by the number of hectares, is therefore generally linked to the structure of agriculture across the Member States i.e. Member States (Bulgaria, the Czech Republic, Germany, Denmark, Slovakia and Hungary) which have, on average, the largest farms will have fewer farms that are exempted and a higher proportion of land will therefore be subject to the three- crop requirement.
- after the first year of implementation showed that at EU -level, 25% of total arable land is not subject to crop diversification, 13% is subject to the two-crop requirement applicable to arable land of between 10 ha and 30 ha (pursuant to the first paragraph of Article 44(1) of Regulation (EU) No 1307/2013), and 62% is subject to the three-crop requirement.

It is important to note that areas subject to the obligation, as reported, are determined by the area of farms, which have to respect the obligation, on the grounds of their arable land size, so the number of crops already present in the farm is actually sufficient to comply with the obligation and minimize the impact of the measure on changing farming practices. This means that the impact of the measure on changing crop management or adoption by farmers will actually be quite low (2% of total UAA).

Although permanent grassland under greening measures has not been evaluated yet, the main impact is expected to be on maintaining permanent pasture in areas defined by the Nature Directives and Natura 2000. This measure requires MS to maintain a baseline ratio of permanent grasslands to arable crops and can require reconversion of arable crops to permanent grasslands if a decrease in the ratio of more than 5% occurs. Initial internal review of greening measures<sup>104</sup> shows that permanent pasture accounts for 29% of the total agricultural area at EU level. This varies between MS with the highest levels of around 90% in

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<sup>102</sup> *ibid*

<sup>103</sup> SWD (2016) 218, COMMISSION STAFF WORKING DOCUMENT Review of greening after one year.

<sup>104</sup> SWD (2016) 218, COMMISSION STAFF WORKING DOCUMENT Review of greening after one year.

Ireland to 2% in Cyprus. Concerns by stakeholders have also been expressed, because farmers cannot plough up areas covered by grass or pasture that has been out of rotation for more than 5 years<sup>105</sup>

In general, studies indicate that greening measures have been applied in MS to different degrees. There is a general perception among stakeholders that greening measures have not led to any measurable or detectable improvements to the basic requirements under cross-compliance and through AEC measures under Pillar II<sup>106</sup>, and that in many cases farmers were already using management and practices that would qualify for payments under greening measures<sup>107</sup>. Although greening measures indicate a strategic change to green direct payments under Pillar 1 of the CAP, the choices made do not seem ambitious enough and are not likely to lead to major changes in action on the ground for environmental management (Hart, 2015; Hart et al., 2016). However, payments have been mainly focused on paying for the implementation of specific farming practices rather than for measurable environmental outcomes (Hart, 2015). This suggests that most countries appear not to have used the flexibility permitted in the regulations to increase overall environmental ambition. Rather, they have often maximised opportunities for farmers to meet their obligations without having to make significant changes (ibid.; Turpin et al., 2015).

Cross-compliance is an important policy to ensure that farmers' receiving basic payments, comply with regulations and standards relating to environment, health and animal welfare, and 3 of the GAECs relate specifically to soil quality. As such, data on compliance with relevant GAECs would provide a useful overview of the extent to which soil-related standards integrated into the cross-compliance system are being met. The majority of farmers within the EU benefit from direct payments: there were around 7.5 million farms benefitting (received approx. 47 billion in aid) from support in 2015, covering almost 156 million ha of land, or roughly 90% of the land actually farmed (the utilised agricultural area - UAA). Cross-compliance has existed since 2003, when direct payments were decoupled from production and changed to payments based on area farmed. Even though cross-compliance has been in effect for a sufficient period for both ex-ante and ex-post evaluation, no clear indicators on compliance have been put in place and the objectives of cross-compliance remain unclear (ECA, 2008; ECA 2016). The 2016 report from the European Court of Auditors (ibid.), summarises:

- The performance indicators used by the Commission gave a partial view of the effectiveness of cross-compliance. The indicators did not take into account the level of non-compliance by farmers. Furthermore, the Commission did not analyse the reasons for the infringements and the means of addressing them.

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<sup>105</sup> NGO official, Interviewed by: Bradley, H.

<sup>106</sup> NGO official, Interviewed by: Bradley, H.

<sup>107</sup> NGO official, Interviewed by: Bradley, H.

- The changes in the CAP for the period 2014–2020 reduced the number of cross-compliance rules, are not sufficiently relevant to farming activity, control procedures remain complex and simplifications measures such as the small farmers' scheme, relieving administrations and farmers of additional burdens need to be balanced against the necessity to achieve the objectives of cross compliance.
- Despite their similarities, the compulsory GAEC and greening rules are checked under two control systems. This may lead to inefficiencies in the control systems and an additional administrative burden.

Cross-compliance potentially impacts on the majority of farmers, and the threat of reduction of payments for non-compliance is perceived as impacting on farmers' decisions relating to cropping systems, however indicators for non-compliance and actual change in practices have not been developed.

Rural Development Policy includes priorities and focus areas that specifically target improving agricultural practices to improve soil quality and a number of measures to facilitate this. Turpin et al. (2015) assessed the extent to which soil-relevant objectives and measures are embedded in the design of the RDPs through case studies in Austria, France, Germany, Italy, the Netherlands, Poland and Spain. They conclude that soil stakes are always quoted in the strategic and operational objectives, yet in many cases other environmental concerns, such as water quality or biodiversity are prioritised over soil in the policy packages. Only Austria and Germany, and to a lower extent some regions in Italy, have comprehensively embedded soils in their programs. RDPs assessed for France, the Netherlands and Spain included no soil-relevant measures. It is important to note that it is difficult to change practices on arable land through RD measures, very few AECM in national programmes address arable land and that go beyond greening measures in Pillar I. It is difficult because the opportunity costs are so high i.e. the crops have a high market value, and the value provided by RDPs cannot compete with market prices (ibid.).

Turpin et al. (2015), on exploring the reasons for the lack of integration of measures targeting soil, conclude that EU legislation does not permit Member States to include measures targeted at improving country- or regional-specific soil threats, like acidification in Poland, or soil-related landscape degradation in Italy. Secondly, they point out that resource- and time-consuming implementation of some EU Directives at national level prompts MS to implement measures that are believed to have some side effect on soil rather than designing soil-specific measures. In summary, the study concludes that, whilst the coherence of agricultural and environmental policies has improved over the past decades, the embeddedness of soil stakes in the existing policy packages is not at the same level all over Europe (ibid.).

Spending on the different priorities and focus areas varies between MS (see Figure 4.1) no figures are available for funding of specific focus areas that are soil related (4a and 5c) but rather for priority areas. Priority 4 ecosystems spending is the highest while priority 5 resource

efficiency spending is generally lower compared to priority 4, and in a number of MS (AT, EE, FI, LU, LV, PL, SE, SI and SK) is the lowest priority in spending.

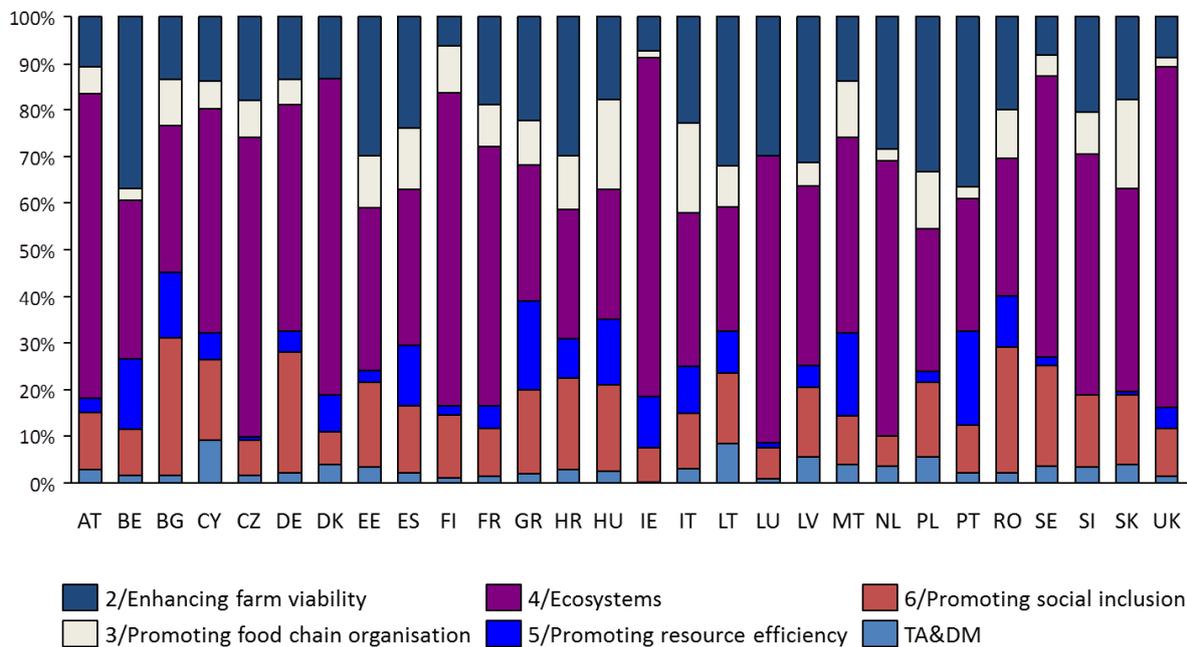


Figure 4.1: Relative expenditure by MS on Rural Development priority areas

(Source: Kantor, 2015)

An analysis and synthesis of the ex-ante evaluations of Rural Development Programmes and National Rural Network Programmes for the programming period 2014-2020 found significant variations in the definition of priority and investment choices among MS (Kantor, 2015). The authors analysed the budget allocated to M10 (Agri-environment-climate), M11 (Organic farming) and M12 (Natura 2000 and Water Framework Directive payments) in selected RDPs across 15 MS. They found:

- that out of the 15, 7 MS (AT, DE, EE, FI, IE, NL, UK) allocate more than 30% of their RDP to the three examined measures (M10, M11, M12);
- In two MS, the UK and IE, this is more than 45% (UK-52.6%, IE-45.4%) (Kantor, 2015).

These findings are echoed by a study compiled for the European Parliament (2016), which finds that there is considerable continuity in priorities and patterns of Member States' allocation to priorities in the 2014-2020 when compared to the previous programming period. Notable changes, however, include a greater focus on environmental objectives and measures.

RDPs are developed, implemented and monitored at MS or regional level, so in order to evaluate the impact on soil quality and cropping systems it is necessary to evaluate individual RDPs at MS or regional level in relation to spending on specific focus areas relating to soil

quality and case studies to illustrate how funding is used to facilitate adoption of agricultural practices that improve soil quality. This falls outside the scope of this section, but will be examined in PART III of this report

#### 4.4 Conclusions

Greening measures, Cross-compliance and Rural Development Policy potentially impact on farmers adoption of cropping systems and several of the instruments have explicit links to maintaining or improving soil quality. Evaluation of the different instruments, especially greening measures, is early in the process of implementation, and because of this difficult to evaluate. The policies use a variety of instruments but mainly focus on incentives or payments to farmers by providing payments conditional on maintaining environmental standards or by penalizing non-compliance with regulation and standards by reducing payments to farmers as is the case for greening payments and cross compliance. Rural Development Policy mainly uses payments to compensate farmers for transaction costs associated with improving practices relating to Agri-Environmental and climate change objectives.

In general, there seems to be a lack of data, good quality indicators and evaluation of CAP's real impact on the environment, and in particular impact on soil quality. This is in part due to the complexity of natural systems, which makes it difficult to establish causal links between inputs or practices and observed change. One example given by a stakeholder, is that measuring SOM is difficult and that field inspectors do not have the measurement tools to assess SOM.

Relating to the overall impact of CAP on the environment and sustainable farming systems, a number of concerns are expressed by stakeholders. For example, that CAP and its system of payments has negative consequences since it potentially encourages farmers to engage in practices that are hazardous for the environment in order to obtain or maximise their payments<sup>108</sup>. Concerns are also raised that CAP actually supports a "lock in" to current practices favouring industrial farming practices and does encourage transition to more sustainable practices and creates a sense of entitlement that creates resentment when rules for payments are changed<sup>109,110,111</sup>. On the other hand, some stakeholders are more optimistic indicating that CAP has the potential of delivering real impact but is undermined by lack of proper implementation, control and sanctions or penalties for non-compliance.

The three policy instruments described in this section have complex links with other policy areas, which need to be understood in order to better judge how they affect adoption or changes in cropping systems, for example:

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<sup>108</sup> NGO official. Interviewed by: Bradley, H.

<sup>109</sup> NGO official. Interviewed by: Bradley, H.

<sup>110</sup> NGO official. Interviewed by: Bradley, H.

<sup>111</sup> NGO official b. Interviewed by: Bradely H.

- Cross-compliance includes SMRs relating water quality and specific regulation such as the Nitrates Directive and Birds and Habitats Directives
- Greening measures or payments are intended to go beyond basic payments subject to cross-compliance, so it is important to consider that greening measures, including EFAs should provide added value above and beyond baseline cross-compliance conditions (SMRs and GAECs)
- Greening measures or payments also address practices that are covered by agri-environmental and climate change objectives resulting in the potential for funding the same practice through two separate instruments (double funding)
- Measures described in greening requirements are also covered by other legislation i.e. establishing buffer strips is also covered under the WFD and can improve water quality by limiting run off from agricultural land to water ways and increased use of nitrogen fixing crops and catch crops/green cover influence nitrogen leaching as covered by the Nitrates Directive
- Landscape features included in EFAs can influence positively on birds and habitats as regulated by Birds and Habitats Directives, although evaluation shows that greening, specifically EFAs has had little impact on landscape features such as hedgerows, trees in line etc.
- There are strong links between Farm Advisory Services (FAS) financed in part by RDPs and implementation of Cross-compliance and greening measures.<sup>112</sup>

Understanding these links is necessary to understand the impact of the specific impacts on adoption of or changes in cropping systems by farmers, but to date no assessment of these interactions has been carried out.

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<sup>112</sup> FAS are more thoroughly analysed in WP 8.

## 5 Water policies

Protecting Europe's water resources has been a high priority for the EU since the 1970's when specific legal instruments were adopted to protect Europe's water. Water is an essential part of environmental management and water quality problems caused by excessive nutrients and hazardous chemicals can pose a risk to human, animal and plant health.

The Water Framework Directive (WFD) was adopted in 2000 to establish a legal framework for protecting and restoring waterbodies in Europe and to ensure the long-term sustainability of water use. River basin management plans (RMBPs) and programmes of measures (PoMs) are the main instruments used by MS to implement the policy and funds from other EU policies can be used to implement the policy<sup>113</sup>.

Water management is centralised at EU level, as many water bodies transcend national boundaries. Right from the very beginning of the WFD, water is defined "not as a commercial product like any other but, rather, a heritage which must be protected, defended and treated as such."<sup>114</sup>

In relation to this study, Agriculture is an important factor in environment pressures on water. In the EU, agriculture accounts for around 33% of water use and is the main source of nutrient pollution in water<sup>115</sup>.

EU water legislation focuses on addressing the exploitation of water by adopting a "polluter pays" approach. Such legislation either sets out specific standards for pollution (or helps MS to define their own standards), or ensures MS have adequate management systems in place to ensure effective water management. The WFD forms the basis of EU water legislation, building on previous legislation, and paves the way for subsequent water legislation.

### 5.1 Water Framework Directive

The purpose of the WFD is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater. The main aim of WFD is to:

- prevent further deterioration, protect and enhances the status of aquatic ecosystems:
- promote sustainable water use
- protect and improve the aquatic environment through measures to reduce discharges, emissions, and losses of priority substances, and the cessation or phasing-out of discharges, emissions, and losses of priority hazardous substances
- ensure the progressive reduction of pollution of groundwater, and the prevention of

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<sup>113</sup> No EU funding is available for implementation of the Water Framework Directive

<sup>114</sup> Recital 1 of the WFD

<sup>115</sup> ECA (2014) Integration of EU water policy objectives with the CAP: a partial success. Special Report No. 4, European Court of Auditors – Luxembourg.

further pollution,

- contribute to mitigating the effects of floods and droughts<sup>116</sup>

Under the WFD, a Programme of Measures (PoM) is established in each Member State. These PoM must include the 'basic measures' set out in the Directive, as well as any national legislative requirements and any 'supplementary measures' deemed relevant.

Basic measures include the requirements set out in:

- The Nitrates Directive (91/676/EEC)
- The Habitats Directive (92/43/EC)
- The Birds Directive (79/409/EEC)
- The Sewage Sludge Directive (86/278/EEC)

Water plays a large role in agricultural practices, from irrigation to waste water disposal to unintentional flooding. On one hand poor agricultural practices, such as insufficient waste management or improper fertiliser use, can impact negatively on the quality of surface or groundwater, while intensive irrigation can affect water availability for other uses.

This section focuses on several key pieces of EU water legislation

- WFD<sup>117</sup>
- Floods Directive<sup>118</sup>
- Groundwater Directive<sup>119</sup>
- Drinking Water Directive<sup>120</sup>
- Environmental Quality Standards Directive<sup>121</sup>

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<sup>116</sup> Adapted from Article 1 of the WFD

<sup>117</sup> Directive 2000/60/EC of 23 October 2000 establishing a framework for Community action in the field of water policy

<sup>118</sup> Directive 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks

<sup>119</sup> Directive 2006/118/EC of 12 December 2006 on the protection of groundwater against pollution and deterioration

<sup>120</sup> Council Directive 98/83/EC of 3 November 1998 on the quality of water intended for human consumption

<sup>121</sup> Directive 2008/105/EC of 16 December 2008 on environmental quality standards in the field of water policy

- Nitrates Directive<sup>122</sup>

It is important to note that none of these policies, with the exception of the Nitrates Directive, have a direct impact on agricultural practices<sup>123</sup>, but have in so far indirect impacts on agricultural practices and ensure sufficient quality and quantity of water.

## 5.2 Main objectives

The WFD has the overall objective of good status for all European waters by 2015. Since it entered into force in 2000, there have been various “daughter Directives” which aim to ensure this goal is met. The Floods Directive, the Groundwater Directive, and the EQS Directive were all established to achieve specific objectives in the WFD.

Each of these daughter Directives correspond with different parts of the WFD – the Groundwater Directive aims to prevent the deterioration of the chemical status of all ground water bodies, while the Floods Directive requires Member States to carry out a preliminary assessment to identify river basins and coastal areas at risk of flooding, which are then subject to Flood Risk Management Plans which set out measures on prevention, protection, and preparedness. The EQS Directive sets out the priority substances and certain other pollutants, which need to be avoided in order to achieve good chemical status in water bodies.

The other two pieces of legislation considered in this section, the Nitrates and the Drinking Water Directive, both predate the WFD. The Drinking Water Directive aims to ensure water intended for human consumption is wholesome and clean<sup>124</sup>, while the Nitrates Directive aims to reduce and prevent water pollution cause/induced by nitrates from agricultural sources. The overall objective of all these pieces of water legislation is to ensure that all water in the EU is of sufficient quality and quantity.

## 5.3 Policy instruments

Some of these Directives introduced above set specific standards for pollutants, some establish planning structures. In more than one instance, a Directive may do both. For this reason, this section considers EU water legislation as single body of legislation. The table below provides a brief overview of the six Directives.

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<sup>122</sup> Council Directive 91/676/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources

<sup>123</sup> SWD (2015) Commission Staff Working Document: Report on the progress in implementation of the Water Framework Directive Programme of Measures. European Commission – Brussels.

<sup>124</sup> According to the Directive, this means it is free from any micro-organisms and parasites, and from any substances which constitute a potential danger to human health.

Table 5.1: Overview of Water Framework Directive and daughter directives

Directive	Primary policy instrument	Brief description
WFD	Planning instrument	River Basin Management Plans must be produced, setting out a programme of measures. A monitoring programme must be established progress reported
Floods Directive	Planning instrument	Flood Risk Management Plans must be produced for areas with flood risk, setting out measures and objectives.
Groundwater Directive	Regulatory instrument (setting standards)	Groundwater threshold values, are set by MS, groundwater quality standards are set out in Annex I of the GWD
Environmental Quality Standards Directive	Regulatory instrument (setting standards)	Standards are set and monitored for priority substances and other pollutants.
Drinking Water Directive	Regulatory instrument (setting standards)	Minimum standards are set, along with monitoring requirements and specifications for the analysis of parameters.
Nitrates Directive	Planning instrument	MS identify problem areas, set codes of good practices, implemented them via action programmes, and monitor the results.

As seen in the table above, water legislation is broken down into Directives that either set specific limits, or guide MS to identify risks and produce planning documents that mitigate them (and perhaps include site-specific limits/thresholds). Some, such as the Groundwater and Nitrates Directives do both. In addition, the WFD is the first piece of EU water legislation to explicitly integrate economics into its measures (WISE, 2008). Not only are water users called on to pay for the full cost of the water services they receive, but Member States are required to use economic analysis in the management of their water resources and assess the cost-effectiveness and overall costs of alternatives when making key decisions.

The merits and shortcomings of the different types of policy instruments is beyond the scope of this section, but it should be noted that even the planning instruments retain a certain degree of EU-centralisation. FRMPs and RBMPs are to be submitted to the European Commission for assessment on a regular basis, and “nitrate vulnerable zones” identified under the Nitrates Directive are to be submitted to the Commission.

It is also worth differentiating between mandatory and voluntary actions. The WFD, for example, requires Member States to produce RBMPs with POMs and implement 'basic' measures. Member States can, however, voluntarily implement, where necessary, 'supplementary' measures<sup>125</sup>.

## 5.4 Relationships to and impacts on cropping systems

### 5.4.1 Potential impacts on cropping systems

With the exception of the Nitrates Directive, EU water legislation does not explicitly address agricultural policies or practices. However, these Directives have been selected as they do have a (mostly) indirect impact on cropping systems, through objectives, standards and instruments aimed at either protecting, maintaining and improving water quantity or water quality. The key impacts are:

- Crop rotation (impacting water quantity);
- Integrated nutrient management (impacting water quality and quantity);
- Enhanced efficiency irrigation (impacting water quantity);
- Integrated pest management (impacting water quality);
- Controlled drainage (water quality and quantity).

#### *Nitrates Directive*

The Nitrates Directive is the key piece of water legislation referring specifically to agricultural practices, as follows:

- Member States are required to identify waters that are or could be affected by pollution (according to criteria set out in Annex I). Member States must also designate land, which drain into these pollution waters as "nitrate vulnerable zones" (NVZ).
- Member States are required to establish a code or codes of good agricultural practices to be implemented by farmers on a voluntary basis, and a programme, including training and information was to be set up to promote the application of the code(s).
- Action programmes are to be established with respect to the designed NVZ (either collectively or on a case by case basis). These action programmes are to be implemented by farmers within NVZ on a compulsory basis.
- Monitoring programmes are to be drawn up and implemented, including the monitoring of waters to establish the extent of nitrate pollution from agricultural sources.

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<sup>125</sup> A non-exhaustive list of supplementary measures is included in Part B of Annex VI to the WFD.

The use of fertilizers in agriculture is reported to be the main source of nitrogen loading (over 50% of total discharge into surface waters), and a significant source of phosphorus loading<sup>126</sup>. Nitrate Vulnerable Zones are subsequently often regions with high animal densities or intensive arable crop production (Monteny, 2001). There is also a close correlation between water consumption and fertiliser use (Gómez-Limón et al., 2001), as fertilisers should be reduced in arid conditions so as to prevent stress on soil and crops. In addition, fertiliser use should take into account drainage patterns when irrigation (or flooding) is increased. At the same time, more severe droughts could reduce pollutant dilution, thereby increasing toxicity problems (Landrum et al., 1987).

### *Water quality*

The underlying theme of EU-level water legislation is reducing pollution both from nutrients and chemicals, and thus improving water quality. This means the most obvious links with cropping systems stem from fertiliser use and pest management (i.e. the amount of chemicals that are used on the land in the first place) and drainage and irrigation (i.e. preventing chemicals from entering water bodies).

The Nitrates Directive is the only directive considered in this section that specifically targets agriculture. However, the Directives that set out specific chemical standards (the Groundwater and EQS Directives in particular) may greatly impact cropping practices by placing restrictions on what chemicals can be used for pest control or fertiliser.

### *Water quantity*

The WFD explicitly uses economic tools to ensure users pay the real costs of the water they use. This is expected to provide incentives to stop users (for example, farmers) from wasting water<sup>127</sup>. This may have an impact on cropping systems, as the costs associated with irrigation no longer make water-intensive crops financially viable. Farmers may thus reduce their irrigation programmes, and plant crops more suited to the natural environment. Research has shown that this is likely only when water prices are above a certain threshold (Gómez-Limón, 1987).

### *Mandatory vs voluntary measures*

As mentioned above, both the WFD and the Nitrates Directives set out voluntary measures. In the WFD, these supplementary measures are those that Member States “may choose to adopt as part of the programme of measures”. Several of these specifically concern agricultural

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<sup>126</sup> <http://data.consilium.europa.eu/doc/document/ST-8705-2017-INIT/en/pdf>

<sup>127</sup> [http://ec.europa.eu/environment/water/participation/pdf/waternotes/water\\_note5\\_economics.pdf](http://ec.europa.eu/environment/water/participation/pdf/waternotes/water_note5_economics.pdf)

practices (in order of relevance)<sup>128</sup>:

- Demand management measures, *inter alia*, promotion of adapted agricultural production such as low water requiring crops in areas affected by drought;
- Efficiency and reuse measures, *inter alia*, promotion of water-efficient technologies in industry and water-saving irrigation techniques i.e. precision agriculture;
- Abstraction controls;
- Recreation and restoration of wetlands areas.

The Nitrates Directive also requires Member States to establish a code or codes of good agricultural practice to be implemented by farmers on a voluntary basis (as long as they are not NVZs), covering at least the items mentioned in Annex II A of the Directive:

- Periods when the land application of fertilizer is inappropriate;
- The land application of fertilizer to steeply sloping ground;
- The land application of fertilizer to water-saturated, flooded, frozen or snow-covered ground;
- The conditions for land application of fertilizer near water courses
- The capacity and construction of storage vessels for livestock manures, including measures to prevent water pollution by run-off and seepage into the groundwater and surface water of liquids containing livestock manures and effluents from stored plant materials such as silage;
- Procedures for the land application, including rate and uniformity of spreading, of both chemical fertilizer and livestock manure, that will maintain nutrient losses to water at an acceptable level.

Annex II B of the Directive sets out items, which Member States may include in their codes(s) of good agricultural practices:

- Land use management, including the use of crop rotation systems and the proportion of the land area devoted to permanent crops relative to annual tillage crops;
- The maintenance of a minimum quantity of vegetation cover during (rainy) periods that will take up the nitrogen from the soil that could otherwise cause nitrate pollution of water;
- The establishment of fertilizer plans on a farm-by-farm basis and the keeping of records on fertilizer use;

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<sup>128</sup> WFD Annex VI, Part B

- The prevention of water pollution from run-off and the downward water movement beyond the reach of crop roots in irrigation systems.

These measures, while voluntary on the part of the Member State (for the WFD) or on the part of the farmer (for the Nitrates Directive), may influence a farmer's decision with regard to, nutrient management, efficient irrigation, or crop rotation and decisions on crop types.

#### **5.4.2 Empirical evidence**

There are few studies that examine the actual impact of water policy on agricultural management and practices. However, studies using modelling show that although the Nitrates Directive may not affect farm income, significant modification to cropping systems and crop allocation to soil types were simulated and showed that overall water consumption and soil erosion decreased mainly due to modification in cropping patterns and management by soil type (Belhouchette et al., 2011). Other studies highlight the problem of classification of NVZs in relation to soil type and suggest that soil type can be a deciding factor i.e. all entire soil types could be classified as NVZs (Arauzo, 2013). Although relevant literature shows that the objectives of EU water policy are integrated into agricultural policy at the strategic level, the impact of this integration depends on the effective implementation of the agricultural policies. Some stakeholders have indicated that the ND has certainly changed the way manure is handled, specifically establishing facilities to store manure to prevent problems with runoff, and that this would not have been done if not for the WFD and its respective legislation (see studies cited by Gómez-Limón et al., 2002). There are some studies that argue that price above a certain threshold increases in water force farmers to change cropping patterns in favour of less water-intensive crops and can influence crop choices. For example, maize is very water intensive and uses three times as much nitrogen as winter cereals and is also subsidized by CAP (Gómez-Limón et al., 2002).

The European Commission and Council have stressed the importance of better integration of water policy within other policies, such as the Common Agricultural Policy. The European Court of Auditors audit (ECA, 2014) found that EU water policy has been only partially integrated in the CAP, and highlighted weaknesses in the two instruments currently used by the Commission to integrate water concerns into the CAP (cross-compliance and rural development). The report recommended that the Commission should propose the necessary modifications to the current instruments (cross-compliance and rural development) or, where appropriate, new instruments capable of meeting the more ambitious goals relating to improved integration of water policy objectives into the CAP. The Member States should address the weaknesses highlighted in relation to cross-compliance and improve their use of rural development funding to better meet the water policy objectives.

### **5.5 Conclusions**

Protecting water resources has long been a priority for the European Union, and the Water Framework Directive was established to protect this public good and has a transboundary

dimension that makes it relevant as an EU policy. Quantity and quality of water is explicitly related to land use, agriculture and management practices. Indeed, agriculture is an important factor as agriculture accounts for about one-third of the water use in Europe and is a major source of pollution both from excessive nutrients and pesticides applied to crops to maximise productivity. Agricultural management and practices impact on nutrients, water use and pollution, and maintaining or enhancing soil quality can impact or is impacted on by all of these management areas. The WFD is composed of a number of regulations – commonly referred to as daughter regulations. These are all potentially impacted on by agriculture i.e. there are a number of mechanisms whereby management of agriculture and specific practices can influence water quality, flooding etc., but the regulation that most directly influences agricultural practices and management is the Nitrates Directive. The Nitrates Directive is one of the SMRs in cross-compliance regulation and has impacted directly on farmers management of nutrients and specifically on application of fertilisers, establishing buffer strips and storage of manure. Some suggest that better integration of the WFD across policies should include inclusion of the WFD as a more integral part of CAP as a cross compliance SMR.

## 6 Nature Directives

While biodiversity is often associated with wild and pristine environments, much of the EU's territory is covered in farmland. Many of its native protected bird, and other animal species, as well as the habitats that house them, are intricately linked with agricultural activity – from extensively grazed pastures to intensive cereal cropland. There is therefore an incentive to protect certain forms of agriculture, which are locally necessary to the survival of protected species. However, agriculture can also have a negative impact on biodiversity, by displacing habitats or by disturbing certain species. There is therefore an incentive to prevent agricultural activity from causing environmental harm.

In the area of EU biodiversity policies, two Directives have substantial links to farmers' choices of cropping systems, namely the Birds<sup>129</sup> and Habitats<sup>130</sup> Directives. This section will therefore focus on these two Directives, often collectively referred to as the Nature Directives. Indeed, while the two Directives spell out distinct obligations, they share substantial commonalities. For instance, natural and semi-natural areas can be designated as protected sites under either Directive. These sites form part of the same network, and the same provisions regarding the assessment of projects that might have an impact on protected sites – enshrined in article 6 of the later Habitats Directive – also apply to sites designated under the earlier Birds Directive.

### 6.1 Main objectives

The overall objective of the Birds Directive is to protect birds across the EU. The overall objective of the Habitats Directive is to protect a number of animal species as well as habitats. Taken together, the directives can be said to be the cornerstone of EU biodiversity policy.

### 6.2 Policy instruments

- Article 6(2) of the Habitats Directive: a form of regulatory instrument, Article 6(2) requires Member States to “take appropriate steps to avoid, in the special areas of conservation, the deterioration of natural habitats and the habitats of species as well as disturbance of the species for which the areas have been designated (...)”. The scope of the Article therefore covers all types of activities past, present, or future, which might be expected to have an impact on habitats and species. This restricts farmers' agricultural practices to those that do not cause significant harm to the habitats and species for which the site has been designated.
- Article 6(3) of the Habitats Directive: a form of ban, the article calls on Member States to assess the impacts of plans or projects that are likely to have a significant impact on Natura 2000 sites. While agriculture per se does not fall within the scope of article 6(3),

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<sup>129</sup> Directive 2009/147/EC of the European Parliament and of the Council of 30 November 2009 on the conservation of wild birds

<sup>130</sup> Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora

agricultural intensification and large-scale irrigation projects do. Therefore, projects with an agricultural connotation may be banned under the Habitats Directive, and farmers would, as a result, be affected by the ban.

## 6.3 Relationships to and impacts on cropping systems

### 6.3.1 Potential impacts on cropping systems

While neither Directive explicitly refers to any agricultural practice, both require Member States to protect areas within their territory for the protection of, respectively, bird species, and animals as well as the habitats that host them. In the case of the Birds Directive, these areas sometimes cover agricultural land – 11.5% percent, on average, across all EU Member States – and the policy instruments discussed above apply to cropping systems used by farmers within these areas– i.e. farmers are bound by a number of rules depending on the habitats found within the area under their management. The potential impacts of the Birds Directive apply across all components of cropping systems.

The Habitats Directive similarly requires Member States to designate sites appropriate for the conservation of species native to their territory and requiring a certain degree of protection, as well as the for the protection of the habitats that host them. Within the list of protected habitat types at EU level, a total of 63 are associated with extensive agricultural practices. Across the EU Member States, these habitat types currently cover 19.9% of land designated under the Habitats Directive as sites of community importance. The policy instruments discussed above apply to cropping systems used by farmers within these areas – i.e. farmers are bound by a number of rules depending on the habitats found within the area under their management. The potential impacts of the Habitats Directive apply across all components of cropping systems.

What's more, the Habitats Directive requires Member States to assess the impacts of plans or projects that may have substantial impacts on Natura 2000 sites. Plans for agricultural intensification and large-scale irrigation projects can be banned under article 6(3) of the Habitats Directive, when these plans and projects are found to affect the Natura 2000 sites. This ban would naturally have a potentially limiting impact on farmers' choices of cropping systems.

A number of Member States have also chosen to enact certain preventive measures in order to ensure that farmers comply with the requirements under Article 12 of the Habitats Directive, which enacts a strict protection regime for over 400 species listed under Annex IV of the Directive. A number of these species, including e.g. the hamster, the great bustard, the corncrake, the bittern, etc., have life cycles that are intricately linked to certain forms of agriculture. For instance, threats to the hamster include changes to crop rotations, the improvement of harvesting methods, land abandonment, tilling early in the season, and the use of sewage sludge on land as well as excessive irrigation (Orbicon et al., 2009). Many Member States have drafted guidelines and provided recommendations to farmers in order

to ensure that their agricultural practices do not pose threats to these species.

### 6.3.2 Empirical evidence

A report published by the Commission in 2014 (Keenleyside et al., 2014) stated that outside Natura 2000 habitat sites, obligations set on farmers to protect threatened habitats, as well as species of Community importance, were often poorly defined, and the legislation was not enforced. Concerns from stakeholders are expressed about the impact of the Directives on farmers and the lack of control and consequences i.e. destruction of grasslands covered under the Birds and Habitats Directives without any consequences<sup>131</sup>. 18 % of EU is covered by Natura 2000 and the Birds and Habitats Directives and they impact on how farmers manage their land<sup>132</sup>. Even within Natura 2000 sites, management plans drawn up for each site have little impact on farmers' decisions. Voluntary efforts made by farmers, as well as funded efforts under CAP (agri-environment schemes) and LIFE+, were found to have a greater impact. A study providing input to a regulatory fitness check (REFIT) of the Birds and Habitats Directives (Milieu et al., 2016), concluded that the availability of funding has the biggest influence on implementation of the Nature Directives. The CAP and Nature Directives are potentially complementary, as some of the CAP's incentives and associated environmental conditions (e.g. cross-compliance) can be beneficial for biodiversity, although much depends on Member State implementation choices. For example, direct payments, as well as payments for areas facing natural and other specific constraints can support farming systems associated with certain European protected habitats and species, although eligibility rules have led to unintended biodiversity damage in some areas. Pillar 2 funded measures, and especially agri-environment-climate schemes are the primary means of supporting management practices that are beneficial to biodiversity. Without such support via the CAP the conservation status of agricultural habitats and species would be worse than it currently is. However, the CAP could contribute more to the goals of the Nature Directives, especially if Pillar 2 funding was increased and Member States better tailored and targeted their measures more towards biodiversity priorities.

### 6.4 Conclusions

The Birds and Habitats Directives comprise the main policies in relation to protection and enhancement in relation to conservation and improvement of biodiversity in relation to farming. These policies, and the instruments described above have an impact on farmers and their decisions in relation to management practices, mainly at a landscape level and not necessarily at field or crop level. In some cases, the measures or perhaps more relevant their objectives relate to cropping patterns, timing of tillage and crop rotation in relation to preserving wildlife. In many cases habitats and wildlife are explicitly interlinked with agricultural lands and certain agricultural management practices can help to preserve habitats, and in the

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<sup>131</sup> NGO official. Interviewed by: Bradley, H.

<sup>132</sup> NGO official. Interviewed by: Bradley, H.

case of farmland birds can lead to gains in biodiversity. Birds and habitats directives are explicitly addressed by agricultural policy vis-à-vis cross compliance in Pillar I of CAP, but evidence suggests that management practices that support biodiversity are primarily funded under RDP measures, primarily AECM. In this context, CAP could contribute more to the goals of the Nature Directives and biodiversity in general if Pillar 2 funding was increased and Member States better tailored and targeted their measures more towards biodiversity priorities

## 7 Sewage Sludge Directive

The term waste refers to something which is discarded after having been used, e.g. within a production process. Some forms of waste, such as sewage sludge, may contain valuable resources for agriculture. Re-using waste as agricultural inputs can therefore fulfil two objectives at the same time, by providing a safe means of waste disposal, and by providing valuable resources for agricultural production. In the area of EU waste policies, one Directive has substantial links to farmers' choices of cropping systems, namely the Sewage Sludge Directive<sup>133</sup> (SSD). This section will therefore focus on this Directive.

The key need addressed by the Sewage Sludge Directive consists in finding alternatives to incineration or landfilling of sewage sludge, given that the disposal of sludge to surface waters – including the marine environment – is now banned by provisions of the Urban Waste Water Treatment Directive.

Sewage sludge refers to the semi-solid residual fraction obtained from the treatment of wastewater. Given its high concentration in organic matter and plant macronutrients such as nitrogen, phosphorus, and potassium, and in a number of micronutrients as well, it can be of high value as a form of organic fertiliser in agriculture. What's more, the use of sewage sludge in agriculture can help avoid the concentration of macronutrients in holding areas such as landfills, which can lead to risks of e.g. nitrogen runoff.

Due to greatly increased rates of treatment of urban waste water across the EU-28 – in no small part thanks to the Urban Waste Water Treatment Directive – the availability of sewage sludge has grown significantly, making it an affordable source of nutrients and organic matter for spreading on soils used for crops.

The SSD has contributed, through the limits on heavy metal concentrations in sewage sludge used in agriculture, to the improvement of sewage sludge quality. The use of sewage sludge in agriculture has therefore become more acceptable. Farmers are reassured about the safety of using sewage sludge within the parameters of the Directive. Sewage sludge can contribute to implementing the principles of the circular economy, due to its high concentration in macronutrients, particularly in phosphorus, for which the EU is practically entirely dependent on foreign imports.

While nitrogen fertiliser, derived from ammonia, can be manufactured from atmospheric nitrogen – albeit at a high energy cost – phosphorus must be mined, and world supplies of the resource are limited. The EU imports practically 100% of its phosphorus – primary production in the Member States is nearly non-existent. European imports of phosphorus take two forms: the first consists in direct imports of phosphorus rock and mineral fertiliser. The second consists in embodied phosphorus present within imported food and feed as

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<sup>133</sup> Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture

phosphates – most prominently animal feed. These phosphates ultimately find themselves in manure, which can then be spread on fields. By not recovering the phosphates in sewage sludge, the EU is ultimately making itself dependent on imports of mined phosphorus while pouring valuable nutrients into the environment.

Its value in agriculture notwithstanding, sewage sludge can pose a risk to human health, due to its relatively high concentration in heavy metals, pharmaceuticals and micro-plastics, and due to sanitary concerns. Heavy metals such as arsenic, copper, cadmium, chromium etc. are taken up by plants, as well as non- or poorly biodegradable organic compounds. These compounds and heavy metals can present significant risks to plant, animal and human health. Furthermore, pathogens present in sewage sludge can present a substantial contamination risk if the sludge is applied in the wrong conditions.

### 7.1 Main objectives

The two main objectives of the SSD are the following:

- to prevent harmful impacts on soil, human beings, animals, plants and the environment; of the application of sewage sludge on agricultural land; and
- to encourage such application.

These overarching objectives are translated into specific objectives. In particular, the aim to prevent harmful impacts due to the use of sewage sludge is essentially implemented in practice through two more specific objectives. The first of these aims to limit the quantity of seven specific heavy metals<sup>134</sup>.

### 7.2 Policy instruments

The SSD specifies two instruments that have an impact on cropping systems. Both are regulatory instruments. The first introduces standards on the quality of sewage sludge that may be used in agriculture. The second imposes obligations on farmers, regarding the way in which sewage sludge may be applied to crops – namely, the instrument consists in a ban on using sewage sludge within a certain period until the expected harvest date, the length of which depends on the crop being grown.

Article 5 prohibits the use of sludge where the concentration of one or more heavy metals in the soil exceeds the limit value set by Member States in accordance with ranges specified in Annex I A. Article 5 provides two alternative measures for limiting the accumulation of heavy metals in agricultural soils: Member States may either set limits for the quantity of sludge applied to soils per year, while observing limit values for the concentration of heavy metals in said sludge, specified in Annex I B; or they may set limits for the quantities of heavy metals introduced in the soil per unit of area and unit of time, in accordance with limit values set out

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<sup>134</sup> Cadmium, copper, nickel, lead, zinc, mercury and chromium.

in Annex I C.

Article 7 regulates the way in which sewage sludge may be used in agriculture, with regard to the minimum period between application and harvest. The article distinguishes between types of crops with regards to farmers' obligations. For instance, there are no restrictions on applying sewage sludge to land on which fruit trees are grown. Land dedicated to the production of fruit or vegetables which are usually eaten raw, and are in direct contact with the soil, may not receive sewage sludge within 10 months of the expected harvest date.

### **7.3 Relationships to and impacts on cropping systems**

#### **7.3.1 Potential impacts on cropping systems**

The main way in which the SSD could influence agricultural practices relates to fertilisation and nutrient management. While the Directive does not specify any instrument incentivising the use of sewage sludge in agriculture, it is generally credited for creating the policy environment favourable to the use of sewage sludge in agriculture. Due to the value of sewage sludge in agriculture – up to 15% of the EU's phosphorus needs could be met through the use of sewage sludge – and the increased availability of sludge, thanks to the Urban Waste Water Treatment Directive, the use of sewage sludge in agriculture has naturally risen. The SSD has provided the regulatory framework allowing this development, while regulating it.

Each Member State has implemented the SSD independently. Some have chosen to set limits on the amount of sludge that may be used per unit of area per year, in accordance with article 5.2 (a), while others have set limits on the amounts of heavy metals that may be spread on soils per unit of area per unit of time, in accordance with article 5.2 (b). In both cases, almost all Member States have adopted limit values for heavy metals in sewage sludge, or limit values for the amount of heavy metals that may be applied to soils through sewage sludge that are inferior to the ranges provided in Annex I B and Annex I C of the Directive respectively. The impact of the use of sewage sludge on agricultural practices therefore specifically consists in lower use of mineral fertilisers, particularly with regard to phosphorus needs.

The use of sewage sludge also has a direct impact on soil quality, as it is a valuable soil-building material thanks to its high organic matter content.

#### **7.3.2 Empirical evidence**

Member States have largely implemented stricter limits than those recommended by the Directive, but there is substantial variation between Member States. Partially as a result of this, but also due to a number of factors, not least of which public opinion regarding food safety issues, there are a number of Member States, which currently use practically no sewage sludge in agriculture, preferring to incinerate it (Milieu et al., 2008; Bio Intelligence Services et al., 2014). In Germany, 30% of sewage sludge obtained from the treatment of urban waste water is used in agriculture, but there are initiatives to phase out the use of sludge. In Denmark, the share rises to 70%, and it reaches up to 80% in the UK ((Bianchini et al., 2016) Recent evaluation

of the SSD suggest that implementation of the directive remains unproblematic and that although the generation of sludge was reduced by 2% between 2010 and 2012 compared to between 2007 and 2009, the Member States reported that almost the same amount of sludge was used in agriculture as in the previous period. This corresponds to approximately 45% of the amount of sludge produced<sup>135</sup>.

There are no studies that examine how the SSD impact on farmer decisions regarding use of sewage sludge in nutrient management and as way to increase soil organic matter. Questions have also been raised about the value of sewage sludge because the bioavailability of nutrients (both N&P are lower compared to traditional fertilisers) and because it contributes very little to improving the physical properties of soil (Kirchmann et al., 2017). A study that included an acceptance analysis of sludge use (SEDE & Arthur Andersen, 2002) suggests that farmers main motivation for the use of sludge in agriculture is the supply of organic fertiliser at a low cost and highlighted that the main constraints come from their customers, either food industries or retailers, who have specific quality requirements. In a growing number of cases, these quality requirements include restrictions on, and sometimes the prohibition of, the use of sludge in agriculture. In this context, the main consequences for farmers associated with the use of sludge in agriculture could be a reduction in their market share and a drop in profits, as well as additional liability costs in the event of an accident.

#### 7.4 Conclusions

The SSD promotes the use of sewage sludge in agricultural areas by providing a legal framework to administer potential risks mainly due to sludge content of heavy metals that can accumulate in soil. The directive has been in place for over 30 years and evaluation shows that implementation is unproblematic, although the use of sewage sludge in agriculture varies widely between MS and most MS have chosen to enforce more stringent limits on pollutants than the directive requires. It appears that farmer acceptance of sewage sludge, although there are potential concerns by their customers relating to associated risks, is mainly motivated by the supply of organic fertiliser at low cost. Questions have been raised about the actual value of sewage sludge in terms of availability of nutrients (N and P) and in increasing soil organic matter but composting and combining with bulk agents such as sawdust can improve its ability to increase soil organic matter. A differentiated approach to waste streams (i.e. waste streams from large cities or smaller towns) and their uses could potentially improve utilisation of sewage sludge. Organic waste recycling, complemented by nutrient extraction, can potentially offer more efficient solutions to closing nutrient loops enabling more sustainable agricultural production in line with resource efficiency and the circular economy. Finally, the SSD is consistent with other waste policies, WFD and ND, but the links with the forthcoming Fertilisers Regulation should be examined and assessed for overlaps and potential synergies, both in

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<sup>135</sup> COM(2017) 88 final REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS



general and in relation to their role in facilitating adoption of management practices that could improve nutrient management, resource efficiency and soil organic matter.

## 8 Sustainable Use of Pesticides Directive

Agriculture in the EU has become increasingly reliant on agro-chemical inputs, including on plant protection products designed to repress or exterminate pest – the latter word is used in the broadest sense, i.e. including fungi, weeds and small rodents as well as insect pests. Although a number of policies exist, such as authorisation of plant protection products and biocides regulation under the broader framework of EU chemicals policies, one Directive has substantial links to farmers' choices of cropping systems, namely the Sustainable Use of Pesticides Directive<sup>136</sup> (SUPD). This section will therefore focus on this Directive.

Despite policy efforts at EU level to limit levels of pesticide residues in food, and to limit concentrations of active substances in ground- and surface waters, pesticide use by European farmers had not declined in the decade before 2003, when the Commission adopted the European Environment and Health Strategy. In 2006, the Commission adopted a Thematic Strategy on Pesticides, whose aim was to address the lack of legislation regarding the use of pesticides in the EU – knowing that EU legislation controls the process of placing pesticides on the market already. Following adoption of the Thematic Strategy, the EU adopted the Sustainable Use of Pesticides Directive (hereafter SUPD, or the Directive) in 2009.

Among the options considered in the impact assessment accompanying the Directive were quantitative targets for the reduction in use of pesticides as well as taxes and levies on pesticides. Both were rejected. Nevertheless, the Directive calls on Member States to draft and implement National Action Plans, wherein they must set “quantitative objectives, targets, measures and timetables to reduce risks and impacts of pesticide use on human health and the environment”.

### 8.1 Main objectives

The overall objectives of the SUPD are to reduce harmful impacts from pesticide use on a) human health and b) the environment.

The key challenge addressed by the SUPD regards pesticides' negative impacts on human health and the environment. Indeed, exposure to pesticides can have a negative impact on the health of agricultural workers. Spray drift – defined as the unintentional side effect of spraying pesticides wherein a fraction of what is sprayed misses its target, e.g. by being taken up by wind – can result in harmful effects both for operators of pesticide machinery and for bystanders. Finally, continuous exposure to residual pesticide levels in food can also have negative consequences for human health.

Pesticide use can also have negative impacts on the environment. While EU legislation regarding the placing on the market of pesticides safeguards against these impacts to a certain extent, the misuse of pesticides – e.g. using more than the recommended dose or applying

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<sup>136</sup> Directive 2009/128/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides.

pesticides at the wrong time – can lead to environmental harm. The Directive specifically addresses the aquatic environment and drinking water, both for the sake of aquatic biodiversity and for public health reasons.

## 8.2 Policy instruments

The SUPD specifies five different policy instruments that can be said to be relevant to farmers' agricultural practices:

- National Action Plans (Article 4): these are a form of planning instrument, consisting in a set of concrete measures to reduce the risks of harmful impacts of pesticide use. These must be drawn up at Member State level within the National Action Plans.
- Training (Article 5): this is a form of education instrument. Member States must design certification systems to ensure that professional users of pesticides, such as farmers, as well as distributors and advisors are educated in the subjects listed in Annex I of the Directive, including knowledge of the legislation regarding pesticides, hazards and risks associated with them, integrated pest management methods, etc. (Article 5).
- Sales (Article 6): this is a form of information instrument. Under Article 6, Member States must ensure that distributors of pesticides retain staff holding certificates proving their knowledge of pesticides, as foreseen in Article 5. In conjunction with the latter, this ensures that farmers are properly informed of the proper use of particular pesticides.
- Aerial spraying (Article 9): this is a form of regulatory instrument, and more specifically a ban. Under Article 9, the practice of aerial spraying is banned, except under specific circumstances when no other suitable alternative exists. The Directive regulates the circumstances and ways in which aerial spraying may be practiced when authorised.
- Specific measures to protect the aquatic environment and drinking water (Article 11): this is a form of regulatory instrument, calling on Member States to take several measures to protect the aquatic environment and drinking water supplies. The measures must support the Water Framework Directive and the Regulation on the Authorisation of Plant Protection Products.

## 8.3 Relationships to and impacts on cropping systems

### 8.3.1 Potential impacts on cropping systems

The SUPD has a direct impact on pest management and weed control. Indeed, the Directive calls on Member States to draft and implement National Action Plans aiming at risk reduction with regards to pesticide use, and at the promotion of integrated pest management. These two objectives link to farmers' choices regarding pest management and weed control – the former due to advice regarding and restrictions on pesticide use, and the latter through direct promotion of certain types of agricultural practices.

### 8.3.2 Empirical evidence

No evidence of the Directive's impacts on agricultural practices exists. However, a report from the Commission summarising MS action plans and progress on implementation of the SUPD<sup>137</sup> indicates that:

- there is a high level of compliance in the area of training and certification of professional users, distributors and advisors. There is no accurate data, however, on the total number of professional operators in this area and therefore it cannot be certain that all are trained;
- while Member States generally have systems to gather information on pesticide acute poisoning, the accuracy of this data and its use was questioned. Systems for gathering such information on chronic poisoning are not widely implemented;
- Member States had generally established systems as required, but there is an incomplete picture regarding the overall rate of compliance which varies widely between Member States.;
- Aerial spraying is banned, and derogations are only granted under strict conditions. The area sprayed is low, is declining and is effectively controlled;
- The provision on information and awareness raising is used comprehensively in some Member States and in some areas but there remains the potential for disseminating good practice and for these practices to be used more widely, in order to inform the public and stakeholders;
- Member States have taken a range of measures to protect the aquatic environment from pesticide use, but in the absence of measurable targets in most national action plans it is difficult to assess the progress achieved;
- Member States have put extensive measures in place for the reduction of pesticide use in specific areas, and the positive effect this has achieved, but notes also the absence of measurable targets in the majority of Member States;
- While systems for controlling the handling and storage of pesticides are in place in nearly all Member States, their effectiveness cannot always be assessed due to the lack of measurable targets; and
- Member States need to develop clearly defined criteria so that they can assess systematically whether the eight principles of IPM are implemented and take appropriate enforcement measures if this is not the case. Such tools could confirm that the intended outcome of IPM as specified in the Directive, a reduction of the

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<sup>137</sup> COM (2017) 587 Final report on Member State National Action Plans and on progress in the implementation of Directive 2009/128/EC on the sustainable use of pesticides.

dependency on pesticide use, is being achieved

A forthcoming REFIT evaluation of EU pesticides legislation will not cover the SUPD – the Directive will be object of a separate evaluation at a later date.

#### 8.4 Conclusions

Substantial legislation and support measures have been in place in the European Union for more than 20 years, designed to deliver safe, reduced and more precise use of pesticides in agriculture. The SUPD offers the potential to greatly reduce the risks derived from pesticide use, but until it is more rigorously implemented by Member States, these improvements are limited, and certainly insufficient to achieve the environmental and health improvements the SUPD was designed to achieve. National Action Plans with clear measurable targets will improve efforts to reduce risks from pesticides.

The SUPD potentially impacts on farmers decisions relating to pest management and weed control, because MS are required to develop and put in place NAPs to reduce pesticide use. Provisions relating to IPM are perhaps the most promising in relation to promoting agricultural practices that improve soil quality and synergies exist i.e. crop rotation and reduction of pests but are poorly utilized in arable crops. Although IPM is sustainable from a long-term perspective, IPM can mean a higher economic risk in the short- term, and not be adopted by farmers. For example, it may be seen as preferable to grow maize or wheat in monoculture for economic reasons. However, this short-term approach to land management comes at considerable risk of longer term cost, for example due to increasing populations of pests or weeds in monoculture. Ultimately, monoculture can cause loss of biodiversity, soil erosion and even desertification.

There are number of potential synergies with other policy areas that are not adequately addressed in relation to farmers practice, such as:

- Using farm advisory services (CAP Pillar II) to facilitate information exchange and advice to farmers on pesticide use, especially relating to IPM
- Facilitating uptake of IPM and promoting innovation in alternative pest and weed management through operational groups (M16 Cooperation under rural development).
- Synergies with cross compliance measures relating to water and greening measures i.e. EFAs under CAP measures relating to maintaining water quality

## 9 Fertilisers Regulation

Agricultural production relies on a set of inputs to drive the production of outputs. These inputs include, among many others, several nutrients essential to plants. These valuable resources include the so-called “macro-nutrients” nitrogen, phosphorus and potassium; and a number of other “micro-nutrients”, equally required, but in smaller quantities, such as manganese, zinc, copper etc. In the area of EU resource policies, one Regulation has substantial links to farmers’ choices of cropping systems, namely the Fertilisers Regulation<sup>138</sup>. This section will therefore focus on this Regulation.

The Fertilisers Regulation aims to fully implement the principles of the free internal market for mineral fertilisers used in agriculture, while ensuring certain quality standards regarding nutrient content, safety, and environmental impacts. Fertilisers falling within the scope of the Regulation may be marketed as “EC fertiliser”, and therefore enjoy free circulation within the EU market, if they comply with the technical standards of the Regulation.

The scope of the Fertilisers Regulation is currently limited to mineral, i.e. inorganic fertilisers. As a result, many categories of organic fertilisers, such as manure, sewage sludge, animal by-products etc. are not covered, either as is, or as components of compound fertilisers. In the spirit of the circular economy, the Commission wishes to ensure free movement of organic fertilisers as well, by including these categories in the scope of the Fertilisers Regulation, through a proposal for a new Regulation to boost the use of organic and waste-based fertilisers<sup>139</sup>.

The proposed new Regulation also aims to address concerns shared by nearly all Member States over the risk of contamination by heavy metals, particularly cadmium, present in phosphate-rich fertilisers, both organic and inorganic.

### 9.1 Main objectives

The main objectives of the Regulation are two-fold:

- Harmonise, across all EU 28 Member States, the regulatory framework applying to market approval for fertilisers; and
- Address environmental and human health concerns regarding the use of fertilisers.

The aims and objectives of the Regulation do not target agricultural practices explicitly. To the extent that the Regulation conditions the marketing of fertilisers in the EU, and that fertiliser choice – or, more specifically, lack of a given fertiliser due to, e.g., rejection on the basis of environmental criteria – can have an impact on farmers’ choices of agricultural practices, the

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<sup>138</sup> Regulation (EC) No 2003/2003 relating to fertilisers

<sup>139</sup> COM(2016) 157 final Circular Economy Package Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL laying down rules on the making available on the market of CE marked fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009

Regulation can be said to implicitly target agricultural practices. More indirectly, the Regulation has also introduced requirements regarding the information to be displayed on fertiliser labels, such as the content in various nutrients, handling instructions and environmental precautions.

## 9.2 Policy instruments

The Fertilisers Regulation specifies two policy instruments – one an information requirement, the other a regulatory instrument – that are relevant to farmers' agricultural practices.

The first is a labelling requirement under Article 9 of the Regulation, requiring fertilisers sold under the EC label to indicate levels of several important macro- and micro-nutrients. This information may also include information on storage, dosage, conditions suitable for soil and crop conditions under which the fertiliser is used.

The second, under Article 14, consists in a ban on the sale of fertilisers that may have harmful impacts on human health or on the environment. Article 14 of the Regulation states that "A type of fertiliser may only be included in Annex I if: (...) (c) under normal conditions of use it does not adversely affect human, animal, or plant health, or the environment."

The inclusion of new types of fertilisers requires the submission of a technical file compiling a number of different data on the fertiliser, per Article 31 of the Regulation. Guidance documents specify these requirements: manufacturers of fertilisers or their representatives must submit scientific evidence that the product being submitted for approval does not have harmful impacts on human health or on the environment, and that it effectively acts as a fertiliser, i.e. that it provides nutrients efficiently.

## 9.3 Relationships to and impacts on cropping systems

### 9.3.1 Potential impacts on cropping systems

The labelling requirements specified by the Regulation may have an impact on cropping systems in that they inform users of fertilisers, in a clear and consistent way, about the nutrient contents within the fertilisers. This in turn may encourage responsible use of fertilisers.

The Regulation's requirements regarding fertilisers' impacts on human, animal or plant health, and on the environment, may influence agricultural practices as well. Indeed, products deemed to have a negative impact on the environment may be refused approval and be removed from the EU market as a result. This could, in turn, impact farmers' choices of agricultural practices. However, in practice, fertiliser manufacturers may still market fertilisers under national legislations. These products, not having been approved as "EC fertilisers", do not enjoy the free movement foreseen in the Regulation. Therefore, it's not guaranteed that the Regulation has a substantial influence on agricultural practices.

### 9.3.2 Empirical evidence

It is estimated that, out of the 17.8 million tonnes of fertilisers consumed in the EU in 2008, around 60 to 70 percent were sold under the EC label, compared to being labelled under

national legislation. In practice, many of these fertilisers sold under national legislation comply with the technical standards specified in the Fertilisers Regulation. However, there is no evidence supporting the argument that the Regulation has led to improvements regarding fertilisers' impacts on the environment, particularly regarding the presence of heavy metals in fertilisers, which may leach into soils. In fact, this has been one of the criticisms from MS of the current regulation (CSES, 2010), combined with its negative impact on introduction of new fertiliser formulations and product, has prompted work on new legislation. The impact assessment<sup>140</sup> for new fertiliser regulation highlights, that access to a broad range of valuable domestic raw materials (e.g. compost) is currently hampered by their classification as waste or variations in the implementation of waste legislation in Member States and is potentially in conflict with new agri-environmental climate measures are in place under the Rural Development Programs to promote the use of organic fertilisers with the aim to increase the organic matter content of arable soils.

## 9.4 Conclusions

Regulation of Fertilisers mainly impacts on the market for fertilisers i.e. producers of fertilisers. This however indirectly impacts on farmers and practices, because it affects the range of fertilisers that are accessible and may not be compatible with efforts to promote soil organic matter in the CAP.

The current regulation focuses on inorganic fertilisers and does not adequately cover organic fertilisers or potential new fertiliser products derived from animal waste streams. The new regulation, although still in process, will potentially make a wide range of organic fertilisers accessible and eliminate obstacles in developing new organic fertilisers.

The main policy objective of the initiative is to incentivise large scale fertiliser production in the EU from domestic organic or secondary raw materials in line with the circular economy model, by transforming waste into nutrients for crops. The proposal will provide a regulatory framework radically easing access to the internal market for such fertilisers, thereby levelling their playing field with that of mined or chemical fertilisers produced in line with a linear economy model. First, to bring fertilisers regulation in line with the strategy for a circular economy. It is expected that ultimately increased production and trade in innovative fertilisers would also lead to a more diverse range of fertilisers offered to farmers, potentially contributing to making production more cost- and resource-effective<sup>141</sup>.

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<sup>140</sup> SWD(2016) 64 final: Impact assessment accompanying the document Proposal for a Regulation of the European Parliament and of the Council laying down rules on the making available on the market of CE marked fertilising products

<sup>141</sup> COM(2016) 157 final Circular Economy Package Proposal for a REGULATION OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL laying down rules on the making available on the market of CE marked fertilising products and amending Regulations (EC) No 1069/2009 and (EC) No 1107/2009

## 10 Synthesis of the analysis of EU-level policies

Soil is a valuable resource and is clearly on the EU and international policy agendas. International frameworks, strategies and voluntary agreements highlight the importance of soil degradation, maintaining and improving soil quality, and provide guidance and strategy for improving soil quality and policies to support this, but are non-binding with the exception of the UN Convention to Combat Desertification (UNCCD). With the withdrawal of the Soil Framework directive, EU soil policy remains fragmented with no framework legislation to address the issue of soil in its own right and relies on a number of other policies that address different aspects of soil management and softer policy initiatives and non-binding targets both at EU and international levels. Soil degradation remains a problem and perhaps indicates that current efforts do not sufficiently address this problem. One of the questions that still remains is - Should there be an overarching soil policy at EU level or is a more coherent approach to existing policies that cover soil management sufficient? This study has identified a number of policies and their specific instruments that implicitly impact on farming practices and management in relation to improving soil quality.

**Greening measures, Cross-compliance and Rural Development Policy**, under the broader framework of **CAP**, potentially impact on farmers adoption of cropping systems and several of the instruments have explicit links to maintaining or improving soil quality. These policy instruments mainly focus on incentives or payments to farmers by providing payments conditional on maintaining environmental standards or by penalizing non-compliance with requirements relating to soil management, maintaining habitats and nutrient management. In addition, priorities and measures under rural development policy can support changes in agricultural practices and facilitate information and provision of advice to improve soil quality.

Protecting water resources has long been a priority for the EU, and the **Water Framework Directive** was established to protect this public good and has a transboundary dimension that makes it relevant as a EU policy. Agriculture is an important factor, accounting for about one-third of the water use in Europe and as a major source of pollution both from excessive nutrients and pesticides. Agricultural management and practices impact on nutrients, water use and pollution, and maintaining or enhancing soil quality can impact or is impacted on by all of these management areas. The **Nitrates Directive**, under the broader framework of the WFD, is the legislation that most directly influences agricultural practices and management, requiring standards on management of nutrients and physical features such as buffer strips and storage of manure.

The **Birds and Habitats Directives** comprise the main policies in relation protection, conservation and improvement of biodiversity in relation to farming. Instruments under these measures impact on farmers and their decisions in relation to management practices, mainly at a landscape level, but in some cases on farmer's specific management practices such as cropping patterns, timing of tillage and crop rotation in relation to preserving wildlife. Habitats and wildlife are explicitly interlinked with agricultural lands and certain agricultural

management practices can help to preserve habitats, and in the case of farmland birds can lead to gains in biodiversity. Birds and habitats directives are explicitly addressed by agricultural policy vis-à-vis cross compliance in Pillar I of CAP, but evidence suggests that management practices that support biodiversity are primarily funded under RDP measures, in particular AECMs. In this context, evaluation has suggested CAP could contribute more to the goals of the Nature Directives and biodiversity in general if Pillar 2 funding was increased and Member States better tailored and targeted their measures more towards biodiversity priorities

**The Sewage Sludge Directive (SSD)** promotes the use of sewage sludge in agricultural areas by providing a legal framework to administer potential risks mainly due to sludge content of heavy metals that can accumulate in soil. The directive has been in place for over 30 years and evaluation shows that implementation is unproblematic, although the use of sewage sludge in agriculture varies widely between MS, and most MS have chosen to enforce more stringent limits on pollutants than the directive requires. Farmer acceptance of sewage sludge, although there are potential concerns by their customers relating to associated health risks, is mainly motivated by the supply of organic fertiliser at low cost. The actual value of sewage sludge in terms of (bio) availability of nutrients (N and P) and its role in increasing soil organic matter has been questioned, however composting and addition of bulking agents can improve its capacity to improve soil organic matter. Use of sewage sludge in agriculture could be an important part of a strategy to close nutrient loops in line with the circular economy strategy.

The **Sustainable Use of Pesticides Directive (SUPD)** is designed to achieve more sustainable use of pesticides by requiring MS to develop clear, measurable targets to reduce risks from pesticides. The SUPD affects farmer's decisions and practices relating to pest management and weed control, because MS are required to develop and in put in place NAPs to reduce pesticide use. Provisions relating to Integrated Pest Management (IPM) are perhaps the most promising in relation to promoting agricultural practices that improve soil quality and synergies exist i.e. crop rotation and reduction of pests, but IPM is poorly utilized in arable crops. Although IPM is sustainable from a long-term perspective, IPM can mean a higher economic risk in the short-term, and because of this may not be adopted by farmers.

The **Fertilisers Directive** mainly impacts on the market for fertilisers i.e. producers of fertilisers, however indirectly impacts on farmers and their practices, because it affects the range of fertilisers that are accessible. This may not be coherent with efforts to promote soil organic matter under other policies such as CAP because current regulation focuses on inorganic fertilisers and does not adequately cover organic fertilisers or potential new fertiliser products derived from animal waste streams. A new regulation on fertilisers under the circular economy package, although still in process, will potentially make a wide range of organic fertilisers accessible and eliminate obstacles in developing new organic fertilisers or products. It is expected that ultimately increased production and trade in innovative fertilisers would also lead to a more diverse range of fertilisers offered to farmers, potentially contributing to making

production more cost- and resource-effective.

Empirical evidence on how the instruments affect adoption of soil improving management and practices is lacking, in many cases because the instruments are new and have not been evaluated or in other cases because no specific assessment has been conducted of how the policy affects decisions made by farmers. It is however, apparent that more can be done to increase the horizontal integration and coherence between policy areas to better promote soil quality in general and more specifically agricultural management practices that address soil threats and enhance soil quality. For example, Cross-compliance addresses soil quality through GAECs specifically relating to erosion and maintaining soil organic matter but are not necessarily integrated with other cross-compliance measures such as SMRs related to the Nitrates, and Birds and habitats directives. Along these same lines, it has been suggested that to better integrate the WFD across policies it should be included as a cross-compliance measure, instead of the Nitrates Directive alone. Another area for potential improvement is ensuring that greening measures and payments should go beyond cross compliance and measures already included in AECMs and so that greening measures provide added value above and beyond baseline cross-compliance conditions as defined by SMRs and GAECs. In addition, some of the measures covered in cross-compliance and greening measures are already covered by requirements in other regulation, so that in practice farmers are paid subsidies for conditions that are already obligatory under other legislation. Another important area is integrating exchange of information and capacity building relating to practices that improve soil quality through the Farm Advisory Services and operational groups funded by Rural Development Programmes. Finally, better coherence between the sewage sludge directives and the coming Fertilisers Directive could improve the market for organic fertilisers improving the availability of organic fertilisers and fertiliser products that could facilitate improving soil organic matter and better management of nutrients without compromising the environment and health.

One of the key issues highlighted by stakeholders, is that in many cases the policy and its instruments is good or adequate to address the issues at stake, but the main problem is how the policy is implemented at MS level, lack of adequate controls and no real sanctions or penalties for non-compliance. Examples were given of destruction of habitats under the Birds and Habitats Directives without any sort of penalty or sanction. This has also been a critique point relating to cross-compliance, that the idea is good, but it only works if it is implemented properly at MS level and infringement is penalised by withdrawing or paying back direct payments.

Although our inventory and analysis of relevant policies has focused on current policy, it is important to note two policies currently under revision, namely the Fertilisers Directive and the Common Agricultural Policy. The upcoming Fertilisers Directive will deal more specifically with organic fertilisers and products that can increase the efficiency of fertilisers. This will potentially have a substantial impact on management practices and soil quality by making a

wider range of organic fertilisers accessible, at lower costs for farmers. It is expected that the current reform of CAP will have increased focus on implementing international agreements on climate change (COP21) and sustainable development (SDGs) this will potentially increase focus on soil and measures to improve soil quality.

In conclusion, agriculture, biodiversity, environment, resource and water related regulations have all an impact on the soil, but none succeeds to comprehensively address the issues. **Error! Reference source not found.** provides a summary of impacts of EU policies, instruments and measures covered by this analysis on SICS adoption. Whether specific legislation relating to soil is the answer or better integration and implementation of current policy is the best solution, needs to take into account costs and benefits of the respective approach as well as the extent to which they might impact on farmers' adoption of management practices.

Table 10.1: Summary of impacts of EU policies, instruments and measures covered by this analysis on SICS adoption

Policies/instruments	CAP			WFD	Birds and Habitats Directives	Sewage Sludge Directive	Sustainable Use of Pesticides Directive	Fertilisers Directive
	Greening	Cross-compliance	RDP	Nitrates Directive				
<b>SICS</b>								
<b>Cover crops</b>	Cover crops and catch crops are one eligible measures under EFAs under the greening measures, however evaluation shows that impact of greening on Cover crops is low in most MS.	No directly relevant standards	RD measures can be used to cover transaction costs associated with cover crops i.e. seeds and increased use of machinery, an agri-environmental-climate payment (Pillar 2) could be envisaged for cover crops used in permanent crops.	No directly relevant standards. However voluntary codes of Good Agricultural Practice include requirements for crop rotations, soil winter cover, and catch crops to prevent nitrate leaching and run-off during wet seasons.	No directly relevant standards	No directly relevant standards	Cover crops and catch crops are included under measures relating to integrated pest management and can be included in MS action plans for reducing pesticide use.	No directly relevant standards
<b>Crop rotation</b>	Although the greening measure Crop Diversification incentivizes increasing the number of in agricultural holdings, it does not specifically address crop rotations. The measure permanent pasture can potentially limit long crop rotations by limiting the possibility plough up pasture that has been established for > 5 years.	No directly relevant standards	Costs associated with crop rotation can potentially be covered by AECM.	No directly relevant standards. However voluntary codes of Good Agricultural Practice include requirements for crop rotations, soil winter cover, and catch crops to prevent nitrate leaching and run-off during wet seasons.	No directly relevant standards	No directly relevant standards	Crop rotation can be beneficial for pest management and are included under measures relating to integrated pest management and can be included in MS action plans for reducing pesticide use.	No directly relevant standards
<b>Nutrient management</b>	No directly relevant standards	Cross-compliance with the SMR on Nitrates Directives directly impacts on farmers management of	RDP measures can be used to finance manure storage, small scale bio refineries to reduce GHG/Ammonia emissions, and	Directly impact on farmers nutrient management by establishing maximum levels of nitrogen applied,	HD Annex II species may require more stringent conditions to reach	Sewage sludge is a cost-efficient source nutrient.	No directly relevant standards	Does not directly affect nutrient management but provides stable operating environment for

Policies/instruments	CAP			WFD		Sewage Sludge Directive	Sustainable Use of Pesticides Directive	Fertilisers Directive
	Greening	Cross-compliance	RDP	Nitrates Directive	Birds and Habitats Directives			
		nutrients. Some MS have included manure storage as a mandatory cross compliance measure.	information and awareness building relating to nutrient management and nutrient runoff/leaching	periods and landscapes where application of nitrogen based fertilisers is inappropriate, designation of NVZ and GAPs relating to reducing nitrogen runoff such as cover, catch crops, and buffer strips.	favourable conservation status than the ones necessary to achieve good ecological status including nutrient levels.	SSD sets limits for land-based applications and establishes maximum levels of pollutants in sewage sludge (although most MS have stricter standards compared to SSD).		trade in fertilisers. The new fertilisers directive is expected to make organic fertilisers and products that improve uptake of nutrients more readily accessible for farmers.
<b>Enhanced efficiency irrigation</b>	No directly relevant standards	No directly relevant standards	RDP measures relating to physical investments can be used for investments in more efficient irrigation systems and/or drainage systems.	No directly relevant standards, but have indirect impacts relating to ensuring sufficient quality and quantity of water.	No directly relevant standards	No directly relevant standards	Annex III includes use of balanced fertilisation, liming and irrigation/drainage practices in general list of practices for Integrated Pest Management.	No directly relevant standards
<b>Controlled drainage</b>	No directly relevant standards	No directly relevant standards	RDP measures relating to physical investments can be used for investments in more efficient irrigation systems and/or drainage systems.					
<b>Reduced tillage</b>	No directly relevant	No directly relevant standards for reduced tillage, but would be fulfilled by GAECs on improving soil organic matter	RDP investment measure can be used to cover costs associated with specific machinery required for zero tillage or low tillage practices.	No directly relevant standards, but technique reduces need for application of nitrogen-based fertilisers and could	No directly relevant standards, but reduced tillage systems can be beneficial	No directly relevant standards	Annex III includes use conservation agriculture i.e. reduced tillage in list of general practices for Integrated Pest Management.	No directly relevant standards

Policies/instruments	CAP			WFD	Birds and Habitats Directives	Sewage Sludge Directive	Sustainable Use of Pesticides Directive	Fertilisers Directive
	Greening	Cross-compliance	RDP	Nitrates Directive				
		and reducing soil erosion		be used as strategy for reduction of nitrogen leaching especially in designated NZVs.	for farmland bird population and habitats.			
<b>Integrated pest management</b>	No directly relevant standards, although several measures that qualify as EFAs could also be part of IPM strategies	No directly relevant standards	No directly relevant standards	No directly relevant standards		No directly relevant standards	Integrated Pest Management is one of the key features of the regulation and stresses that Member States shall establish or support the establishment of necessary conditions for the implementation of integrated pest management	No directly relevant standards
<b>Smart weed control</b>	No directly relevant standards	No directly relevant standards	No directly relevant standards	No directly relevant standards	No directly relevant standards	No directly relevant standards	Integrated Pest Management includes different measure to control weeds and reduce the use of herbicides	No directly relevant standards
<b>Smart residue management</b>	No directly relevant standards	Cross-compliance includes GAECs on improving soil organic matter and a ban on burning of stubble, but does not include measures per se on residue management	No directly relevant standards	No directly relevant standards	No directly relevant standards	No directly relevant standards	No directly relevant standards	No directly relevant standards, although residue management is part of the broader principles of Integrated pest management described in annex III of the directive

## Part III

# Analysis of national and regional policies and their potential for promoting SICS adoption

Part III of this report focuses on the policy review and analysis of national instruments relevant for shaping agricultural practices in 16 study site countries. Each study site is described in detail in a dedicated section and presents results of the policy analysis per site. The last section of Part III provides a synthesis of the study sites' results based on the policy inventories.

Each study site section is organised along the following sub-themes:

- Description of the study site;
- Identification of main soil threats;
- Description of current agricultural practices and SICS to be tested;
- Overview of key institutions and policies;
- Analysis of potential shortcomings and opportunities.

The context setting of each case study is based on the distinction between the EU and MS origin policy, and details what policy category and type of instrument the highly relevant policies falls into. For an overview and definitions of all policy categories and types of instruments please see Section 2.1. The analysis of potential shortcomings and opportunities is based on the policy inventories compiled by the WP 7 partners working at site level.

## 11 Flanders, BE

The study site is situated in the East of Leuven, Flanders. 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. 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.

The main soil threats include:

- poor soil quality (low soil organic carbon content and acid pH),
- erosion,
- soil compaction

Current agricultural practices can be described as conventional cropping systems and tillage (ploughing), conservation cropping systems (e.g. reduced tillage) and to a smaller extent organic cropping system, drip irrigation and sprinkler irrigation, organic and mineral fertiliser application (resulting in poor water quality). In addition, long-terms trials of reduced tillage and compost on-going.

SICS to be tested in Flanders include minimized input and tillage, crop rotation, cover crops, as well as organic amendments

### 11.1 Overview of key institutions and policies

The key institutions in the Flanders Study site include the following authorities:

- Departement Landbouw en Visserij van de Vlaamse Overheid (Department of Agriculture and Fishery, Flanders)
- Vlaamse Milieumaatschappij (VMM) (Flemish Environmental Agency)
- Vlaamse Landmaatschappij (VLM) (Flemish Land Agency)
- NAPAN (National Actin Plan) Task Force
- Public Waste Agency (OVAM)
- Agency for Nature and Forest (ANB)
- LNE (Departement Leefmilieu, Natuur en Energie) Vlaamse Overheid (Department of Environment, Nature and Energy of the Flemish Authorities)

The vast majority of policies identified as the most relevant for shaping agricultural practices are the ones which transposed various EU Directives – namely Water Framework Directive,

Nitrates Directive and Pesticides Directive. In addition, compulsory CAP instruments have high relevance for impacting agricultural practices in Flanders. With regards to legislation and policy stemming from national initiatives, there is one instrument identified as highly relevant - Decision of the Flemish Government on Erosion Control which provides subsidies to municipalities to address soil erosion.

In terms of policy categories, the most frequent category is regulatory and economic category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans, and (2) subsidies/conditional payments/voluntary agreements

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Flanders study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having direct impact on farmers.<sup>142</sup>

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<sup>142</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 11.1: Overview of key policies, Flanders (BE)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Randvoorwaarden: Norm voor een goede landbouw- en milieuconditie van grond (GLMC)	CAP GAEC Cross-compliance Standards	Regional	EU	Landscape management; permanent grassland; plant cover; tillage management; crop residues; drainage management	Implements CAP Cross compliance GAECs 4-7 involve soil protection measures: GAEC 4 On erosion endangered land, farmers have to take several measures depending on the crop type on the parcel. On parcels with a very high risk of erosion, the conversion of permanent grassland to arable land is prohibited. 80% green cover is required for permanent crops. For other crops, the farmers have to establish a green cover in the winter period or when the previous crop is yielded very late, they can also choose to keep the crop residues on the field or to apply a conservation tillage. GAEC 5 On parcels with a very high risk of erosion farmers have to apply conservation tillage, or create microdams in between ridges. Depending on site conditions and crop grown, requirements for a buffer strip at the bottom of the plot may apply. GAEC 6 Ban on stubble burning. Requirement for soil analysis. GAEC 7 Hedges, lines of trees, ponds and orchards are protected, plus terraces, groups of trees, stone walls, ditches and field margins/balk where other protections also apply.
Vergroeningspremie: vergroening in het kader van het Gemeenschappelijk Landbouwbeleid	CAP Greening Payment Requirements	Regional	EU	Landscape management; cover crops; catch crops; nutrient management; agroforestry; crop rotation; tillage management;	Implements CAP greening requirements The list of EFA elements which Belgian farmers in Flanders can choose from includes the following elements that can protect soils and soil carbon: land lying fallow, buffer strips, catch crops/green cover, nitrogen-fixing crops, agroforestry, afforested areas and short rotation coppice (SRC). There is a ban on the use of pesticides on land lying fallow. Flanders has designated 18 098 ha of environmentally sensitive permanent grassland (ESPG) within Natura 2000 areas and 4 083 ha outside Natura 2000 (from 2016 onwards). Farmers

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
				pesticide management	are not allowed to plough or convert this grassland. Flanders applies the obligation to maintain permanent grassland at regional level.
Agromilieumaatregelen	CAP Agro-environmental measures	Regional	EU	Landscape management; permanent grassland; plant cover; tillage management; crop residues; drainage management; weed control	Implements CAP Agro-environmental measures In the Flemish Program for Rural Development (PDPO III), subsidies are provided for the application of different agro-environmental-climate measures. There are 2 types of these measures: the agro-environmental measures of the Department of Agriculture and Fishery and the "Management Agreements" (Beheerovereenkomsten) of the Flemish Land Agency. Agro-environmental measures can include techniques such as: mechanical weeding, cultivation of legumes, cultivation of fiber flax or hemp with reduced fertilisation.
Beheerovereenkomsten (VLM)	Management Agreements (Flemish Land Agency)	Regional	EU	Landscape management; permanent grassland; plant cover; tillage management; crop residues; drainage management	Encouragement of farmers to apply 5-year commitment, yearly subsidy. The following types of Management Agreements are specifically connected with soil quality: <ul style="list-style-type: none"> <li>- agreement on erosion control</li> <li>- agreement on the maintenance of small landscape elements</li> <li>- agreement on the development and maintenance of multispecies grassland</li> <li>- agreement on the development and maintenance of buffer strips</li> <li>- agreement on water quality improvement, improving cropping techniques.</li> </ul>
Decreet betreffende het integraal waterbeleid	Decree on Integrated Water Management	Regional	EU	Drainage management	Implements the Water Framework Directive (WFD) and the Floods Directive (FD) and constitutes the general framework (organization, planning, instruments) for the integrated water policy in Flanders. The decree contains environmental objectives for surface and groundwater bodies, including objectives for the soil quality of surface waterbodies. The objectives for the waterbeds are used to evaluate the global state of a surface waterbody; they are no sanitation standards. The river basin management plans contain also measures to prevent the inflow of sediments in the watercourse and for an efficient management of rainwater (reuse, infiltration, storage, ...). Those measures have an indirect contribution to soil protection.

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					Soil Protection measures: No specific measures defined, just broad categories: characterisation of river basins, setup of basin secretariats, financial instruments (e.g. the procedure for expropriation of land, right to purchase land by the authorities, financial compensation), the water assessment procedure (to test the risk of a particular land to floods) and associated permits, development of a monitoring programme, development of a programme of measures.
Mestdecreet - Actieprogramma ter uitvoering van de Nitraatrichtlijn 2015-2018 (het 5de Mestactieplan))	Manure Decree - Action Programme for the Implementation of the Nitrate Directive 5th Manure Action Plan	Regional	EU	Nutrient management; catchcrops/ plant cover	<p>Implements the WFD and the Nitrates Directive, updates the national Manure Decree. The instrument aims to reduce the nutrient losses from the soil and decrease nitrate and phosphate concentrations in groundwater and surface water through an area and farm specific approach. To reduce the loss of soil organic matter is also a concern.</p> <p>The action programme consists of the following sections: integrated approach on soil and water quality addressing diffuse nitrogen and phosphorus pollution based on spatially targeted (area and farm specific) approach, more efficient fertilisation, approach to close the nutrient cycle and enforcement. The targeted approach to reduce diffuse nitrogen pollution consists of the following sub-categories: the appointment of priority areas and priority companies (based on the progress made in water quality of ground and surface water in the different (sub)catchments; a map for the region of Flanders is included). For the priority companies, the following measures are included: stricter standards for nitrate residues in soil, extended closed period at the beginning and the end of the growing season, compulsory sowing of winter crops. Also detailed requirements for the monitoring and evaluation of the nitrate residue in soil are defined.</p> <p>The different Flemish Manure Action Plans contain measures to reduce pollution of water by nitrates and phosphates from agricultural sources and to prevent further contamination.</p> <p>The Flemish Manure legislation contains rules on:</p> <ul style="list-style-type: none"> <li>- prohibition periods for the application of manure, mineral fertilisers and organic fertilisers</li> <li>- restrictions on the use of fertilisers:</li> <li>- on slopes</li> </ul>

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					<ul style="list-style-type: none"> <li>- on water-saturated, flooded, frozen or snowy fields</li> <li>- near water streams</li> <li>- compulsory low-emission fertiliser application</li> <li>- nitrogen and phosphorus fertilisation standards</li> <li>- manure production by cattle:</li> </ul>
NAPAN - National Actie Plan d'Action National	National action plan	Regional	EU	Pest management	Coordination of plans concerning pesticides in Belgium
Decreet duurzaam gebruik van pesticiden en de bijhorende besluiten	Decree on the Sustainable Use of Pesticides and Associated Decisions	Regional	EU	Pest management	The instrument regulates the sustainable use of pesticides, including the development of the Flemish Action Plan for Sustainable Pesticide Use. From 2015 onwards, the use of pesticides is prohibited for all public services. For commercial activities – non agricultural – there is a regulation: minimal use or prohibition in those zones to protect water or to protect vulnerable groups. Also protected areas indicated in the regulations on nature and biodiversity are covered. Sometimes specific derogations of the prohibitions can be granted. The Decree does not refer explicitly to the impact on soil. But it can be assumed that the ban to use pesticides aims to reduce the impact on soils and water.
Besluit van de Vlaamse Regering betreffende de erosiebestrijding	Decision of the Flemish Government on Erosion Control	Regional	MS	Landscape management; tillage management; drainage management	The Decision of the Flemish Government on Erosion Control provides subsidies to municipalities to address soil erosion and muddy floods. The policy helps municipalities to inform and encourage farmers to apply erosion limiting cropping techniques. It doesn't provide subsidies directly for the farmers. Subsidies are eligible for: The development of a municipal erosion control plan which delineates areas sensitive to erosion, making use of reports of muddy floods and thematic maps such as the soil map, topographic map, erosion sensitivity map etc. Furthermore, focus areas for erosion control are delineated, for which the plan describes possible erosion control measures. The subsidy accounts for 100% of the development costs of the plan (total budget is maximal 12,50 €/ha of erosion sensitive area in the municipality). Indirect (I) impact on agricultural practices:

## 11.2 Analysis of shortcomings and opportunities

Table 11.2: SICS components addressed by key policies, Flanders (BE)

Policies	Cover crops	Crop rotation	Permanent grassland	Drainage	Nutrient management	Pest management	Tillage management	Agroforestry	Landscape management
Water protection policy	X			X	X				
PPP and nutrient policy (chemical & organic)						X			
Agriculture/environment				X			X		X
CAP	X		X	X	X	X	X	X	X

Table 11.3: Linking soil problems, appropriate SICS and existing policies, Flanders (BE)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Low SOM	Nutrient management Pest management Tillage Cover crops	<ul style="list-style-type: none"> <li>Nutrient management addressed in CAP and water policy</li> <li>Pest management addressed in PPP and nutrient policy (chemical &amp; organic) and CAP</li> <li>Tillage addressed in CAP and agriculture/environment</li> <li>Cover crops addressed in CAP and water policy</li> </ul>	<ul style="list-style-type: none"> <li>Water protection policy - regulatory category only, bans/standards/targets, EU based, indirect impact on soil</li> <li>PPP and nutrient policy (chemical &amp; organic) - Legislation imposing bans and restrictions on use;</li> <li>Introduction of voluntary measures/actions and training – positive impact on soil; based on EU law, indirect impact on soil protection</li> <li>Agriculture/environment policy – national law, direct impact on soil, based on subsidies for municipalities</li> <li>CAP – highly influential, addresses many SICS</li> </ul>

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Soil compaction	Machine management/tillage management	<ul style="list-style-type: none"> <li>Addressed in agri/environment and CAP</li> </ul>	<ul style="list-style-type: none"> <li>Agri/environment policy – national law, direct impact on soil, based on subsidies</li> <li>CAP – highly influential, addresses many SICS</li> </ul>
Erosion	Irrigation/drainage Tillage Cover crops	<ul style="list-style-type: none"> <li>Drainage addressed in water policy</li> <li>Tillage addressed in CAP and agriculture/environment</li> <li>Cover crops addressed in CAP and water policy</li> </ul>	<ul style="list-style-type: none"> <li>Water protection policy - regulatory category only, bans/standards/targets, EU based, indirect impact on soil</li> <li>Agriculture/environment policy – national law, direct impact on soil, based on subsidies for municipalities</li> <li>CAP – highly influential, addresses many SICS</li> </ul>

## 12 Akershus, NO

The study site is located in Akershus county in south-eastern Norway, one of the main areas for cereal cropping systems. Marine sediments with clay and silt dominate. In some municipalities, up to 40 % of the agricultural area is levelled, resulting in high erosion risk. Precipitation range between 665-785 mm annually and winter period with frozen soils and snowmelt has a major influence and soil processes (infiltration, erosion). Within the Akershus study site, there are two experimental sites - Apelsvoll cropping system experimental site and Kjelle experimental fields. The first one is concerned the experiment comprising of 12 mini-farms, each having a four-year crop rotation (since 1988/89). Altogether six cropping systems are represented (two replicates). The second one started in 2014, the emphasis of this experiment is on analysing soil management effects on soil surface discharge and infiltration.

The main soil threats identified in cereal fields in the study site include

- erosion,
- soil compaction,
- lack of good drainage,
- lack of crop rotation,
- plant diseases,
- crop variety choices,
- genetic material,
- suboptimal level of fertilizer,
- plant health issues.

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. All farmers are obliged to have a fertilizer plan based on soil samples to receive production support. 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, and use of catch crops. In addition, support is given for grass on areas with high erosion risk, buffer zones, grassed waterways and sedimentation ponds.

SICS to be tested in Akershus include cover crops, biological compaction release and precision agriculture.

## 12.1 Overview of key institutions and policies

The key institutions in the Akershus Study site

- Ministry of Agriculture and food,
- Ministry of Climate and Environment,
- Ministry of Health and Care Services
- County Governor of Oslo and Akershus

Norway as a non-EU country does not have an obligation to formally transpose the EU legislation. Nevertheless, the laws and policies identified as relevant for shaping agricultural practices are modelled according to several EU environmental directives, namely Pesticides, Sewage Sludge and Water Framework Directive.

In terms of policy categories, the most frequent category is regulatory and economic category with one planning category. In terms of type of instruments, the following types were identified as the most frequent ones: national legislation imposing bans; subsidies; and national strategies.

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices Akershus study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy.<sup>143</sup>

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<sup>143</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 12.1: Overview of key policies, Akershus (NO)

Policy name	English translation	Scale	Impact on SICS	Description of policy
Forskrift om produksjonstilskudd og avløsertilskudd i jordbruket	Regulations for production subsidies and replacements in agriculture	National	All	Guidelines for land use - The regulation lays down the rules for subsidies in agriculture. The applicant must have a map of the agricultural areas at which the undertaking is disposed of at all times and which are affected by agricultural operations. Cultural monuments, areas that are important for biodiversity, areas with a risk of soil and nutrient damage and other environmental significance must be mapped and described.
FOR-2003-07-04-951 Forskrift om gjødselvarer mv. av organisk opphav	Regulation on organic fertilisers	National	Nutrient management	The objective of this regulation is to ensure satisfactory quality of products covered by the regulations, to prevent pollution, health and hygiene disadvantages in the manufacture, storage and use of fertilizers of organic origin and facilitate the use of these products as a resource. The regulation will also contribute to environmentally sound management of the soil and to take into account the importance of biodiversity. The regulation includes organic fertilizer products, including livestock manure, silage paste, sewage sludge, water sludge, compost products and other organic fertilizers, organic-mineral fertilizers, organic and inorganic cultivation media, soil improvers, soil removers, anaerobically reacted biomass, combustion products, composting preparations and microorganisms. The regulation sets limits for content of heavy metals (Pb, Cd, Hg, Ni, Zn, Cu and Cr). The regulation also sets the timing where application is allowed and quantities in relation to total nitrogen (17 kilo/hectare). Note - This regulation refers to the Sewage Sludge Directive.
FOR-2015-05-06-455 Forskrift om plantevernmidler	Regulation on plant protection products	National	Pest management, integrated management	The regulation applies to the approval, sale and use of pesticides, active substances including microorganisms and other pesticide ingredients. Pesticide authorization certificates are required for purchase and use of professional products and to provide professional guidance on chemical crop protection. The regulation limits the types of applications especially relating to aerial applications. The regulation lays down rules for application of pesticides in relation to dwellings, summer homes and waterways. Integrated Pest Management is also covered by the regulation, so that users of professional products should integrate and apply the general principles of integrated plant protection as set out in Appendix 2. Note – it is modelled according to SUD

Policy name	English translation	Scale	Impact on SICS	Description of policy
FOR-2006-12-15-1446 Forskrift om rammer for vannforvaltningen	Regulation on water management framework	National	Nutrient management	The purpose of this regulation is to provide a framework for setting environmental targets that will ensure the most comprehensive protection and sustainable use of water resources. The regulation will ensure that regional management plans and associated action programs are prepared and approved with a view to meeting the environmental objectives and ensure that the necessary knowledge base is obtained for this work. Note – the regulation is based on the WFD.
FOR-2016-04-06-392 Forskrift om tilskudd til regionale miljøtiltak i landbruket, (forskrift om RMP-tilskudd), Oslo og Akershus	Regulations on subsidies for regional environmental measures in agriculture (regulation on RMP subsidies), Oslo and Akershus	Regional	Nutrient management, integrated management, crop sequence, cover crops	The purpose of this regulation is to ensure that the farms in Oslo and Akershus are environmentally responsible and safeguard the cultural landscape. The regulation establishes rules for subsidies to improve the environment or reduce environmental impact of agriculture. A number of specific measures that are soil/cropping system related are eligible for subsidies such as no or postponed tillage (maintaining cover in fields) and direct sown grains i.e. no tillage seeding systems. Catch crops are also eligible for subsidies proving there is no application of pesticides and fertilisers and no tillage until following spring. Buffer zones along waterways and fields are eligible for subsidies, but must meet a number of criteria defined by the regulation in relation to the area, application of fertilizers etc. Specific subsidies are available for establishing perennial grasses erosion exposed areas or areas at risk of flooding. Chapter 3 deals with subsidies targeting reducing use of chemical such as mechanical weeding and burning. Chapter 5 deals with subsidies targeting measures to protect biodiversity, such as natural landscapes i.e. trees and hedgerows and habitats where birds breed.
Nasjonal jordvernstrategi	National Soil Protection Strategy	National	All	The Government has provided a national soil conservation strategy that aims to ensure that the annual reassignment of fertile soil does not exceed 4000 ha (by 2020).

## 12.2 Analysis of shortcomings and opportunities

Table 12.2: SICS components addressed by key policies, Akershus (NO)

Policies	Cover crops	Crop Sequences	Nutrient management	Pest management	Integrated management
Water protection policy					
Chemicals use policy (pesticides, fertilizers)			X	X	X
Agriculture and organic production	X	X	X		X

D7.1: Inventory of opportunities & bottlenecks in policy to facilitate the adoption of soil-improving techniques

Table 12.3: Linking soil problems, appropriate SICS and existing policies, Akershus (NO)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Erosion, soil compaction	Tillage management/nutrient management/integrated management	<ul style="list-style-type: none"> <li>• Tillage management – not addressed</li> <li>• Nutrient management addressed in PPP and nutrient policy (chemical &amp; organic) and agriculture policy</li> <li>• Integrated management addressed in PPP and nutrient policy (chemical &amp; organic) and agriculture policy</li> </ul>	<ul style="list-style-type: none"> <li>• PPP and nutrient policy (chemical &amp; organic) – Legislation imposing bans and restrictions on use; Regulatory category only; none addressed soil protection measures specifically</li> <li>• Agriculture – Regional regulation targeting specific area;</li> <li>• Number of SICS addressed;</li> <li>• Directly addresses soil protection</li> </ul>
Lack of good drainage	Efficient drainage/irrigation	Not addressed	
Suboptimal level of fertilizer, plant health issues	Nutrient management/pest management	<ul style="list-style-type: none"> <li>• Nutrient management addressed in chemicals use and agriculture policy</li> <li>• Pest - addressed in PPP and nutrient policy (chemical &amp; organic)</li> </ul>	<ul style="list-style-type: none"> <li>• PPP and nutrient policy (chemical &amp; organic)– Legislation imposing bans and restrictions on use; Regulatory category only; none addressed soil protection measures specifically</li> <li>• Agriculture – Regional regulation targeting specific area;</li> <li>• Number of SICS addressed;</li> <li>• Directly addresses soil protection</li> </ul>
Lack of crop rotation, crop variety choices	Crop sequences and rotation	<ul style="list-style-type: none"> <li>• Addressed in agriculture policy</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture – Regional regulation targeting specific area;</li> <li>• Number of SICS addressed;</li> <li>• Directly addresses soil protection</li> </ul>

## 13 Keszthely, HU

The study site is located in Keszthely, Hungary in western part of Hungary. The climate is semi-continental with maritime influences, is moderately warm, moderately humid, while the number of sunshine hours per year is high. The naturally available phosphorus content of the soil is low, the potassium content medium and the soil organic matter content fairly low. Land use type is arable land.

The main soil threats in Keszthely Study Site include soil compaction and SOM decline. Current agricultural practices can be described as conventional tillage, no irrigation, different rates of organic and mineral fertilization, integrated pest management.

SICS to be tested include rotation, intercropping, mulching, green manure, and minimal tillage.

### 13.1 Overview of key institutions and policies

The Plant Protection and Soil Protection Directorate is the key institution with regards to agricultural practices. The most relevant policies for shaping agricultural practices in Hungary are CAP together with the national legislation stemming from the Nitrates Directive. In terms of MS-legislation, there are two prominent legislative Acts relevant for SICS in Hungary, namely Ministerial Decree on Preparation of Soil Protection Plan and Act on the Protection of Cultivated Soil.

In terms of policy categories, the most frequent category is regulatory and economic instruments as seen in the table below. In terms of type of instruments, the following types were identified as the most frequent ones:

- national legislation imposing bans/standards
- subsidies/payments in form of CAP instruments
- national legislation based on payments to farmers

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Keszthely study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having direct impact on farmers.<sup>144</sup>

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<sup>144</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 13.1: Overview of key policies, Keszthely (HU)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
A földterület jó mezőgazdasági és környezeti állapotára vonatkozó előírások (GAEC)	CAP GAEC Cross-compliance Standards	National	EU	Integrated management; Crop rotations; Plant cover; Landscape management	Cross compliance' is a set of rules which farmers and land managers must follow on their holding if they are claiming rural payments. The cross compliance is set in the Common Agriculture Policy Regulations 2014 and further explained in the national policy documents. The national policy documents require the following: GAEC 4 - Soil cover must be maintained after summer and autumn arable crops by: sowing another/cover crop; keeping stubble until 30 October or carrying out deep cultivation at most; GAEC 5 - Ban on growing tobacco, sugar beet, potato or artichoke on land sloping more than 12%. Requirement to maintain terraces in vineyards; GAEC 6 - Limitations on crops which can be grown in two, three or four consecutive years on the same piece of land. Restrictions on stubble burning; GAEC 7 - Protected landscape features – hedges, ditches, trees, ponds, ditches, field margins, terraces, stone walls.
	CAP Greening Payment Requirements	National	EU	Crop rotation; Agroforestry; Plant cover; Landscape management; Integrated management	The green direct payments are paid to farmers on the condition that they undertake practices beneficial to environment. There are three aspects of greening: crop diversification (crop rotation, winter soil cover), which are expected to improve soil quality; maintaining existing permanent grassland; ecological focus areas (terraces, landscape features, buffer strips, agroforestry and afforested areas).
59/2008. (IV. 29.) FVM rendelet vizek mezőgazdasági eredetű nitrátszennyezéssel szembeni védelméhez szükséges cselekvési program részletes szabályairól, valamint az adatszolgáltatás	Rules for Action Program against Agricultural Nitrate Pollution, Data Reporting and Record Keeping	National	EU	Nutrient management	The Rules transpose the Nitrates Directive in Hungary. The Rules lay down details concerning the action program necessary for the protection of waters against pollutions by nitrates from agricultural sources and concerning the rules on data requirements and record-keeping.

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
és nyilvántartás rendjéről					
27/2006. (II. 7.) Korm. Rendelet a vizek mezőgazdasági eredetű nitrátszennyezéssel szembeni védelméről	Decree on the Protection of Waters against Nitrates Pollution from Agricultural Origin	National	EU	Nutrient management	The Decree aims to protect waters against pollution caused by nitrates from agricultural sources and to reduce the existing nitrate pollution of waters. The Decree provides for the designation of zones vulnerable to nitrate pollution, the preparation of programs in relation to zones vulnerable to nitrate pollution and specifies the essential rules on the protection of waters against nitrate pollution. The Decree prohibits certain activities concerning slurry, dung water, and leachate; sets environment-related rules on construction, or expansion and operation of livestock holdings.
36/2006. (V. 18.) FVM rendelet a termélnövelő anyagok engedélyezéséről, tárolásáról, forgalmazásáról és felhasználásáról	Rules about Authorization, Storage, Marketing and Utilization of Fertilising Products	National	EU	Nutrient management	The Rules lay down detailed provisions concerning authorization, storage, marketing and utilization of fertilising products. The Rules define 11 product functions categories (eg. organic fertilizer, national inorganic fertilizer, soil improver etc.) and regulate their placement on the market.
90/2008 (VII. 18) FVM rendelet a talajvédelmi terv készítésének részletes szabályairól	Ministerial Decree on Preparation of Soil Protection Plan	National	MS	Crops; Nutrient management; Irrigation; Landscape management; Integrated management	The Decree details the requirements of the soil protection plans that need to be prepared for the following cases: Improvement of saline soils; Landscaping for agricultural purposes; Plantation of grapes, fruits and other berries; Saving of the top soil layer (humus) in case of an investment of larger than 400 m <sup>2</sup> ; Re-cultivation for agricultural purposes; Irrigation; Use of slurry; Use of sludge for agricultural purposes; Drainage of agricultural areas; Use of non-hazardous and non-agricultural waste on cultivated soil; and

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					Implementation of technical interventions to prevent soil erosion. Annex II of the Decree includes technical details on all issues when a plan needs to be developed.
2007. évi CXXIX. Törvény a termőföld védelméről	Act on the Protection of Cultivated Soil	National	MS	Tillage management; Nutrient management; Drainage management; Landscape management; Integrated management;	Chapter III of the Act regulates soil protection. The Chapter specifically lists the soil protection measures that need to be applied by the users of the land and categorises them according to the main threats to soils, e.g. what needs to be done for soils prone to salinization, etc (Articles 35 - 42). The Act also introduces a fee aimed at protecting organic matter in soils.

## 13.2 Analysis of shortcomings and opportunities

Table 13.2: SICS components addressed by key policies, Keszthely (HU)

Policies	Crop rotation	Nutrient management	Crop cover	Tillage management	Integrated management	Landscape management	Drainage/Irrigation	Agroforestry
CAP	X		X		X	X		X
Soil policy		X		X	X	X	X	
PPP and nutrient policy (chemical & organic)		X						

Table 13.3: Linking soil problems, appropriate SICS and existing policies, Keszthely (HU)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Compaction	Tillage/machine/landscape management	<ul style="list-style-type: none"> <li>• Tillage addressed in soil policy</li> <li>• Landscape management addressed in CAP and soil policy</li> </ul>	<ul style="list-style-type: none"> <li>• CAP – direct impact on soil; subsidy based, regulatory category; enforcement issue</li> <li>• Soil policy – direct impact on soil health; targeted SICS used for soil problems, fees payable for SICS; MS regulatory category</li> </ul>
Low Soil organic matter (SOM)	Pest management/nutrient management/cover crops/ crop rotation/mulching	<ul style="list-style-type: none"> <li>• Pest/mulching not addressed</li> <li>• Nutrient addressed in soil and nutrient policy and soil policy</li> <li>• Cover crops and crop rotation addressed in CAP</li> </ul>	<ul style="list-style-type: none"> <li>• CAP – direct impact on soil; subsidy based, regulatory category; enforcement issue</li> <li>• Soil policy – direct impact on soil health; targeted SICS used for soil problems, fees payable for SICS; MS regulatory category</li> <li>• PPP and nutrient policy – regulatory category; bans on usage; direct impact on soil</li> </ul>

## 14 Frauenfeld, CH

The study site is located near Frauenfeld, the capital of the canton Thurgau, in the northeastern part of the Swiss Midlands. The topsoil is a sandy loam. 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 due to the proximity of the pre-alpine relief in the South.

The main soil threats in Frauenfeld Study Site include yield loss, which is closely linked to soil properties, climatic conditions, selected crops in the rotation and the peak workload over the year. The threats are as follows: low organic carbon content, compaction (autumn) The compaction risk under wet soil conditions causes crop loss not enough time remaining for cover cropping and green manuring in autumn.

In the 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 plough (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 favourable for controlled traffic farming (CTF). 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.

SICS to be tested in Frauenfeld (which are currently applied in the site) include:

- soil tillage,
- reduced ploughing -the precision by sowing and planting is ensured by mean of GPS,
- combination seed drill for cereals after potato,
- flotation tires on traction vehicle,
- Trickle irrigation is used for strawberries.

### 14.1 Overview of key institutions and policies

The following organisations were identified as key institutions in the agricultural sector:

- Bundesamt für Umwelt (Federal Department for the Environment)
- Cantons – regional authorities
- Kantonales Amt für Umwelt (Cantonal Department for the Environment)

- Bundesamt für Landwirtschaft (Federal Department of Agriculture)
- Departement für Wirtschaft, Bildung und Forschung (Federal Department of Economy)
- Kantonales Landwirtschaftsamt (Cantonal Office for Agriculture)
- Kantonale Pflanzenschutzstelle (Cantonal Office on Plant Protection)
- Bundesamt für Lebensmittelsicherheit und Veterinärwesen (Federal Food Safety and Veterinary Office)
- Bundesamt für Gesundheit (Federal Health Office)
- Zulassungsstelle für Pflanzenschutzmittel des Bundes (Federal Office for Permissioning of Plant Protective Products)
- Agroscope (Federal Research Institute on Agriculture)

The most relevant policies for shaping agricultural practices in Switzerland are the legislative acts (national and regional) in the area of environment, agriculture, pesticides and fertilizers management and soil protection policy. There is a specific act – Soil Damage Ordinance - which promotes protection of soils setting standards and introduces financial penalties for non-compliance. In addition, Direct Payment Ordinance regulates direct payments to farmers which form a main income-source for most Swiss farmers. There are several specific soil-improving requirements set out in the legislation. Following these measures is voluntary, but only fulfilment allows for financial support.

In terms of policy categories, the most frequent category is regulatory as seen in the table below. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans/standards/targets, (2) national legislation imposing financial penalties, and (3) national legislation based on payments to farmers.

The table below provides an overview of policies, which were identified as most relevant for shaping the agricultural practices in the Frauenfeld study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having direct impact on farmers.<sup>145</sup>

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<sup>145</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 14.1: Overview of key policies, Frauenfeld (CH)

Policy name	English translation	Scale	Impact on SICS	Description of policy
Bundesgesetz ueber den Umweltschutz	Federal Act on the Protection of the Environment	National	Crop rotation Plant cover Tillage management Nutrient management Pest management Machine and traffic management Mulching Drainage management	Part 1, Chapter 2, Art 7.4: "Soil" is defined as the most upper layer of the ground, where plant growth is possible. Soil impacts are physical, chemical or biological change in the natural soil quality. Part 2, Chapter 5 of the Environmental Protection Law is dedicated to soil and highlights the need to ensure the long-term preservation of soil fertility, the prevention of soil compaction and erosion as well as the remediation of polluted soils. It states that soil may be physically affected only to the extent that its fertility is not durably degraded and that the Federal Council may issue regulations or recommendations on measures against physical impacts such as erosion or compaction (Art. 33, see Soil Damage Ordinance). Art 34 allows federal and regional authorities (cantons) to adopt stricter measures against soil pollution to regulate sewage infiltration, the use of substances and organisms or physical impacts on soil in cases where fertility cannot be guaranteed in the long term. When soil is used agriculturally, and its cultivation methods will threaten people, animals or plants, the cantons decree measures to reduce soil burden to such an extent that a least-hazardous cultivation is possible (Art 34 <sup>3</sup> ).
Verordnung ueber die Belastungen des Bodens	Soil Damage Ordinance	National	Crop rotation Plant cover Tillage management Nutrient management Pest management Machine and traffic management, Mulching	Soil fertility shall be sustained on a long-term (Art.1). A fertile soil is defined as a soil, whose biosphere, soil structure, layers and thickness are typical for the location and its degradation processes take place undisturbed (Art. 2a). The quality of the soil and its produce must be safe and may not harm humans and animals taking them up (Art.2c-d). This ordinance applies to all types of farms and formulates provisions for all types of soils where crops/plants may grow. Anyone who cultivates soil and uses vehicles, machinery and equipment for this purpose is required to take into account the physical properties and the moisture of the soil to avoid compaction and other structural changes of the soil, so that soil fertility is maintained in the long term (Art 6). Soils are to be managed according to the state of the art and in such a way that the water bodies are not affected, in particular by washing out of fertilisers and plant

Policy name	English translation	Scale	Impact on SICS	Description of policy
				protection products (in reference to Article 27 (1) GSchG). To prevent the decrease of soil fertility by erosion, appropriate construction and management methods are to be applied, in particular through erosion-inhibiting construction or cultivation technology and crop rotation and river formation. Annex 3 (in accordance with Art. 5.1 and 5.6) gives standard values for controlling soil erosion on arable lands. If these values are not met, the canton sets mandatory measures to be taken and will, with repeated unsatisfactory control, take financial measures. If a farmer does not meet the standard values or has soil loss, he has to take cantonal-ordered measures. If there are repeatedly bad soil conditions due to inadequate agricultural practices, he can be punished financially. Indicator values are given for erosion and for assessing soil loss on arable areas (Annex 3). The Federal Office for Environment and The Federal Office for Agriculture provide a nation-wide surveillance plan. The monitoring lies at cantonal level and results are reported to the Federal Offices (Art. 3-5).
Bundesgesetz ueber die Landwirtschaft	Federal Act on Agriculture	National	Crop rotation Plant cover Tillage management Nutrient management Pest management Machine and traffic management Mulching	The Act aims to ensure that the agricultural sector makes a significant contribution towards inter alia the reliable provision of the population with food, preserving natural resources, the upkeep of the countryside through sustainable, market-orientated production. Provisions are included allowing for direct payments to farmers providing public and ecological services (see Direct Payment Ordinance). Via the Act, the state supports agricultural production financially, creates good socio-economic conditions for agricultural businesses, supports research and information and more. Agricultural production methods must comply with the provisions of legislation on the protection of waters, the environment and animal welfare, and the land farmed does not lie within a designated building zone that has been legally excluded under planning legislation. Farmers are obliged to report on the nutrient flows from and to their farms (HODUFLU - web application for reporting fertilizer flows between different businesses) LwG, 910.1 Art. 165f. Under Title 3 from Art. 70 on, the receipt of direct payments

Policy name	English translation	Scale	Impact on SICS	Description of policy
				is formulated. Requirements and obligations for farmers are described, which create the framework for the DZV (Direct Payment Ordinance – see below). SICS are not explicitly mentioned in the act, but indirectly affected.
Landwirtschaftsgesetz	Act on Agriculture	Regional	Crop rotation Plant cover Tillage management Nutrient management Pest management Machine and traffic management Mulching management Drainage management	The cantonal Act supplements the federal act on agriculture. The canton's aim and duty of supporting and enabling an economically and ecologically sustainable agriculture is formulated in a guiding policy. Supporting measures are to be taken by the canton and also on a community level. Chapter 2, Art. 6.2: The canton can promote ecological cultivation methods. Methods such as crop type and adequate crop rotation must be followed by the farmers to prevent plant pests (Chapter 5, Art. 13-15).
Verordnung ueber die Strukturverbesserungen in der Landwirtschaft	Ordinance on structural improvements in agriculture	National	Drainage management, Landscape management	Governs financial support to farms or groups of farms for investing in structural improvement measures. Communal measures include inter alia soil improving measures, regional development projects, as well as measures to improve biodiversity. Soil improving measures that get financial support are defined in Chapter 2, Article 14: Measures for improving or keeping structure and hydrologic balance of the soil (payments for drainage, dry stone walls) and their maintenance; restoration of arable soil after natural hazard; supporting diverse business plans of individual farmers OR financially supporting soil-improving investments of at least two agricultural or two horticultural businesses.
Direktzahlungsverordnung	Direct Payment Ordinance	National	Plant cover Nutrient management Pest management, Crop rotation, tillage management,	Direct payments present a main income-source for most Swiss farmers. They are in fact a nearly imperative income source without which a financially sustainable agricultural business is hardly possible. The Ordinance refunds agricultural businesses for their contribution on additional values, i.e. (a) agricultural landscapes, (b) agricultural produce self-subsistence, (c) biodiversity, (d) quality of landscapes, (e) production

Policy name	English translation	Scale	Impact on SICS	Description of policy
				<p>system (higher animal care standards, ecological standards), (f) efficient resource management. It details the procedures and conditions for receiving direct payments; inter alia the Proof of Ecological Performance, which includes a detailed report on production both of animal and plant produce. Agricultural businesses can additionally to the compulsory regulations in the Act on Agriculture, comply with regulations defined under this Ordinance. The Ordinance defines the main categories, for which farmers will receive additional financial support. The Appendix contains specific data on mandatory aims for crop rotation (Art. 16; Appendix 1 chapter 4.2-4.3), cropping areas, nutrient management (Art. 13), adequate soil covering and protection (Art. 17), pesticide use (Art. 18), . In Appendix 1 Chapter 5, "adequate soil protection" is defined in more detail. The funding is distributed onto the cantons, which are then responsible for inspection of measures on farm level and for distributing or cancelling monetary support.</p> <p>Following these measures is voluntary, but only fulfilment allows for financial support.</p> <p>The ordinance formulates the obligations to close nutrient cycles (Art. 13);</p>
Chemikalien-Risikoreduktions-Verordnung (ChemRRV)	Chemical Risk Reduction Ordinance	National	Pest management, weed control	<p>This Ordinance prohibits or restricts the use of the particularly dangerous substances, preparations and articles covered by the Annexes; it also specifies the personal and professional qualifications required for the use of certain particularly dangerous substances, preparations and articles. Art. 4 specifies applications requiring a license, such as aerial spreading and spraying of plant protection products, biocidal products and fertilisers. Art. 7 lists the uses which require an appropriate certificate or qualification, such as the use of plant protection products. Annex 2.5 specifies areas where the use of plant protection products is prohibited; Annex 2.6 formulates provisions for the use of fertilisers.</p>
Pflanzenschutzmittelverordnung (PSMV)	Ordinance on Plant Protectants	National	Pest management, weed control	<p>Plant protection products are chemical or organic. Anyone producing or importing plant protection products must ensure that they have no unacceptable side effects for humans, animals or the environment (so to prevent plant protective residues in the foodchain), neither immediate nor</p>

Policy name	English translation	Scale	Impact on SICS	Description of policy
				<p>long-term. They may be applied only to the extent necessary for the intended purpose. Marketing and usage approval are duties of the producers or importers. Approval for application is given by the Federal Office of Agriculture and may require information on (a) max. applicable dose per usage (b) time between last application and harvesting (c) max. applications per year (d) protective measures for health of users (e) non-/professional application (f) application intervals (g) time until area can be entered again. The information on the packaging, in the package leaflet or on the safety data sheet as well as the notes on the possible applications and the requirements for the use (see Annex 11) must be observed. (Annex 9: 9BII-2.4.1.4) The labelling of the product includes suitability/exclusion of use on certain soil types or cropping systems. Only devices can be used that allow for a proper and targeted use of the plant protection product (Article 61 PSMV). Users of plant protection products need to keep records of applied product, time of use, amount, area treated and on which crop type for at least 3 years (Article 62). In groundwater protection zones S2, Article 68 (1) and (2) PSMV are authoritative: Plant protection products cannot be used in groundwater protection zones if they or their biologically significant metabolites can enter drinking water due to their mobility or lack of degradability.</p> <p>The authorization and permission lie at the Federal stage (Chapter 8, 1<sup>st</sup> section), whereas the market surveillance lies at the cantons' authority (Ch. 8, 2<sup>nd</sup> section).</p> <p>According to Annex 9 (9BII-2.7.4) the risk for the environment, specifically for soils is only considered in terms of soil-living microorganisms.</p>

## 14.2 Analysis of shortcomings and opportunities

Table 14.2: SICS components addressed by key policies, Frauenfeld (CH)

Policies	Cover crop	Crop rotation	Nutrient management	Pest management	Tillage management	Mulching	Machine management	Landscape management	Drainage
Environment policy	X	X	X	X	X	X	X		X
Soil policy	X	X	X	X	X	X	X		X
Agriculture	X	X	X	X	X	X	X	X	X
PPP and nutrient policy (chemical & organic)			X	X					

Table 14.3: Linking soil problems, appropriate SICS and existing policies, Frauenfeld (CH)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Compaction	Tillage/machine/landscape management	<ul style="list-style-type: none"> <li>Tillage and machine addressed in environment, soil and agriculture policy</li> <li>Landscape addressed in agriculture policy</li> </ul>	<ul style="list-style-type: none"> <li>Environment – regulatory category; standards and targets; direct focus on soil quality</li> <li>Soil – direct impact on soil; regulatory category; financial penalties for non-compliance; bans/targets</li> <li>Agriculture – regulatory category; based on direct payments on a voluntary basis; reporting requirements; bans/targets/standards</li> </ul>
Low Soil organic matter (SOM)	Pest management/nutrient management/cover crops/ crop rotation/mulching	<ul style="list-style-type: none"> <li>Pest and nutrient addressed in all policies</li> <li>Cover crops, crop rotation and mulching in environment/ agriculture/soil policy</li> </ul>	<ul style="list-style-type: none"> <li>PPP and nutrient policy – direct focus on soil health; bans and targets; regulatory category</li> </ul>

## 15 Viborg, DK

The Danish site is centred in the Municipality of Viborg in the Region of Central Denmark. It is situated on the border between the Atlantic and the continental biogeographical region, Atlantic North climate. The sites draw on extensive long-term data from the field stations, 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 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 following main soil threats were identified in the in the Viborg Study Site: loss of 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), and severe nutrient losses (N and P) to the environment (especially from livestock farms).

Conventional agriculture makes up the majority of farming systems in the site (92% of the area) with only a small area occupied by organic agriculture (8%). Intensive use of livestock manure (about 60% of the area with livestock farms), with precision fertilisation of slurry and fertilisers. Good examples from precision farming. Most soils are ploughed but minimum tillage is practiced. Strict norms on fertilizer application. Irrigation widespread on the mostly sandy soils and cropping systems with for e.g. potatoes or forage crops. SICS being currently tested include minimum tillage, incorporation of straw and cover crops, increasing use of grassland to prevent nutrient losses and erosion as well as short rotation coppice energy crops.

### 15.1 Overview of key institutions and policies

The key institutions in the Viborg Study site are

- Danish Ministry of Food and Environment
- Danish Agricultural Agency
- Environmental Protection Agency of the Ministry of Environment and Food of Denmark

The vast majority of policies identified as the most relevant for shaping agricultural practices are the ones which transposed various EU Directives – namely Nitrates Directive, and Pesticides Directive. In addition, both voluntary and compulsory CAP instruments have high relevance for impacting agricultural practices in Viborg. With regards to legislation and policy stemming from national initiatives, there are two instruments identified as highly relevant - Act on Management of Agricultural Land and Order on Commercial Livestock, Livestock Manure,

Silage, etc. (The Livestock Manure Order).

In terms of policy categories, the most frequent category is regulatory in addition to CAP implementing instruments which fall within the economic category and one instrument falling within planning category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans/targets/standards, (2) subsidies in form of CAP instruments and taxes, and (3) national strategies/plans.

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Viborg study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. Majority of policies in the table below were identified as having direct impact on farmers.<sup>146</sup>

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<sup>146</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 15.1: Overview of key policies, Viborg (DK)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Bekendtgørelse om krydsoverensstemmelse BEK nr 100 af 30/01/2015	CAP GAEC cross compliance standards	National	EU	Integrated management, nutrient management	<p>The cross-compliance standards set forth in the Danish legislation based upon CAP requirements directly affect agricultural practices adopted by farmers. The standards explicitly address how farmers are to manage land and livestock, including soils. Transposition of cross-compliance relating to soil is as follows, and does not differ from GAECs as set out under the regulation on direct payments and horizontal measures:</p> <p>GAEC 4 Establishment and maintenance of plant cover on set-aside land. Uncultivated agricultural land must have plant cover established by the 31st of May in the year of the set-aside at the latest.</p> <p>GAEC 5 Protection of agricultural land against erosion. Ban on ploughing arable parcels of 5 hectares or more between harvest and 15th of February, when the slope is greater than 12°.</p> <p>GAEC 6 Burning of stubble or similar parts of agricultural crops. Ban on burning stubble, except in some of Denmark's smaller islands without bridge connections and stubble from grass grown for seeds where a crop is to be grown in the following year.</p> <p>GAEC 7</p> <p>a. Preservation of landscape elements. Mandatory preservation of natural and artificial ponds and lakes and ancient monuments of up to 0.2 ha.</p> <p>b. Prohibition of pruning of shrubs and trees in the breeding period of birds. The ban covers the period from 15th of March to 31st of July.</p>
CAP Greening requirements		National	EU	Tillage management, integrated management, crop sequences/rotation	<p>Farmers are directly impacted as land management standards are linked to payment schemes and thereby incentivize particular management practices. The list of EFA elements which Danish farmers can choose from includes five elements that can protect soils and soil carbon: fallow, buffer strips (9 meters wide), catch crops/green cover, short rotation coppice (SRC) and ancient monuments (GAEC 7 landscape element). Denmark has chosen a short list of eligible options</p>

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					because most farms are expected to comply with demands without major changes. In 2015 the EFA elements covered: Set-aside (19 600 ha); Buffer strips (15 575 ha); Short rotation coppice (3 887 ha); Ancient monuments (143 ha.) The total agricultural area of Denmark is 2 600 712 ha. 87 farmers with a total agricultural area of 3 062 ha chose in 2015 not to comply with the EFA demand and accept a reduction in the support.
Det danske landdistriktsprogram 2014-2020	Rural Development Programme 2014-2020	National	EU	Integrated management, pest management, crop sequences, tillage management	<p>Farmers are directly impacted as the level of financial support can either inhibit or support policy implementation in terms of capacity to carry out particular objectives. The Danish RDP acknowledges that soil erosion and soil quality problems do occur in Denmark. The three main issues identified are: (1) Compression of soils due to the use of heavy machinery. (2) Loss of organic matter in the soils due to monocultures, simplified cropping sequences, removal of straw, reduction in animal fertilizers and loss of permanent grassland. (3) Soil erosion, especially on slopes. However, the RDP also points out that there is a lack of knowledge on the threats and on affected risk areas. In the implemented measures, only a few have soil erosion as primary target and none has carbon conservation and sequestration as primary target. The soil related targets are mentioned as secondary targets for several measures. Especially organic farming, catch crops, permanent grassland and forest are seen as land management practices addressing the soil issues.</p> <p>Under Priority 4C Soil erosion and management there is no specific budget identified because the expenditure is programmed for the priority as a whole, not for individual focus areas. In total Focus area 4A (Biodiversity) 4B (Water management) and 4C (Soil erosion) amounts to 576.136.862 € corresponding to 63.5 % of the total RDP programme. Under priority 5E Carbon conservation / sequestration – no specific budget has been allocated.</p>

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
LBK nr 388 af 27/04/2016 Bekendtgørelse af lov om jordbrugets anvendelse af gødning og om plantedække	Act on Agricultural Use of Fertilizers and on Plant Cover	National	EU	Nutrient management	Farmers are directly impacted by the requirements set forth in the Act relating to fertilizer use and additional land management practices. The objective of the Act is to regulate the agricultural use of fertilisers and to set requirements to plant cover and other management practices in order to reduce leaching of nitrate. The act set rules on the total amount of fertilisers to be used at farm level based on crops, type of fertiliser etc.. The act also authorise the Ministry of Environment and Food to set rules on plant cover and catch crops. Finally, according to the Act farmers are required to carry out fertilizer planning and accounting. In relation to soil protection the Act protects against excess use of fertilisers and, as a consequence of the plant cover rules, against erosion.
Aftale om fødevarer- og landbrugspakken 2015	Agreement on Food and Agriculture Package 2015	National	EU	Nutrient management, integrated management, crop sequencing	The Danish government with coalition parties reached an agreement on a new food and agriculture package that will create better conditions for the food and agriculture sector. It transposes the Water Framework Directive. The package contains 30 initiatives in 5 main areas: sustainability, natural resources, improved competitive ability, development of future food production, forward looking export initiative. The package will affect buffer strips, nitrate application standards and a number of environmental regulations in the agricultural sector. Farmers are directly impacted by environmental standards set forth which directly relate to land management practices adopted by farmers.
Bekendtgørelse af lov om afgift af bekæmpelsesmidler, LBK 232 26/02/2015	Act on Tax on Pesticides	National	EU	Pest management	Farmers are directly impacted by pricing schemes relating to pesticide use. Higher prices incentivize farmers to purchase less and maximize utility to reduce costs. Since 2013, the tax on pesticides has been targeted to reflect the effect of the pesticide on health and on the environment in order to guide the use towards the least harmful pesticides. Soil protection is not directly targeted, but for example the effect of the pesticides on earth worms is included in the calculation of the tax. The tax in itself aims to have a direct positive effect on the environment in general by encouraging use of least harmful products

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					and an indirect effect by allocating the funds from the taxation to reduce impact of pesticides further. Evaluations of the tax on pesticides are available from the Danish EPA for 2014 and 2015. The tax has a link to the Sustainable Use Directive as a program for IPM is a central theme in reducing use and volume of pesticides along with the tax.
Bekendtgørelse af lov om drift af landbrugsjorder, LBK nr 191 af 12/03/2009	Act on Management of Agricultural Land	National	MS	Integrated management, pest management	Farmers are directly impacted as sustainable land management practices are incentivized thereby impacting decision-making by farmers of on-site management practices. The objective of the Act is to promote the sustainable development of the management of agricultural land by combining soil protection as a resource for production and nature, environment and landscape values. The Act ensures that agricultural land is kept and managed as agricultural land with a focus on the border between agricultural land and nature areas. According to the Act, farmers have to make sure that unfarmed agricultural land is not overgrown by keeping the areas free of bushes and trees. The Act and underlying Orders establish the rules and procedures for changing the status of areas from agricultural into nature area. Furthermore, the Act and underlying Orders regulate actions to control unwanted plants and animals such as wild oat and giant hogweed on agricultural land.
BEK nr 764 af 28/06/2012 Gældende (Husdyrgødningsbekendtgørelsen) BEK nr 764 af 28/06/2012 Gældende (Husdyrgødningsbekendtgørelsen)	Order on Commercial Livestock, Livestock Manure, Silage, etc. (The Livestock Manure Order)	National	MS	Nutrient management	Farmers are directly impacted as rules on manure management, including length of holding time and application procedures are set forth and expected to be followed. The objective of the Order is to establish a set of rules and guidelines for livestock manure management that covers production, storage and use. Capacity and storage requirements stipulate that practices must meet the standards set forth in the Order of Farm's Use of Fertilizer and Plant Cover.

## 15.2 Analysis of shortcomings and opportunities

Table 15.2: SICS components addressed by key policies, Viborg (DK)

Policies	Crop rotation management	Crop Sequences	Nutrient management	Pest management	Tillage management	Integrated management
PPP and nutrient policy (chemical & organic)			X	X		
Agriculture and food		X	X	X		X
CAP	X	X	X	X	X	X
Water protection		X	X			X

Table 15.3: Linking soil problems, appropriate SICS and existing policies, Viborg (DK)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Policy instrument
Loss of organic matter (primarily caused by ploughing and other soil tillage)	Tillage management	<ul style="list-style-type: none"> <li>Tillage – addressed in CAP</li> </ul>	<ul style="list-style-type: none"> <li>CAP - Highly influential and direct impact on farmers, financial incentives</li> </ul>
Soil Compaction (primarily caused by heavy machinery for instance for slurry application)	Tillage management/machinery management	<ul style="list-style-type: none"> <li>Tillage – addressed in CAP</li> </ul>	<ul style="list-style-type: none"> <li>CAP - Highly influential and direct impact on farmers, financial incentives</li> </ul>
Erosion (especially a problem in cereals and maize)	Tillage management Crop rotation/sequences/cover crops	<ul style="list-style-type: none"> <li>Tillage – addressed in CAP</li> <li>Crop rotation/sequences – addressed in CAP and agriculture and food policy</li> </ul>	<ul style="list-style-type: none"> <li>CAP - Highly influential and direct impact on farmers, financial incentives</li> <li>Agri/food policy - Both EU and national origin ; Direct impact on soil and farmers</li> </ul>
Severe nutrient losses (N and P) to the environment (especially from livestock farms)	Nutrient management	<ul style="list-style-type: none"> <li>Nutrient management – addressed in CAP, water, PPP and nutrient policy (chemical &amp; organic) and agriculture and food policy</li> </ul>	<ul style="list-style-type: none"> <li>CAP - Highly influential and direct impact on farmers, financial incentives</li> <li>PPP and nutrient policy (chemical &amp; organic)- Legislation imposing bans and restrictions on use of chemicals;</li> <li>Direct impact on farmers</li> <li>Water- legislation imposing bans, direct impact</li> <li>Agriculture/food policy - Both EU and national origin; Direct impact on soil and farmers</li> </ul>

## 16 Loddington, GB

The study site is located in a farm at Loddington in central England. The climate is Atlantic Central/North, with clay soils. The main soil threats identified for the study site include compaction, low soil organic matter, and Blackgrass (*Alopecurus myosuroides*) which involve high herbicide costs as it tends to crowd out other plants.

Current agricultural practices include integrated farm management approach with the creation of habitats to encourage beneficial predatory and pollinating insects and other wildlife. There is also 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. The testing of SICS will focus on practices already in place, particularly reduced tillage or no-till, crop residue returned as well as cover crop.

### 16.1 Overview of key institutions and policies

The following key institutions in the Loddington Study site are responsible for the implementation and enforcement of various policies and policy instruments in the site:

- Department for Food, Agriculture and Rural affairs
- Natural England
- Rural Payment Agency
- Environment Agency
- Chemical Regulations Directorate

The vast majority of policies identified as the most relevant for shaping agricultural practices are either stemming from the EU rural policy (CAP and RDP) and EU Directives (Pesticides Directive). Nationally initiated legislation and the Campaign for Farmed Environment was identified as highly relevant for impacting farmers behaviours. In terms of policy categories, the most frequent category is regulatory and economic category together with the information/education category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans, (2) subsidies in form of CAP instruments and guidance document, and (3) Information campaigns.

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in the Loddington study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having a direct impact on farmers.<sup>147</sup>

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<sup>147</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 16.1: Overview of key policies, Loddington (GB)

Policy name	Scale	EU or MS level	Impact on SICS	Description of policy
CAP GAEC Cross-compliance Standards	National	EU	Plant cover; Agroforestry; Nutrient management; Tillage management; Machine & traffic management; Mulching	'Cross compliance' is a set of rules which farmers and land managers must follow on their holding if they are claiming rural payments. The cross compliance is set in the Common Agriculture Policy Regulations 2014 and further explained in the Guide to cross compliance in England 2017. Schedule 2 of the Common Agriculture Policy Regulations 2014 requires restoration of a footpath or bridleway after ploughing and prohibits crop and specified vegetation burning (section 2). The Schedule further requires the farmers to cover the soil with crops or other vegetation, although exceptions are allowed (section 3); maintain green cover, prevent erosion and refrain from applying fertilisers or pesticides to land near watercourses and hedgerow, although exemptions are allowed (sections 4 and 5).
The Guide to Cross-compliance in England 2017	Regional	EU	Plant cover; Agroforestry; Nutrient management; Tillage management; Machine & traffic management; Mulching	The Guide contains the 'Good Agricultural and Environmental Conditions' (GAECs) which cover, inter alia, environment, climate change and good agricultural condition of land. GAEC 4 establishes that farmers must take all reasonable steps to protect soil by having a minimum soil cover all year around unless there is an agronomic justification for not doing so, or where establishing a cover would conflict with requirements under GAEC 5 that causes soil erosion. GAEC 5 requires measures to be put into place to limit soil and bankside erosion (cropping practices and structures, vehicles, trailers and machinery). GAEC 6 prohibits farmers from burning cereal straw or cereal stubble or certain crop residues, with the aim of maintain the level of organic matter in soil.
CAP Rural Development Programme 2014 - 2020	National	EU	Intercropping, crop rotations	The Rural Development Programme (RDP) for England was formally adopted by the European Commission in 2015. It outlines England's priorities for using the €4 billion available from 2014-2020 (national and EU contributions). The main objective of the RDP is better management of natural resources and the wider adoption of farming practices which are climate friendly. Soil degradation has been estimated to cost the economy £0.9-1.4bn per year in England and Wales (p. 108). Soil erosion and acidification and climate change have been recognised as an important issue in England (p. 37 - 39). To tackle these issues, RDP's Focus area 4C focuses on preventing soil erosion and improving soil management. One of the measures concerns crop diversification (p. 396); buffer strips on cultivated land (p. 397); winter cover crops (p. 398).

Policy name	Scale	EU or MS level	Impact on SICS	Description of policy
Countryside Stewardship	Regional	EU	Plant cover, Landscape Management, Integrated Management.	Countryside Stewardship (CS) provides financial incentives for land managers to look after their environment through activities such as: conserving and restoring wildlife habitats; flood risk management; woodland creation and management; reducing widespread water pollution from agriculture; keeping the character of the countryside; preserving features important to the history of the rural landscape and encouraging educational access. The scheme is open to all eligible farmers, woodland owners, foresters and other land managers in England and is suitable for many types of land use (for example conventional and organic farmland, coastal areas, uplands and woodlands). It is a competitive scheme with application scored against local priority targets to maximise environmental benefit.
Pesticides Control legislation	national	EU	Pest management	The Control of Pesticides Regulations (1986, as amended in 1997) provides a high-level regulatory setting with details of pesticides subject to control and a system of approvals required for supply, storage and use. In addition, the Plant Protection Products (Sustainable Use) Regulations 2012 transpose Directive on sustainable use of pesticides. Users of plant protection products/pesticides are required to take all reasonable precautions to protect, inter alia, soil.
Campaign for the Farmed Environment	Regional	MS	Integrated management, Pest Management, Landscape, Plant cover & Nutrient Management	The Campaign for the Farmed Environment (CFE) is an industry-led initiative encouraging voluntary management that will benefit the environment, whilst ensuring efficient and profitable food production. CFE guidance includes voluntary measures and best practice actions to benefit wildlife and to protect natural resources on farmland and promoting resource use efficiency is a natural progression for CFE. It is a partnership of 15 farming and Environmental Organisations working together.

## 16.2 Analysis of shortcomings and opportunities

Table 16.2: SICS components addressed by key policies, Loddington (GB)

Policies	Cover crops	Crop rotation	Intercropping	Mulching	Nutrient management	Pest management	Tillage management	Integrated management	Agroforestry	Landscape management
PPP and nutrient policy (chemical & organic)						X				
Agriculture/Environment	X				X	X		X		X
CAP	X	X	X	X	X		X		X	

Table 16.3: Linking soil problems, appropriate SICS and existing policies, Loddington (GB)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Compaction	Tillage/machine use	<ul style="list-style-type: none"> <li>Tillage addressed in CAP</li> </ul>	<ul style="list-style-type: none"> <li>CAP - Highly influential;</li> <li>Positive perception of farmers;</li> <li>Different types of instruments</li> </ul>
Low Soil organic matter (SOM)	Pest management/nutrient management/cover crops/mulching	<ul style="list-style-type: none"> <li>Pest management addressed in PPP and nutrient policy (chemical &amp; organic) and agri/environment policy</li> <li>Nutrient management addressed in agri/environment and CAP</li> <li>Cover crops – addressed in agri/environment and CAP</li> <li>Mulching - addressed in CAP</li> </ul>	<ul style="list-style-type: none"> <li>PPP and nutrient policy (chemical &amp; organic) – Based on the EU law</li> <li>Legislation imposing bans and restrictions on use;</li> <li>Direct impact on soil; Regulatory category only; None addressed soil protection measures specifically</li> <li>Agri/environment policy - Direct impact on soil;</li> <li>Payment/subsidies/voluntary schemes encouraging change in behaviour</li> <li>CAP - Highly influential;</li> <li>Positive perception of farmers;</li> <li>Different types of instruments</li> </ul>

## 17 Tachenhausen, DE

The study site is located in Tachenhausen, Germany. The soil type is classified as Luvisol with a silty loamy texture. Soil erosion and pollution from nitrates are identified as the main soil threats in the study site area.

Agricultural producers in the area follow the principles of conservation agriculture with the intention to improve soil fertility and resilience of the soil, and to maximise economic return in the long-term. Practices include long-term non-inversion, no irrigation, application of nutrients according to official recommendations (VDLUF method) and expected yield, pests according to decision support systems. Cover crops composed 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 testing of SICS will include conservation agriculture practices already in place, focusing particularly on no tillage, and the planting of cover crops as a way to control weeds as opposed to herbicides and tillage.

### 17.1 Overview of key institutions and policies

The following key institutions are responsible for implementing and enforcing various policies and policy instruments in the area of the study site Tachenhausen:

- Bundesministerium für Ernährung und Landwirtschaft (Federal Ministry of Food and Agriculture, responsible for legal transposition)
- Ministerium für Ländlichen Raum und Verbraucherschutz Baden-Württemberg (Ministry of Rural Affairs and Consumer Protection Baden-Württemberg, responsible for implementation)
- Regierungspräsidien (State governments, responsible for enforcement)
- Ministerium für Umwelt, Klima und Energiewirtschaft (Ministry for Environment, Climate and Energy Baden-Württemberg)
- Regierungspräsidium Stuttgart (Regional Administrative Council Stuttgart)
- lower agricultural authorities

The vast majority of policies identified as the most relevant for shaping agricultural practices are the ones which transposed various EU Directives – namely Nitrates Directive, Water Framework Directive and Sustainable use of Pesticides Directive. In addition, both voluntary and compulsory CAP instruments together have high relevance for impacting agricultural practices in the study site. With regards to legislation and policy stemming from national initiatives, there are four instruments highlighted as highly relevant – two economic instruments (funds and subsidies) and two regulatory. In terms of policy categories, the most

frequent category is regulatory together with the planning category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) action programmes/plan - bans/targets/, advisory service, trainings, and (2) national legislation introducing e.g. bans/standards/information campaigns. The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in the Tachenhausen study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy.<sup>148</sup>

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<sup>148</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 17.1: Overview of key policies, Tachenhausen (DE)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
Verordnung der Landesregierung zur Umsetzung der Gemeinsamen Agrarpolitik 2014 – 2020 und zur Anpassung der Subdelegationsverordnung MLR	Ordinance on the Implementation of the Common Agricultural Policy 2014-2010	Regional	EU	Cover crops; agroforestry; landscape management; crop rotations; pest management; nutrient management; drainage; integrated management	This regulation specifies administrative procedures and responsibilities for the implementation of the CAP instruments within the state of Baden-Wuerttemberg.
Massnahmen- und Entwicklungsplan Laendlicher Raum Baden-Wuerttemberg (BW) 2014-2020 (MEPL III)	Rural Development Programme for Baden-Wuerttemberg 2014-2020	Regional	EU	All	The RDP for BW emphasises the improvement of soil management as a key priority and reserves a considerable portion for funds to measures improving water management, soil management and to measures contributing to carbon sequestration or conservation. These will be delivered through contracts available under the various funding programmes and will therefore directly impact on farming practices adopted by the participating farmers.
Teilbearbeitungsgebiet 41 - Neckar unterhalb Starzel oberhalb Fils, Bearbeitungsgebiet Neckar, FGE Rhein, Baden-Wuerttemberg	Management plan sub-catchment 41 - Neckar below Starzel and above Fils (RBD Rhine, Neckar catchment, Baden-Wuerttemberg)	Local	EU	Nutrient management; Irrigation; Drainage management; Pest management; Landscape management; Tillage management	The plan contains both basic measures which essentially aim at ensuring compliance with relevant environmental regulations and standards as well as supplementary measures. Supplementary measures formulate actions which are intended to go beyond mandatory requirements and good agricultural practice but are voluntary. They address a variety of practices and should have a direct but probably weak impact due to their voluntary character. The plan for the sub-catchment identifies specific measures in line with the general types of measures identified in the Management plan for the Neckar. The catalogue of measures contains those eligible for funding under SchALVO and FAKT. The latter includes the following specific measures: - Crop diversification (at least 5-unit crop rotation)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
					<ul style="list-style-type: none"> <li>- Extensive management of permanent grassland with livestock</li> <li>- Extensive management of certain permanent grassland areas without nitrogen fertilization</li> <li>- Conservation of fruit orchards</li> <li>- Abandonment of chemical-synthetic means of production</li> <li>- Change to organic farming</li> <li>- Maintaining organic farming</li> <li>- Autumn plant cover in the field</li> <li>- Plant cover in fallow fields with flowering mixtures</li> <li>- No use of herbicides</li> <li>- Application of trichogramma in corn</li> <li>- Pheromone use in fruit production</li> </ul>
Düngegesetz (DüG) Düngeverordnung (DüV)	Fertiliser Act Ordinance on good fertilising practices	National	EU	Nutrient management; soil cultivation; crop production	The purpose of the Fertiliser Act is to ensure the nutrition of agricultural crops, to preserve or improve soil fertility, especially the humus content that is typical of the location and use, to prevent risks to the health of humans and animals and also to the ecosystem, which may arise through the manufacture, placing on the market or application of fertilisers, soil improvers, and plant aids and also growing media or through other fertilisation measures. Fertilisers have to be used in accordance with good agricultural practice, in line with the needs of plants and soils. The Fertiliser Ordinance (DüV) also transposes Directive 91/676/EEC into German law. It rules the correct use of fertilisers in accordance with good agricultural practice and prevents soils from oversupply and therefore rules documentation requirements. These criteria pertain to matters such as determining fertiliser in dependence on plant needs, the timing (off-time during winter), amounts and technical needs of fertiliser application, buffer strips for surface water bodies and rules concerning ammonia emission abatement. Directly impacts on nutrient management by placing certain restrictions on farmers depending on the location of the production areas.

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
Nationaler Aktionsplan zur nachhaltigen Anwendung von Pflanzenschutzmitteln	National Action Plan on the Sustainable Use of Pesticides	National	EU	Pest management	<p>The global targets of the Action Plan are:</p> <ul style="list-style-type: none"> <li>→ The risks and adverse impacts associated with plant protection products for human health and the environment must be further reduced. This means the following: <ul style="list-style-type: none"> <li>= by 2023, there must be a 30 % reduction in the risks that using plant protection products entail for the environment (base: average value for 1996 – 2005),</li> <li>= by 2021, the exceeding of the maximum residue levels must be reduced to below 1 % in all product groups for both domestically-produced and imported foods,</li> <li>= the adverse impacts of use of chemical plant protection products must be further reduced for operators, workers, bystanders and residents.</li> </ul> </li> <li>→ The introduction and further development of plant protection measures, involving limited use of plant protection products in integrated plant protection, must be fostered. This includes further extending the proportion of practicable non-chemical measures in plant protection concepts, e.g. using biological, biotechnical or mechanical plant protection measures, and securing sufficient availability of active substances used in plant protection products for efficient resistance strategies.</li> <li>→ The use of plant protection products must be limited to the necessary minimum.</li> <li>→ Further improvements must be made to safety in dealing with plant protection products.</li> <li>→ Further improvement must be made to the provision of well-balanced information to the public, concerning the benefits and risks of plant protection, including the use of chemical plant protection products. The strength of these impacts will depend on the type of measures implemented under the NAP.</li> </ul>
Pflanzenschutzgesetz	Plant Protection Act	National	EU	Pest management	Germany transposed the SUD into national law via the Plant Protection Act of 6 February 2012. In addition, there are a number

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
					of ordinances under this Act, dealing with the relevant technical standards e.g. in the area of operator training and testing of pesticide application equipment (PAE). The directly applicable rulings in plant protection law relate to the approval of plant protection products, operator-related regulations, application-related regulations, area-related regulations, and also regulations relating to plant protection equipment and also to monitoring. The central role is taken by the Plant Protection Act (PflSchG). The approval of plant protection products is a core element in the reduction of risks which can emerge due to the use of plant protection products. It not only prevents unsuitable substances from being made available for trade: i.e. substances that entail dangers or unjustifiable risks for human beings (particularly for operators, workers, residents, and bystanders), animals, surface water, groundwater and the environment. The provisions directly impact on pest management practices adopted by farmers, but strength of impact depends on specific targets and activities formulated in the NAP and subsequent actions.
Düngegesetz (DüG)	Fertiliser Act	National	EU	Nutrient management; soil cultivation; crop production	Directly impacts on nutrient management by placing certain restrictions on farmers depending on the location of the production areas.
Düngeverordnung (DüV)	Ordinance on good fertilising practices	National	EU	Nutrient management; soil cultivation; crop production	Directly impacts on nutrient management by placing certain restrictions on farmers depending on the location of the production areas.
Förderprogramm für Agrarumwelt, Klimaschutz und Tierwohl (FAKT)	Funding Program for Agronomic Environment, Climate Protection and Animal Welfare	Regional	MS	All SICS	The aim of FAKT is the preservation and maintenance of the cultural landscape, the protection of the climate and the natural resources of water, soil, air, the preservation and improvement of biodiversity and the promotion of animal welfare. Almost a third of the funding for MEPL III is attributable to this program, with around 40 sub-measures. FAKT differs from its predecessor program MEKA in

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
					<p>particular in a better promotion of grassland sites, a stronger promotion of organic farming and water and erosion protection. FAKT is structured as a modular system and foresees the following types of measures:</p> <p>A Environmental management            B Maintenance and preservation of the cultural landscape and protected habitats            C Preservation of endangered animal breeds and uses            D Organic farming / abandonment of chemical-synthetic means of production            E Environmentally friendly plant production and application of biological / biotechnical measures            F Voluntary measures for water and erosion protection            G Species-appropriate husbandry support means to improve soil fertility and the agroecosystem in total.</p> <p>Farmers who apply for funding will need to comply with the requirements of the programme; this means that there is a strong direct impact</p>
<p>Ausgleichszulage Landwirtschaft fuer benachteiligte Gebiete (Verwaltungsvorschrift des Ministeriums für Ländlichen Raum und Verbraucherschutz zur Förderung landwirtschaftlicher Betriebe in Berggebieten und in bestimmten benachteiligten Gebieten (VwV Ausgleichszulage Landwirtschaft)</p>	<p>Compensation for agriculture in disadvantaged location</p>	Regional	MS	All SICS	<p>The financial compensation helps to ensure the sustainable use of agricultural land in less favoured areas (e.g. mountain areas) - to preserve the landscape and to maintain and promote sustainable management. The partial compensation of costs and income losses as well as other disadvantages on agricultural land in mountain areas and other disadvantaged areas of Baden-Württemberg and neighbouring federal states is promoted. Farmers who apply for funding will need to comply with the requirements of the programme; this means that there is a strong direct impact</p>

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
Landesbodenschutzgesetz	Soil Protection Act Baden-Wuerttemberg	Regional	MS	Tillage management; landscape management; cover crops; crop rotation; nutrient and pest management; drainage management	Provisions directly impact agricultural practices.
Erosionsschutzverordnung Baden-Wuerttemberg	Erosion Protection Ordinance Baden-Wuerttemberg	Regional	MS	Tillage management	One of the basic requirements for the conservation of land in good agricultural and ecological condition is erosion control. The protection of the soil must be ensured by complying with comprehensive minimum standards regarding soil cover, tillage and the maintenance of terraces. All parcels with a partial or complete use as arable land need to be classified according to the degree of risk of erosion and risk of wind erosion and are documented in the CCErosion register based on parcels. The classification is based on the risk of erosion by water after soil erodibility and slope, as well as the risk of erosion by wind according to the type of soil. All parcels or sub-areas classified in the CCWasser1 risk class may not be ploughed without an agri-environmental measure for erosion control and cross-slope management from 1 December to the end of 15 February. Ploughing after the harvest of the pre-crop is only allowed for sowing before 1 December. All parcels or sub-areas classified in the CCWasser2 risk class may not be ploughed from 1 December to 15 February without an agri-environmental erosion control measure. Ploughing between the 16th of February and the end of the 30th of November is only permissible in case of an immediate sowing.

## 17.2 Analysis of shortcomings and opportunities

Table 17.2: SICS components addressed by key policies, Tachenhausen (DE)

Policies	Cover crops	Crop rotation	Nutrient management	Pest management	Tillage management	Integrated management	Agroforestry	Landscape management	Drainage/Irrigation
Water protection policy			X	X	X			X	X
Chemicals use policy			X	X					
CAP	X	X	X	X		X	X	X	X
Agriculture/environment	X	X	X	X	X	X	X	X	X
Soil policy	X	X	X	X	X			X	X

Table 17.3: Linking soil problems, appropriate SICS and existing policies, Tachenhausen (DE)

Soil problem	Appropriate SICS to address problems	Policy addressing the SICS	Assessment of current policy framework
Soil erosion	Tillage management/crop rotation/cover drop	<ul style="list-style-type: none"> <li>Tillage management addressed in water, agri/environment and soil policy</li> <li>Crop rotation/cover crop addressed in CAP, agri/environment/soil policy</li> </ul>	<ul style="list-style-type: none"> <li>CAP - Highly influential;</li> <li>Positive perception of farmers</li> <li>Agri/environment – direct impact on soil welfare; MS based, funding/subsidies related</li> <li>Soil policy – direct impact; MS based; influential</li> </ul>
Nitrate pollution	Nutrient management/crop rotation	<ul style="list-style-type: none"> <li>Nutrient management addressed in Water protection policy, PPP and nutrient policy (chemical &amp; organic) CAP, Agriculture/environment, Soil policy</li> <li>Crop rotation addressed in CAP, Agriculture/environment, Soil policy</li> </ul>	<ul style="list-style-type: none"> <li>Water protection policy- planning instrument, direct but weak impact</li> <li>PPP and nutrient policy (chemical &amp; organic)– regulatory category; bans and standards; direct impact but depends on specific actions and measures adopted in NAPs</li> <li>CAP - Highly influential;</li> <li>Positive perception of farmers</li> <li>Agri/environment – direct impact on soil welfare; MS based, funding/subsidies related</li> <li>Soil policy – direct impact; MS based; influential</li> </ul>

## 18 Draganesti Vlasca, RO

Draganesti Vlasca is located within Burnas Plain in the southern part of Romania. The study area is located in Pannonian pedo-climatic zone. The dominant soil in Draganesti Vlasca is phaeozem in different degradation stages, having a low fertility and in some areas with risk of erosion occurrence. 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. Compaction; water deficit, water excess, sometimes erosion are the main soil threats identified in the Draganesti Vlasca study site.

Conventional and conservation agricultural systems are mainly used 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 common crop rotation used in the study area is: wheat, maize, sunflower. 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.

Testing will include practices already in place in the study site area, particularly reduced soil tillage. In the crop rotation, crops with deep rooting system will be included. Irrigation system is presented also. Mineral fertilisation is applied in different doses according to the crop requirements.

### 18.1 Overview of key policies

The key institutions responsible for implementing and enforcing policies and policy instruments in the Draganesti study site area include:

- Ministry of Environment
- Ministry of Agriculture
- Agency for Payments and Interventions in Agriculture
- Management Authority for National Program of Rural Development
- Agency for financing rural investments
- National Administration of Romanian Waters

The vast majority of policies identified as the most relevant for shaping agricultural practices are the ones which transposed various EU Directives – namely Water Framework Directive, Nitrates Directive, Groundwater directive. In addition, both voluntary and compulsory CAP instruments together have high relevance for impacting agricultural practices in the study site.

With regards to legislation and policy stemming from national initiatives, there is one instrument identified as highly relevant - Ordinance on Environmental Pollution Assessment having a direct impact on farmers by imposing limits on the use of chemical inputs and obligations when to avoid it altogether. In terms of policy categories, the most frequent category is regulatory in addition to CAP implementing instruments which fall within the economic category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing e.g. bans/targets/ and (2) subsidies/payments in form of CAP instruments

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Draganesti study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy.<sup>149</sup>

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<sup>149</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 18.1: Overview of key policies, Draganesti Vlasca (RO)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
Cerintele legale in materie de gestionare (SMR); Standardele privind Bunele conditii agricole si de mediu ale terenurilor (GAEC)	CAP GAEC Cross-compliance Standards	National	EU	Crop rotations; Plant cover; Landscape management; Integrated management	Direct payment and market measures may directly impact the agricultural management at farm level by integrating: the compliance with the legislation, good agricultural practices, environmental protection, productivity and profitability. The national policy documents require the following: GAEC 4 - during winter, at least 20% of the arable land on a holding must be left unworked on or covered with winter crops; GAEC 5 - land with greater than 12° slope must be cultivated along the contours and terraces must be maintained; GAEC 6 - ban on burning stubble and vegetation remains on arable land and permanent pasture and sunflowers may not be grown in the same spot for more than two consecutive years; GAEC 7 - hedges, ponds, ditches, trees, field margins, terraces and stone walls must be protected.
PNDR Masura 10 - Agro-mediu si clima: Pachetul 4 - Culturi verzi	National Program of Rural Development Measure 10 - Agri-environment and climate: Subset 4 - Cover crops	National	EU	Crop rotation; Plant cover; Landscape management; Integrated management	Subset 4 of Measure 10 - Agri-environment and climate measures – direct impact on the soil and water quality at farm level by using cover crops which fix the nitrogen, avoiding nutrients run-off and leaching.
Programul Național de Dezvoltare Rurală pentru perioada 2014 – 2020	National Program for Rural Development 2014-2020	National	EU	Crops; Agroforestry; Tillage management; Nutrient management; Integrated management	The National Rural Development Programme has direct impacts on farmers by using agricultural practices with the aim of: avoiding soil degradation, improving soil management, an adequate landscape management as well as an appropriate integrated management at farm level. The Rural Development Programme (RDP) for Romania was formally adopted in 2015, outlining Romania's

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
					priorities for using nearly € 9.5 billion of public money that is available for the 7-year period 2014-2020. The RDP focuses on promoting competitiveness; environmental protection & climate change; and stimulating economic development. The RDP notes that large agricultural areas are affected by soil degradation phenomena (erosion, landslides, and desertification), risks that are expected to intensify as the effects of climate change increase.
Ordonanța de urgență nr. 49/2015 privind gestionarea financiară a fondurilor europene nerambursabile aferente politicii agricole comune, politicii comune de pescuit și politicii maritime integrate la nivelul Uniunii Europene, precum și a fondurilor alocate de la bugetul de stat pentru perioada de programare 2014-2020 și pentru modificarea și completarea unor acte normative din domeniul garantării	Ordinance no. 49/2015 on financial management of the common agricultural policy funds, common fishing policy funds and common maritime policy funds integrated at EU level as well as allocated national funds for the period of 2014-2020	National	EU	All	Ordinance no. 49/2015 has direct impacts at farm level, the farmer obtains funds according to the farm's need, to the landscape profile and with the aim of applying an integrated management. It establishes the general financial framework for the management of non-reimbursable financial assistance for Romania, in order to ensure an efficient financial management of EU funds allocated for rural development, for the period of 2014-2020.
Legea apelor nr. 107/1996 modificată și completată în 2017	Water Law no. 107/1996 modified and improved in 2017	National	EU	Nutrient management; Pest management; Landscape management	The Law provides the regulatory framework for water bodies protection and management. The Law has indirect impacts on farm. The practices related to nutrient management as well as pest management at farm level are applied with the aim of not polluting the water bodies and finally the agri-food production.
Hotărârea Guvernului nr. 964/2000 privind aprobarea Planului de acțiune pentru protecția apelor	Decision on Action Plan for the Protection of Waters Against Pollution Caused by	National	EU	Crop rotations; Tillage management; Nutrient management; Landscape	The instrument transposes into the Romanian legislation the Nitrates Directive which requires Member State to establish a code of good agricultural practice to be implemented by farmers

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
împotriva poluării cu nitrati proveniți din surse agricole.	Nitrates from Agricultural Sources			management; Plant cover	on a voluntary basis. In compliance with the EU requirements, the instrument lists good practices in agriculture. Romania complied with the Directive's requirement by issuing the appropriate action programme. Quality standards may directly impact on fertiliser use since diffuse pollution is a key pressure on water quality.
Hotărârea Guvernului nr. 53/2009 pentru aprobarea Planului național de protecție a apelor subterane împotriva poluării și deteriorării.	National Plan for Groundwater Protection Against Pollution and Deterioration	National	EU	Phytoremediation; Nutrient management; Pest management; Integrated management	The Government Decision has direct impact on agricultural practices at farm level by using nutrient management plans in order to maintain groundwater quality within the thresholds established for good quality. The Government Decision establishes provisions on the prevention and control of groundwater pollution in order to achieve water protection goals. The National Plan establishes groundwater quality standards and threshold values for groundwater chemical status including for nitrates, active substances of pesticides (including the metabolites), and decomposition products. The quality of soil is directly related to quality of groundwater. Therefore, specific soil protection measures must be taken in order to attain groundwater quality standards.
Ordinul nr. 990/1809/2015 pentru modificarea și completarea Ordinului ministrului mediului și gospodăririi apelor și al ministrului agriculturii, pădurilor și dezvoltării rurale nr. 1.182/1.270/2005 privind aprobarea Codului de bune practici agricole pentru protecția apelor	Ordinance no. 990/1809/2015 for modifying and improving the Ordinance of Ministry of Environment and of Ministry of Agriculture no. 1182/1270/2005 related to approval of			Crop rotations; Tillage management; Nutrient management; Landscape management; Plant cover	The Ordinance has direct impact on agricultural practices at farm level by using nutrient management plans in order to protect the water bodies and the ecosystems within the farm. The Ordinance establishes that the Code of Good Agricultural Practices for water protection against pollution with nitrates from agricultural sources is mandatory for all farmers or land users and for local public authorities (cities, villages, municipalities).

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description
împotriva poluării cu nitrați din surse agricole	Code of Good Agricultural Practices for water protection against nitrates pollution from agricultural sources				The Code is applied by Action Programmes for water protection against pollution with nitrates from agricultural sources established for a period of 4 years.
Ordinul ministrului Apelor, Pădurilor și Protecției Mediului nr.756/1997 pentru aprobarea Reglementării privind evaluarea poluării mediului	Ordinance on Environmental Pollution Assessment	National	MS	Integrated management	The Ordinance has a direct impact on farmer – prescribes the use of organic and/or chemical inputs within the farm in order to avoid soil, water and air pollution (restricted by limits). The Ordinance defines the procedure and technical norms needed for identification of environmental damages ultimately resulting in establishment of liability for remediation activities in case of environmental damage.

## 18.2 Analysis of shortcomings and opportunities

Table 18.2: SICS components addressed by key policies, Draganesti Vlasca (RO)

Policies	Cover crops	Crop rotation management	Nutrient management	Pest management	Tillage management	Integrated management	Agroforestry	Landscape management
Water protection policy			X	X		X		X
PPP and nutrient policy (chemical & organic)	X	X	X		X			X
CAP	X	X	X		X	X	X	X
Environmental pollution assessment						X		

Table 18.3: Linking soil problems, appropriate SICS and existing policies, Draganesti Vlasca (RO)

Soil problem	Appropriate SICS to address problems	Policy addressing the SICS	Assessment of current policy framework
Compaction	Tillage management/crop rotation	<ul style="list-style-type: none"> <li>Tillage management addressed in PPP and nutrient policy (chemical &amp; organic) and CAP</li> <li>Crop rotation addressed in PPP and nutrient policy (chemical &amp; organic) and CAP</li> </ul>	<ul style="list-style-type: none"> <li>PPP and nutrient policy (chemical &amp; organic)– Majority based on the EU law;</li> <li>Legislation imposing bans and restrictions on use;</li> <li>Introduction of voluntary measures/actions– positive impact on soil; Regulatory category only;</li> <li>None addressed soil protection measures specifically</li> <li>CAP - Highly influential;</li> <li>Positive perception of farmers</li> </ul>
Water deficit/water excess	Irrigation/crop rotation	<ul style="list-style-type: none"> <li>Irrigation – not addressed</li> <li>Crop rotation addressed in PPP and nutrient policy (chemical &amp; organic) and CAP</li> </ul>	<ul style="list-style-type: none"> <li>PPP and nutrient policy (chemical &amp; organic)– Majority based on the EU law;</li> <li>Legislation imposing bans and restrictions on use;</li> <li>Introduction of voluntary measures/actions– positive impact on soil; Regulatory category only;</li> <li>None addressed soil protection measures specifically</li> <li>CAP - Highly influential;</li> <li>Positive perception of farmers</li> </ul>
Soil erosion	Tillage management/cover crops/pest management	<ul style="list-style-type: none"> <li>Tillage management addressed in PPP and nutrient policy (chemical &amp; organic) and CAP</li> <li>Cover crops addressed in PPP and nutrient policy (chemical &amp; organic) and CAP</li> <li>Pest management addressed in water policy</li> </ul>	<ul style="list-style-type: none"> <li>PPP and nutrient policy (chemical &amp; organic) – Majority based on the EU law;</li> <li>Legislation imposing bans and restrictions on use;</li> <li>Introduction of voluntary measures/actions– positive impact on soil; Regulatory category only;</li> <li>None addressed soil protection measures specifically</li> <li>CAP - Highly influential;</li> <li>Positive perception of farmers</li> <li>Water policy - Based on the EU law;</li> <li>Indirectly addresses soil protection</li> <li>Regulatory category only</li> </ul>

## 19 Legnaro, IT

The study site is located in Legnaro, Padova 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. SOM content is strongly affected by the peculiar texture (low physical protection) and climatic conditions, and usually ranges from 10 to 20 g kg<sup>-1</sup> in the top layer. The pedo-climatic zone is Mediterranean North.

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 North Eastern 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 has raised concern about its 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 substance, no-tillage) showed low acceptance by the farmers. Indeed, implementation of measures has been hindered by a) technical, logistic and economic constraints; 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 carbon cycle. The Study Site 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 organic amendment input and conservative tillage. However, these measures showed low acceptance.

Current agricultural practices are best described as conventional, with different crop rotations, mouldboard ploughing, and chemical weed and pest control. SICS to be tested include different crop rotations and the use of different types and amounts of organic fertilisers.

### 19.1 Overview of key institutions and policies

The key institutions in Legnaro, Padova Study site are:

- AGEA – national Agency for payments in agriculture
- AVEPA - Regional Agency for payments in agriculture (Veneto)
- National Ministry for agricultural and forest politics
- Regional level - Agency for payments in agriculture – Veneto region
- Basin authority for the Eastern Alps area

All policies identified as the most relevant for shaping agricultural practices are the ones which

transposed various EU Directives – namely Water Framework Directive, Nitrates Directive and Pesticides Directive. In addition, both voluntary and compulsory CAP instruments have high relevance for impacting agricultural practices in the study site. In terms of policy categories, the most frequent category is regulatory in addition to CAP implementing instruments which fall within the economic category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans/targets/standards and (2) subsidies in form of CAP instruments.

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Legnaro, Padova study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. Many policies in the table below were identified as having direct impact on farmers (except for Plan of water management which constitutes the RBMP under the WFD).<sup>150</sup>

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<sup>150</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 19.1: Overview of key policies, Legnaro (IT)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Norme per il mantenimento del terreno in buone condizioni agronomiche e ambientali (BCAA)	CAP GAEC Cross-compliance standards	National	EU	Pest management, nutrient management, crop rotation, cover crops	Period of the soil cover is specified. furrows, protection strips and maintenance of amelioration. – Prohibition to burn out harvest fields/remains after harvest of crops and application of solid manure or solid organic manure.
Programmi di Sviluppo Rurale	CAP rural development programmes 2014-20-National Programmes	National	EU	Integrated management, pest management, nutrient management	Italy has got 21 RDPs, one per each administrative Region (19) and autonomous Province (Trento and Bolzano provinces). Each RDP is set up by Regions and Provinces according to Reg. (UE) N. 1305/2013 and related regulations, based on regional specific pedo-climatic and socio-economic conditions and on a dedicated regional needs assessment. Each RDP has to contribute to the achievement of 6 EU priorities. Soil conservation is targeted within priority 4 (environment) (restoring, preserving and enhancing ecosystems related to agriculture and forestry and priority 5 (climate) (promoting resource efficiency and supporting the shift towards a low carbon and climate resilient economy in agriculture, food and forestry sectors). Soil conservation, in particular, is targeted within the Focus Area 4C (preventing soil erosion and improving soil management) and 5E (fostering carbon conservation and sequestration in agriculture and forestry).
Programmi di Sviluppo Rurale	CAP rural development programmes 2014-20-Regional Programmes	Regional	EU	Integrated management, pest management, nutrient management	The Regional RDP defined the specific instruments to achieve the results defined in the National RDP. Considering SICS, the most important actions are related to Integrated and Organic agriculture (limiting the pest management practices available and fertilisations and aiming toward crop rotation) and the specific measures for the implementation of no-tillage. At the agro-environmental level, the measures to preserve and enhance the presence of woody buffer strips are also significant.
Disciplina del regime di condizionalita' ai sensi del regolamento (UE) n. 1306/2013	Application of the 1306/2013 directive, concerning the	National	EU	All SICS	The Decree identifies:

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
e delle riduzioni ed esclusioni per inadempienze dei beneficiari dei pagamenti diretti e dei programmi di sviluppo rurale. (15A01917)	implementation of cross-compliance, reductions and exclusions fom payments in relation to non-compliance with counterparty obligations.				a) the mandatory criteria for agricultural management practices and the standards for maintaining soil health required for accessing the contributions related to cross compliance; b) defines the cases of exclusion or reductions of the contribution to farmers, according the EU regulations n. 809/2014 and n. 640/2014 c) defines the minimal requirements for fertiliser and pesticide applications for accessing cross-compliance.
Programma di Sviluppo Rurale per il Veneto 2014-2020. Apertura dei termini di presentazione delle domande di aiuto per i tipi d'intervento 11.1.1 Pagamenti per la conversione all'agricoltura biologica e 13.1.1 Indennità compensativa in zona montana del PSR 2014-2020. Regolamenti (UE) n. 1303/2013 e n. 1305/2013. Deliberazione/CR n. 16 del 28/02/2017	Decree opening the terms for the presentation of request of contributions within the Rural development plan 2014-2020.	Regional	EU	All SICS	The Regional decree provides for applications for aid for conversion to organic agriculture and for compensation for farms in mountain areas, within the Rural Development plan 2014-2020.
Piano di Gestione delle Acque	Plan of water management	Sub-regional/ Local	EU	Irrigation, drainage management, landscape management	The river basin management plan defines the standards for water quality and the specific measures for protection of waters from pollution, increasing the efficiency of water use. NOTE: the area considered encloses the Provinces of Trento and Bolzano, Veneto Region and Friuli-Venezia Giulia Region. It should be considered as a 'sub-national' regulation.
Criteri e norme tecniche generali per la disciplina regionale dell'utilizzazione agronomica degli effluenti di allevamento	Implementation of Nitrates Directive	National	EU	Crop rotations; Tillage management; Nutrient management;	The national law requires that organic fertilisers are used following the good agricultural practices (defined in the D.M. 19 April 1999 - <a href="http://www.gazzettaufficiale.it/eli/id/1999/05/04/099A3435/sg">http://www.gazzettaufficiale.it/eli/id/1999/05/04/099A3435/sg</a> ) and sets some prohibition of the use of solid and liquid manures in specific environmental conditions. The use of organic fertilisers must be done in

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
				Landscape management; Plant cover	agricultural areas, guaranteeing a high level of efficiency of the inputs. The specific application in agriculture, defining Vulnerable Zones and specific limits in terms of N applicable per hectare, are prescribed for the Regions.
Applicazione della direttiva 91/676/CEE sulla protezione delle acque dall'inquinamento da nitrati provenienti da fonti agricole	Application of the directive 91/676/CEE sulla protezione delle acque dall'inquinamento da nitrati provenienti da fonti agricole	Regional	EU	Crop rotations; Tillage management; Nutrient management; Landscape management; Plant cover	The regional law defines the Vulnerable zones and the limits of application of organic fertilisers for both Vulnerable and non-vulnerable zones. The law imposes the use of crop rotations and defines the application methods to be used for enhancing the efficiency of organic inputs and apply the prohibitions prescribed in the national law.
Attuazione della direttiva 2009/128/CE che istituisce un quadro per l'adozione comunitaria ai fini dell'utilizzo sostenibile dei pesticidi.	Implementation of the directive on the sustainable use of pesticides	National	EU	Pest management, nutrient management	The legislative decree defines the measures to be taken for a sustainable use of pesticides in order to reduce the adverse impacts on human health, the environment and biodiversity and it promotes alternative approaches and non-chemical methods in the phytosanitary domain. The link with soil is mentioned in the articles that regulate the sustainable use of pesticides so that the soil is protected.
Approvazione degli Indirizzi regionali per un corretto impiego dei prodotti fitosanitari, nonché della proposta di regolamentazione comunale per l'utilizzo dei prodotti fitosanitari, in applicazione del Piano di Azione Nazionale per l'uso sostenibile dei prodotti fitosanitari approvato con DM 22 gennaio 2014	Regional implementation of the directive on the sustainable use of pesticides	Regional	EU	Pest management, weed management	Regional application of the national Directive for the Sustainable use of pesticides.

## 19.2 Analysis of shortcomings and opportunities

Table 19.2: SICS components addressed by key policies, Legnaro (IT)

Policies	Cover crops	Crop rotation management	Irrigation/drainage	Nutrient management	Pest management	Tillage management	Integrated management	Landscape management
Water protection policy			X					X
PPP and nutrient policy (chemical & organic)	X	X		X	X	X		
CAP	X	X		X	X		X	

Table 19.3: Linking soil problems, appropriate SICS and existing policies, Legnaro (IT)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
loss of soil organic matter (due to monocultures, uncoupling of livestock and crop production, removal of crop residue).	Tillage management, crop sequences/crop rotation/cover crops, pest/nutrient management	<ul style="list-style-type: none"> <li>Tillage management addressed in PPP and nutrient policy (chemical &amp; organic)</li> <li>Crop sequences/rotation/cover crops addressed in PPP and nutrient policy (chemical &amp; organic) and CAP</li> <li>Pest/nutrient management addressed in PPP and nutrient policy (chemical &amp; organic) and CAP</li> </ul>	<ul style="list-style-type: none"> <li>PPP and nutrient policy (chemical &amp; organic) – Direct impact on farmers and soil;</li> <li>Legislation imposing bans and restrictions on use;</li> <li>Introduction of voluntary measures/actions; Regulatory category only</li> <li>CAP - Highly influential;</li> <li>Positive perception of farmers</li> </ul>

## 20 Szaniawy, PL

The study site is located in the Podlasie region (county Łuków). Continental, sandy and loamy soils are present. The main soil threats affecting soil quality in the study site area are: high acidity of soils, low Soil-organic matter content (SOM), water deficit during growing season, and inadequate use of legume crops to increase Nitrogen fixation and reduce fertilizer needs.

Traditionally conventional farming system is mostly used. The most frequent crops in crop rotation are cereals (60%), maize (35%), potatoes and others (5%). Conventional tillage is the main type of tillage with percentage higher than 90%. The implementation of reduced tillage out of total arable land is only marginal. The figure for zero tillage is approximately 1 percent. 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 depending on the cost. Rain-fed crop production is most common.

SICS currently used will be included in the field testing, such as the use of legume crops in crop rotation, cover or intermediate crops, mulching, liming, organic fertilizers and mineral fertilizers. They are particularly useful on dominant sandy soils, but not used extensively. In addition, afforestation of poor and coarse textured soils ongoing and the conversion of arable land into grasslands in wet and undrained areas will be tested.

### 20.1 Overview of key institutions and policies

The key institutions shaping the policy framework and ensuring its implementation and enforcement include:

- Ministerstwo Rolnictwa i Rozwoju Wsi (The Ministry of Agriculture and Rural Development)
- Urząd Marszałkowski Województwa Lubelskiego w Lublinie (Marshal Office of the Lubelskie Voivodeship in Lublin)
- Agencja Restrukturyzacji i Modernizacji Rolnictwa (Agency for Restructuring and Modernisation of Agriculture)
- Ministerstwo Środowiska (Ministry of the Environment)
- Instytut Uprawy Nawożenia i Gleboznawstwa, Państwowy Instytut Badawczy (Institute of Soil Science and Plant Cultivation, State Research Institute in Pulawy, Poland)
- Marszałek Sejmu Rzeczypospolitej Polskiej (Marshal of the Polish Parliament)
- Ministerstwo Infrastruktury i Budownictwa (Ministry of Infrastructure and Construction)

The vast majority of policies identified as the most relevant for shaping agricultural practices

are stemming from the EU Directives (Pesticides Directive, WFD, Floods Directive). With regards to legislation and policy stemming from national initiatives, one instrument was identified as highly relevant - Environmental Protection Act (see table below). In terms of policy categories, virtually all highly relevant instruments fall within the regulatory category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans/standards and (2) Information/guidance.

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Szaniawy study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having direct impact on farmers.<sup>151</sup>

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<sup>151</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 20.1: Overview of key policies, Szaniawy (PL)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Ustawa Prawo Wodne	Act on Water Law	National	EU	Pest management, nutrient management, irrigation, drainage	Adopted in 2017, the Act on Water Law is the main piece of legislation in Poland to implement the EU Water Framework Directive. It regulates water management in line with the principle of sustainable development. The Act on Water Law plays an important role in soil protection as it frames the water management practices (mainly irrigation and drainage) that affect water balance in soils. The aim of water balance regulation, according to Article 70 of the Act on Law, is to "increase productivity of soil, facilitate its cultivation, and protect utilised agricultural land from flooding." The Act also protects water resources and soils from pollution and by doing so it also protects soils (both topsoil and subsoil).
Kodeks Dobrej Praktyki Rolniczej	Code of Good Agricultural Practice	National	EU	Nutrient management, pest management, tillage management, crop sequences	Released in 2004 by the Ministry of Agriculture and Rural Development jointly with the Ministry of Environment, the Code of Good Agricultural Practice aims to implement national, EU and international environmental legislation in agriculture. One chapter in the Code is dedicated to soil protection, including guidance on preventing erosion and organic matter loss as well as recognition of the importance of soil biodiversity.
Dz.U. 2007 Nr 147 poz. 1033, USTAWA o nawozach i nawożeniu	Law on fertilizers	National	EU	Nutrient management	The law regulates: the conditions and procedure for placing fertilizers on the market, excluding cases related to the placing on the market of fertilizers regulated in Regulation (EC) No 2003/2003 of the European Parliament and of the Council of 13 October 2003 on fertilizers (Dz. Urz. WE L 304 z 21.11.2003, page 1, with later changes hereinafter referred to as "Regulation 2003/2003". Application of appropriate doses of nitrogen fertilizer (no more than 170 kg of nitrogen in a pure ingredient per hectare of agricultural land).
Ustawa Ochronie Przyrody	Nature Conservation Act	National	EU	Pest management, nutrient management	The Nature Conservation Act is the main legal tool for nature protection in Poland. It aims at conservation, sustainable use and renewal of natural resources. It protects soils from contamination, sealing and other threats as part of the landscape, fauna and flora conservation measures. The Act includes [conditional] obligation to conduct soil contamination analysis", "ban of soil contamination and degradation within the limits of the protected

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					areas" "ban of soil degradation in wild fauna or flora refugia" "provision of information on any undertaking affecting water-soil balance in the selected nature conservation areas", "management rules of inanimate nature protective of soil profiles" "ban of soil degradation and land use change in national parks and wildlife reserves.
Ustawa z dnia 27 kwietnia 2001 r. Prawo ochrony środowiska	Environmental Protection Law	National	MS	Nutrient management, pest management	Application of management practices protecting soil against: water and wind erosion, the decline of organic matter content and excessive compaction, salinity and acidification.

## 20.2 Analysis of shortcomings and opportunities

Table 20.2: SICS components addressed by key policies, Szaniawy (PL)

Policies	Irrigation/drainage	Nutrient management	Pest management	Tillage management	Crop sequence
Water protection	X	X	X		
Environmental protection		X	X		
Agriculture		X	X	X	X
PPP and nutrient policy (chemical & organic)		X			

Table 20.3: Linking soil problems, appropriate SICS and existing policies, Szaniawy (PL)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Excessive fertilizer use	Nutrient management	<ul style="list-style-type: none"> <li>Nutrient management addressed in Water, environment, agriculture and PPP and nutrient policy (chemical &amp; organic)</li> </ul>	<ul style="list-style-type: none"> <li>Water – high impact on soil, regulatory category only, based on EU law</li> </ul>

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
			<ul style="list-style-type: none"> <li>• Environment – both MS and EU level; regulatory category; indirect impact on agricultural practices, based on bans and standards</li> <li>• Agriculture – direct impact on soil, but “only” voluntary guidance</li> <li>• PPP and nutrient policy (chemical &amp; organic) - Based on the EU law;</li> <li>• Legislation imposing bans and restrictions on use;</li> <li>• Direct impact on soil; Regulatory category only;</li> <li>• None addressed soil protection measures specifically</li> </ul>
Low Soil organic matter (SOM)	Pest management/nutrient management/cover crops/tillage	<ul style="list-style-type: none"> <li>• Pest management addressed in Water, environment, agriculture</li> <li>• Nutrient management addressed in Water, environment, agriculture and PPP and nutrient policy (chemical &amp; organic)</li> <li>• Tillage management addressed in agriculture policy</li> </ul>	<ul style="list-style-type: none"> <li>• Water – high impact on soil, regulatory category only, based on EU law</li> <li>• Environment – both MS and EU level; regulatory category; indirect impact on agricultural practices, based on bans and standards</li> <li>• Agriculture – direct impact on soil, but “only” voluntary guidance</li> <li>• PPP and nutrient policy (chemical &amp; organic) - Based on the EU law;</li> <li>• Legislation imposing bans and restrictions on use;</li> <li>• Direct impact on soil; Regulatory category only;</li> <li>• None addressed soil protection measures specifically</li> </ul>

## 21 Caldeirao, PT

The study site is located in Caldeirão, Portugal. It is situated in Mondego lower valley, an alluvium plane area located between Coimbra at the east and the sea to the west. The conventional systems in Portugal are considered sustainable agriculture. Thus, focus is on testing and comparing new methods such as organic practices, more sustainable practices, e.g. rotational cropping, cover crops.

The main types of crops grown are maize, rice and wine. 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. Rice - Chisel tillage in the conventional system, for the 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, 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).

SICS testing will focus on implementing more organic farming systems, including the use of compost and the reduction of synthetic fertilizers and pesticides. In addition, crop rotations and optimized irrigation systems will be tested.

### 21.1 Overview of key institutions and policies

Key institutions responsible for shaping, implementing and enforcing the policy framework in which agricultural producers operate are:

- Agency for Development and Cohesion
- Institute for Financing Agriculture and Fisheries
- Portuguese Agency of Environment
- Ministry of Agriculture for Rural Development and Fisheries
- Regional Directorate of Environment
- Regional Directorate of Agriculture
- Regional Directorate for Agriculture and Fisheries
- Directorate-General for Agriculture and Rural Development
- Water Institute

- Commission for Regional Coordination and Development
- Authority of Food and Economic Security
- National Institute of Agrarian and Veterinary Research

The vast majority of policies identified as the most relevant for shaping agricultural practices are either stemming from the EU rural policy (CAP and RDP) and EU Directives (Pesticides and Sewage Sludge Directive). With regards to legislation and policy stemming from national initiatives, National Action Plan (NAP) for the Sustainable Use of Plant Protection Products setting targets and bans have been identified as highly influential for impacting the farmers in the study site.

In terms of policy categories, the most frequent category is regulatory and economic category together with the information/education category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans, (2) subsidies in form of CAP instruments and (3) action plans.

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Caldeirão study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having direct impact on farmers.<sup>152</sup>

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<sup>152</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 21.1: Overview of key policies, Caldeirao (PT)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Portaria n.º 57/2015, de 27 de fevereiro, alterada pelas Portarias 409/2015, de 25 de novembro, 24-B/2016, de 11 de fevereiro, 131/2016, de 10 de maio e 273/2017, de 14 de setembro - PAC - Pagamentos Directos: modalidades de aplicação nacional	CAP - Complementary National Direct Payments Requirement (Greening included)	National	EU	Crop sequences, crop rotation, landscape management, tillage management	Adoption of crops diversification systems or at least winter cover. Maintenance of Permanent Pasture and prohibition of tillage for protected areas. Conversion of 5% of the total surface on ecological focus areas.
PDR 2020 - Programa de Desenvolvimento Rural do Continente para 2014-2020 -- aprovado formalmente pela Comissão Europeia através da Decisão C (2014) 9896	CAP Rural development	National	EU	Crop rotations, Crop Sequence, Plant cover, Tillage management, Nutrient management, Irrigation, Pest management, Machine management (seeding, harvesting), Mulching, Weed control, Landscape management, Integrated management	The objectives of the plan are operationalized in the PDR2020 with measures and actions integrated in four main areas of intervention: Innovation and knowledge, Competitiveness and organization of production, Environment resource efficiency and climate, Local development. Of greater relevance for soil protection is the measure M7 - Agriculture and Natural Resources (of the intervention area - A3) and in particular the sub-measures 7.1 Organic Agriculture; 7.2 Integrated Production; 7.3 Payments Natura Network; 7.4. Soil Conservation: Direct seeding or mobilization in the line or interline seeding for permanent crops; 7.5. Efficient Water Use In Portugal, 37.6% of agricultural land is under management contracts supporting biodiversity and/or landscapes, 10.2% under management contracts to improve water management and 28.5% under management contracts to improve soil management and/or prevent soil erosion. 26,2% of public support is sustaining the priority 4 - P4: Restoring, preserving and enhancing ecosystems related to agriculture and forestry;

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					11.44% specifically supporting measure M10 - AEC (Agri-Environment Climate Payment) Portugal spends over 10% of its RDP budget on focus area 5E- Fostering carbon conservation and sequestration in agriculture and forestry. Dealing with soil erosion was identified as a need, and M10 is used to support commitments by farmers to better soil management eg by direct seeding, sowing along contours and incorporating straw or other matter.
Portaria 50/2015 de 25 de fevereiro alterada pela Portaria n.º 374/2015; pela Portaria n.º 4/2016; pela Portaria n.º 338-A/2016	CAP Rural development	National	EU	Crop rotations, Crop Sequence, Plant cover, Tillage management, Nutrient management, Irrigation, Pest management, Machine management (seeding, harvesting), Landscape management	This Order establishes the system for the application of support measures 7.4, 'Soil conservation', 7.5 'Efficient use of water', 7.6, 'Traditional permanent crops', 7.7 'Extensive grazing', 7.9' Mosaic agro-forestry 'and 7.12' Agri-environmental support for apiculture' measure No 7' Agriculture and natural resources' of the Mainland Rural Development Program.
Despacho normativo n.º 6/2015, de 20 de fevereiro, alterado pelos Despachos Normativos n.os 16/2015, de 25 de agosto, 1-B/2016, de 11 de fevereiro e 4/2016, de 9 de maio – Requisitos legais de gestão (RLG) e normas mínimas para as boas condições agrícolas e ambientais das terras (BCAA) no âmbito da condicionalidade	CAP - Cross compliance - Statutory Management Requirements (SMR) and standards of good agricultural and environmental condition (GAEC).	National	EU	Crop sequences, crop rotation, nutrient management, Machine management, tillage management, landscape management	Establishes the Statutory Management Requirements (SMR) and standards of good agricultural and environmental condition (GAEC) (Cross-Compliance) Statutory Management Requirements are mandatory for beneficiaries receiving direct payments under Regulation (EU) No 1307/2013 List of Indicators: The SMR and GAEC most relevant lands are in Portugal: RGL 1 - on the protection of waters against pollution caused by nitrates from agricultural sources;

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					RGL 2 and RGL 3 - on the conservation of natural habitats and of wild flora and fauna; BCAA 1/2/3 - Water protection; BCAA 4 - Minimum soil cover; BCAA 5 - Minimum land management, reflecting site-specific conditions to limit erosion; BCAA 6 - Maintenance of soil organic matter; BCAA 7 - Maintenance of landscape characteristics.
Decreto-Lei n.º 276/2009 - regime de utilização de lamas de depuração em solos agrícolas	National legal framework for agricultural use of sewage sludge	National	EU	Nutrient management	It lays down the use of sewage sludge in agricultural soils, in order to avoid harmful effects on people, water, soil, vegetation and animals, by promoting their correct use. It establishes standards for analysis of sludge, of soil, dates and applicable quantities, pollution thresholds. It transposes into national law Council Directive 86/278 / EEC of 12 June. Aim is the reduction of mineral fertilizer use and sustainable use of sludges.
Lei n.º 26/2013, de 11 de abril. D.R. n.º 71, Série I - Regulação das atividades de distribuição, venda e aplicação de Produtos Fitofarmacêuticos para uso profissional	National sustainable Use of Pesticides Law	National	EU	Pest management; Integrated management, organic management	Law on the Distribution, Sale and Application of Plant Protection Products for Professional Use - Transposing Directive 2009/128 / EC, regulates the distribution, sale and application of PPPs for professional use and of adjuvants of PPPs and defines the procedures for monitoring the use of PPPs. The distribution, sale and application of pesticides have to be authorized by the competent authority, which also decides on which products can be placed on the market and can only be performed by qualified personnel. Aim is to avoid the use of non-approved pesticides and provide for a sustainable use of pesticides

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
PANUSPF - Plano de ação nacional para o uso sustentável dos produtos fitofarmacêuticos - Portaria n.º 304/2013 de 16 out.	National action plan for the sustainable use of plant protection products	National	MS	Pest management; Integrated management, organic management	National Action Plan (NAP) for the Sustainable Use of Plant Protection Products, sets targets, measures and timetables to reduce the risk and effects of the use of pesticides on human health and the environment as well as how to promote the use of protection strategies less depending of pesticide use, such as protection and integrated production and organic farming. It promotes protection and integrated production and organic farming.

## 21.2 Analysis of shortcomings and opportunities

Table 21.2: SICS components addressed by key policies, Caldeirao (PT)

Policies	Cover sequence	Crop rotation	Nutrient management	Pest management	Tillage management	Integrated management	Machine management	Landscape management	Organic management
CAP	X	X	X	X	X	X	X	X	
PPP and nutrient policy (chemical & organic)			X	X		X			X

Table 21.3: Linking soil problems, appropriate SICS and existing policies, Caldeirao (PT)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Excessive fertilizers and pesticides	Nutrient management/pest management/organic management	<ul style="list-style-type: none"> <li>Nutrient and pest management addressed in CAP and PPP and nutrient policy</li> <li>Organic management addressed in PPP and nutrient policy</li> </ul>	<ul style="list-style-type: none"> <li>CAP - Highly influential;</li> <li>Positive perception of farmers;</li> <li>Different types of instruments; voluntary and mandatory instruments</li> <li>PPP and nutrient – EU and MS policy; introduces standards and bans; both regulatory and action plans; highly influential; direct impact on soil</li> </ul>
Low Soil organic matter (SOM)	Pest management/nutrient management/cover crops/crop sequence/integrated management/organic management	<ul style="list-style-type: none"> <li>Nutrient and pest management and organic and integrated management addressed in CAP and PPP and nutrient policy</li> <li>cover crops/crop sequence in CAP</li> </ul>	<ul style="list-style-type: none"> <li>CAP - Highly influential;</li> <li>Positive perception of farmers;</li> <li>Different types of instruments; voluntary and mandatory instruments</li> <li>PPP and nutrient – EU and MS policy; introduces standards and bans; both regulatory and action plans; highly influential; direct impact on soil</li> </ul>

## 22 Chania, GR

The study site is located in Chania, on the largest Greek island Crete. Crete's climate is classified as dry sub-humid. 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. Soils are mainly Calcisol. 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. 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.

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<sup>-1</sup> y<sup>-1</sup> but more localised investigations assess soil losses one order of magnitude higher. Olive orchards and vineyards often suffer from extreme soil erosion by water due to farm slope and recent intensification of tillage practices. Depending on practices, tilling and irrigation can also 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.

In 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%. Several technologies, mainly associated with cropping intensity and traditional versus modern techniques, are currently applied in the island (traditional crop picking, minimal mechanical equipment). Olive trees are cultivated with little or no irrigation and minimum agricultural inputs, minimised tillage and minimised removal of rocks from the fields. Vineyards practice green manuring, green strips and minimised tillage with lightweight machinery. Innovative techniques already in place will be assessed for their potential to improve soil quality, monitor and mitigate erosion (minimised tillage, green strips, green manuring, erosion traps etc).

### 22.1 Overview of key institutions and policies

The Ministry of Rural Development and Food as well as the Ministry of Environment and Energy are the key institutions responsible for the development and implementation of the policy framework in which agricultural producers operate.

The vast majority of policies identified as the most relevant for shaping agricultural practices are the ones which transposed various EU Directives – namely Water Framework Directive, Nitrates Directive, Pesticides Directive and Habitats and Birds Directive. In addition, both

voluntary and compulsory CAP instruments together with the national laws reflecting Fertilizer and Organic Regulation have high relevance for impacting agricultural practices in Crete and the study site. With regards to legislation and policy stemming from national initiatives, there are two instruments identified as highly relevant - Proposal for the Law on Protection and Sustainable Use of Soil and Law for the Protection of the Environment.

In terms of policy categories, the most frequent category is regulatory in addition to CAP implementing instruments which fall within the economic category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans/targets/standards and/or quotas, (2) subsidies in form of CAP instruments and, (3) legislative proposals.

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Greece and/or Chania study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. Most of the policies in the table below were identified as having direct impact on farmers (except for Law on Conservation of Biodiversity).<sup>153</sup>

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<sup>153</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 22.1: Overview of key policies, Chania (GR)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Πρότυπα για την καλή γεωργική και περιβαλλοντική κατάσταση (ΚΓΠΚ)	CAP GAEC Cross-compliance Standards	National	EU	Plant cover; Tillage management; Irrigation; Mulching	'Cross compliance' is a set of rules which farmers and land managers must follow on their holding if they are claiming rural payments. GAEC 4 - 7 are relevant in the case of SICS in Greece: GAEC 4 requires land parcels with a gradient greater than 10% to be covered by vegetation or stubble during the rainy periods; GAEC 5 requires land with gradient greater than 10% to be tilled perpendicular to the slope, irrigation to be suitable, retention of stone walls, dykes and natural slopes along parcel boundaries; GAEC 6 requires crop residues to be grazed, tilled into the soil or mulched; GAEC 7 requires retention of terraces, hedges, ditches and trees in line and ponds.
Απαιτήσεις πληρωμής για οικολογικό προσανατολισμό/ "πρασίνισμα"	CAP Greening Payment Requirements	National	EU	Crop rotation; Agroforestry; Plant cover; Landscape management; Integrated management	Greening requirements are set out in Regulation (EU) 1306/2013 (Chapter 4), and the associated delegated acts, implementing regulations and Commission guidance to Member States. At Member State level the greening requirements are set out in the very detailed instructions given to all farmers who are eligible for CAP payments. These are made available to all farmers who are registered with the agriculture department's administrative system for CAP payments but are not publicly available.
ΠΡΟΓΡΑΜΜΑ ΑΓΡΟΤΙΚΗΣ ΑΝΑΠΤΥΞΗΣ ΤΗΣ ΕΛΛΑΔΑΣ version 1.3, last modified 8/12/2015	CAP Rural Development Programme 2014 – 2020	National	EU	Crop rotation; Agroforestry; Plant cover; Tillage management; Irrigation; Integrated management	The Rural Development Programme (RDP) for Greece was formally adopted by the European Commission in 2015. It outlines Greece's priorities for using the €5.9 billion available from 2014-2020 (national and EU contributions). The main objectives of the RDP are enhancement of farm viability and competitiveness, preservation and enhancement of ecosystems and promotion of local development in rural areas. RDP's Focus area 4C focuses on improving soil management. As part of this Focus area, the RDP calls for reports on issues such as reduced tillage and crop rotation (p. 34). The RDP refers to other SICS such as plant cover (p. 314 and 741), integrated management (p. 373), irrigation (p. 469), agroforestry (p. 656), etc.
Κανονισμός σχετικά με τη χρηματοδότηση, τη	Regulation on the financing, management	National	EU	Integrated soil management	Horizontal regulation covers important horizontal aspects of the Common Agricultural Policy, such as cross-compliance measures SMRs and GAECs, farm advisory services and the EIP AGRI.

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
διαχείριση και την παρακολούθηση της κοινής γεωργικής πολιτικής	and monitoring of the common agricultural policy				
Κανονισμός για τη βιολογική παραγωγή και την επισήμανση των βιολογικών προϊόντων και την κατάργηση του κανονισμού (ΕΟΚ) αριθ. 2092/91	Regulation on organic production and labelling of organic products	National	EU	Integrated management; crop rotation; restriction chemical inputs, tillage practices	The regulation sets the standards for organic production, marketing and labelling organic products. Organic production standards have rules relating to crop rotation and chemical inputs that have a direct effect on soil quality. The regulation explicitly deals with soil fertility and quality in its objectives i.e.: organic plant production should contribute to maintaining and enhancing soil fertility as well as to preventing soil erosion. Plants should preferably be fed through the soil eco-system and not through soluble fertilisers added to the soil and high; and highlights the essential role of soil fertility management systems such as choice of species, crop rotation, recycling organic materials and cultivation techniques (13, 14). Art. 3 a (i) specifically addresses the relations and balance between health of soil, water plants and animals. Art 5. (a) addresses the maintenance and enhancement of soil life and natural soil fertility, soil stability and soil biodiversity as a means to prevent and combat soil threats such as soil compaction and soil erosion. The regulation also lays down the rules for use of tillage and cultivation practices that maintain or increase soil organic matter, enhance soil stability and soil biodiversity, and prevent soil compaction and soil erosion. In addition, principles for maintaining fertility and the biological activity of the soil, such as crop rotation including green manure and crop rotation with legumes and application of composted manure or organic material.
Οδηγία για την προστασία των υδάτων από την νιτρορρύπανση γεωργικής προέλευσης	Protection of waters against pollution caused by nitrates from agricultural sources	National	EU	Crop rotations; Tillage management; Nutrient management; Landscape	The Nitrates Directive aims to protect surface waters and groundwater against pollution by nitrates from agricultural sources. The Member States are also required to set up where necessary a programme, including the training and information for farmers, promoting the practices. The Directive requires Member States to identify Nitrate Vulnerable Zones and set up action programmes for these zones (Article 5).

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
				management; Plant cover	
Κανονισμός σχετικά με τα λιπάσματα	Fertilizer regulation	National	EU	Nutrient management	The Regulation regulates which products on the European market may bear the words 'EC fertiliser' (Article 1). The minimum requirements to bear this name include that the product does not have negative effects on the health of humans, animals, plants or the environment (including soils) when applied under normal conditions (Article 14). The Regulation is, therefore, relevant for nutrient management.
Πρόταση νόμου Για την Προστασία και αιεφόρο χρήση του εδάφους	Proposal for the Law on Protection and Sustainable Use of Soil	National	MS	Integrated management	The draft Law is based on the draft EU Soil Framework Directive which the Commission formally withdrew in 2014. The draft Law includes measures for preventing pollution from land use, calls for inventory of areas under major soil threats and adoption of programmes of measures for de-contamination as well as a national strategy for rehabilitation of polluted areas. The draft law proposes the adoption of SICS from farmers for improving soil quality and sustainable integrated management of farms.
ΝΟΜΟΣ: 1650/86 Για την προστασία του περιβάλλοντος	Law for the Protection of the Environment	National	MS	Integrated management	The Law provides legal basis for issuance of Joint Ministerial Decisions concerning soil. The Law provides a general framework transposing the Environmental Impact Assessment and Industrial Emissions Directive into the Greek legislation. The Industrial Emissions Directive is important because it requires issuance of integrated permit for relevant activities, including several agricultural activities. The permitted activities must bring their emissions in line with the set emission limit values.

## 22.2 Analysis of shortcomings and opportunities

Table 22.2: SICS components addressed by key policies, Chania (GR)

Policies	Cover crops	Crop rotation management	Crop Sequences	Irrigation/drainage	Nutrient management	Pest management	Tillage management	Integrated management	Agroforestry	Landscape management
PPP and nutrient policy (chemical & organic)	X	X			X	X	X			X
Agriculture (organic production)		X			X	X	X			
CAP	X	X		X			X	X	X	

Table 22.3: Linking soil problems, appropriate SICS and existing policies, Chania (GR)

Soil problem	Appropriate SICS to address problems	Policy addressing the SICS	Assessment of current policy framework
Soil erosion (due to tillage and irrigation)	Tillage management/irrigation/drainage	<ul style="list-style-type: none"> <li>Tillage management – addressed in PPP and nutrient policy (chemical &amp; organic) and agriculture policy and CAP</li> <li>Irrigation/drainage – addressed in CAP</li> </ul>	<ul style="list-style-type: none"> <li>CAP- Highly influential</li> <li>Positive perception of farmers; based on financial incentives</li> <li>Agriculture - Positive perception of farmers; issue of coverage and finances available for organic production</li> <li>PPP and nutrient policy (chemical &amp; organic) - Legislation imposing bans and restrictions on use; Introduction of voluntary measures/actions and training; positive impact on soil; No instrument addresses soil protection measures specifically</li> </ul>

## 23 Orup, SE

The study site is located Orup, Sweden. The site is located in in the county Skåne in Southern Sweden. Soil types are clayey (ca. 15% clay or more). This site belongs to the series of long-term field experiments. The main soil threat affecting soil quality in the Orup study site is compaction. The subsoil (below 30 cm) in Orup is highly compacted which limits root penetration and thereby nutrient and water uptake from deeper soil layers.

The site is treated according to conventional agricultural practices of the region which includes ploughing, cultivation, fertilization, manuring, chemical weed and pest treatment applied. Crops are rain-fed and no catch crops to combat Nitrogen leaching are grown. Feld tests of SICS will focus on crop rotation, use of animal manure, no removal of crop residues in non-manured plots, and regular lime application.

### 23.1 Overview of key institutions and policies

Key institutions in the Orup Study site include:

- The Swedish Board of Agriculture;
- The County Administration Boards;
- Länsstyrelsen - county board;
- The Federation of Swedish Farmers.

Policies identified as the most relevant for shaping agricultural practices are either stemming from the EU legislation such as Pesticides Directive or national origin policy/programmes related to sustainable farming and reducing agriculture's impact on the environment.

In terms of policy categories, there is regulatory and economic category together with the information/education category (training courses/advisory services). In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing standards/targets, (2) subsidies in form of CAP instruments and (3) Information campaigns/advisory services

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in the Orup study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having direct impact on farmers.<sup>154</sup>

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<sup>154</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 23.1: Overview of key policies, Orup (SE)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Greppa Näringen	Focus on Nutrients	National	MS	Integrated management, crop sequence, nutrient management	Focus on Nutrients is a joint venture between The Swedish Board of Agriculture, The County Administration Boards, The Federation of Swedish Farmers and a number of companies in the farming business. 'Focus on Nutrients' is the largest single undertaking in Sweden to reduce losses of nutrients from the soil to air and water from livestock and crop production. The project also focuses on the safe use of crop protection products.
	Courses for farmers (cf. Greppa Näringen)	Regional	MS	All	Courses for farmers concerning sustainable agricultural practices
Normer för god jordbrukshävd och goda miljöförhållanden (GAEC)	CAP GAEC Cross-compliance Standards	National	EU	Integrated management, crop sequences, crop rotation	<p>GAEC 4 In Southern Sweden, farmers with at least 5 hectares must keep 50-60% green cover during the winter months.</p> <p>GAEC 5 Green cover required between mid-September and mid-February on arable land with slope greater than 20° and which is both alongside watercourses and within a nitrate vulnerable zone.</p> <p>GAEC 6 No stubble burning, except where winter oilseed is sown without ploughing. This can only be done once in three years.</p> <p>GAEC 7 Terraces, hedges, ditches, trees, stone walls, ponds, ditches and field margins are protected.</p> <p>The government department administering CAP payments monitors compliance with the defined GAEC standards on a small sample of farms each year (the sample size and risk-based selection criteria are defined in EU legislation). On farms where non-compliance is found, part of the CAP payments for that year will be withheld.</p> <p>Theoretically the target is 100% compliance with relevant standards on all farms in receipt of CAP direct payments (and some RDP land management payments), but there is no means of checking this. There is no requirement to monitor environmental improvements.</p>

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Sveriges miljömål	Environmental Quality Objectives	national	EU	Nutrient management	<p>In 1999 and in 2005, the Swedish Parliament adopted 16 Environmental Quality Objectives which today constitute the backbone of the Swedish environmental policy. The Objectives describe the state in which the Swedish environment shall be following implementation of environmental policy. The instrument stipulates that progress towards the 16 Quality Objectives is to be monitored continuously and reported annually by the responsible authority. Progress is measured based on a number of indicators. The latest progress report stresses the need for rural development policy to compensate farmers for maintaining a good environment and stresses that payments under CAP should provide more targeted support/higher levels of compensation for farmers who deliver greater environmental benefits. In order to identify which instruments and measures provide the desired results, monitoring and evaluation of the programs should be improved. The 2015 report recommends that:</p> <ul style="list-style-type: none"> <li>-that requirements for EFAs are streamlined to increase environmental benefits;</li> <li>-a tax is put in place on commercial (non-organic) fertilisers to limit leaking of nutrients and spread of cadmium;</li> <li>-agriculture policy instruments can be improved if instruments were designed to make the polluters more responsible for the environmental damage caused by agriculture.</li> </ul>

## 23.2 Analysis of shortcomings and opportunities

Table 23.2: SICS components addressed by key policies, Orup (SE)

Policies	Cover rotation	Crop sequence	Nutrient management	Pest management	Tillage management	Integrated management	Agroforestry	Landscape management
Environment			X					
Agriculture	X	X	X	X	X	X	X	X
CAP	X	X				X		

Table 23.3: Linking soil problems, appropriate SICS and existing policies, Orup (SE)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Compaction	Tillage management	<ul style="list-style-type: none"> <li>Tillage addressed in Agriculture policy</li> </ul>	<ul style="list-style-type: none"> <li>Agriculture – national origin; includes voluntary instruments such as courses and projects; involves farmers; regional and local scale</li> <li>Dependent on finances; level of success</li> </ul>

## 24 Prague-Ruzyne, CZ

The study site is Ruzyne, Prague. The climate is continental with brown soil (Luvisol). The main soil threats in the Ruzyne study site are identified to be soil compaction; decrease in SOC and deterioration of soil structure; limited water infiltration; erosion; and unexpected weather events (drought, thunderstorms, heavy rains).

The study site hosts long-term experiments including 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. By products (post-harvest residues) are left 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. There is no irrigation on the site.

SICS to be tested in Ruzyne include the practices already put in place on the experimental site, particularly focusing on various tillage trials (conventional, reduced and no tillage), and fertilizer application and testing organic farming.

### 24.1 Overview of key institutions and policies

The key institutions in the Ruzyne Study site were identified as follows:

- The State Agricultural Intervention Fund
- State Veterinary Administration
- Central Institute for Supervising and Testing in Agriculture
- The Czech Environmental Inspectorate
- Ministry of Agriculture
- Ministry of Environment

All policies identified as the most relevant for shaping agricultural practices are either stemming from the EU rural policy (CAP and RDP) and EU legislation (Fertilizers regulation and Nitrates Directive).

In terms of policy categories, the most frequent category is regulatory<sup>155</sup> and economic

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<sup>155</sup> Impose obligations, prohibitions or restrictions and introduces standards.

category together with the information/education category. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans, (2) subsidies in form of CAP instruments and (3) guidance documents.

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Ruzyne study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having direct impact on farmers.<sup>156</sup>

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<sup>156</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 24.1: Overview of key policies, Prague-Ruzyne (CZ)

Policy name		Scale	EU or MS level	Impact on SICS	Description of policy
CAP GAEC Cross-compliance Standards		National	EU	Crop sequences, nutrient management, crop rotation, landscape management, tillage management	Under the cross-compliance standards farmers have to keep a set of rules and conditions for their farming (crop rotations, nutrient management, pest management, livestock management, etc.). Indirectly farmers (and their farming) are affected by different monitoring and inspection systems.
CAP Greening payments requirements 1st Pillar, EFAs		National	EU	Landscape management (terracing), crop rotation, plant cover	Greening requirements are set out in Regulation (EU) 1306/2013 (Chapter 4), and the associated delegated acts, implementing regulations and Commission guidance to Member States.  Ecological Focus Areas (EFAs)- fallow, terraces, catch crops/green cover, afforested areas and short rotation coppice (SRC).
Cross-compliance, PŘÍRUČKA OCHRANY PROTI VODNÍ EROZI	Anti-water erosion Guidance, January 2014	National	EU	Crop sequences, Tillage management, mulching, plant cover, seeding, harvesting	Anti-erosion measures guidance, addressing GAEC 1 and 2 Number of anti-water and anti-wind erosion measures complying with GAEC 2 no-tillage sowing / planting (technology direct seeding in raw land) sowing / planting mulch sowing / planting in shallow stubble, sowing / planting into protecting crop Dimpling plus more specific ones in the document
Předpis č. 156/1998 Sb., Zákon o hnojivech, pomocných půdních látkách, pomocných rostlinných přípravcích a substrátech a o	Act on Fertilizers Use	National	EU	Nutrient management	Under this Act farmers have to keep a set of rules and conditions for storage and application (limits and periods) of different fertilisers (organic and inorganic). Indirectly farmers (and their farming) are affected by different inspection systems for observing of quality and capacity of storage facilities, administrative activities for data recording (checking system-evidence of fertilisers using). The purpose of the Act is to prevent contamination of the soil through ensuring that the use of fertilizers, some treated sewage sludge and ground sediments is applied in compliance with the limits set out in the relevant legislation. This Act implements the COMMISSION REGULATION (EU)

Policy name		Scale	EU or MS level	Impact on SICS	Description of policy
agrochemickém zkoušení zemědělských půd (zákon o hnojivech)					2016/1618 related to fertilizers, Directive 86/278/EEC on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture, and Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources. The Central Institute for Supervising and Testing in Agriculture is responsible for regular (in 6 years intervals) testing of agricultural soils in relation to specific parameters of the soil fertility levels stemming from fertilizers, sewage sludge and sediments use.
Zákon 254/2001 Sb., o vodách a o změně některých zákonů (vodní zákon)	Water Act	National	EU	Crop rotation, nutrient management	In Part V the Act deals with the protection of water status and water sources. The landowners are obliged to ensure the status of the water on their land is not degraded by preventing soil erosion (caused by water) and improving the water retention capacity of the land. The Act, in accordance with soil protection, also defines vulnerable areas according to the Nitrates Directive (91/676/EEC). In implementing this Directive, Government adopts an Action Programme for these types of territories which include the use and storing of fertilizers, changing of crops and anti-erosion measures. In addition, the Water Act prohibits soil contamination when handling hazardous substances and an obligation to ensure these substances do not leak into waste or rain water. In accordance with the implementation of the Nitrates Directive, two types of measures are defined: 1) responsibilities in the Action Programme - only in vulnerable zones (eg. use of fertilizers, manure storage, changing of crops and anti-erosion measures- § 33), 2) codes of good agricultural practice - over the total area of the MS.
Předpis č. 262/2012 Sb., Nařízení vlády o stanovení zranitelných oblastí a akčním programu	Order Concerning the Establishment of Vulnerable Zones and Action Plan	National	EU	Nutrient management, crop rotation, Landscape management (terracing),	This Order transposes the Nitrates Directive and creates vulnerable zones and the Action Plan applicable to these zones. The Order sets the time periods during which the use of fertilizers containing nitrates on vulnerable zones is not allowed (§ 6). It also sets the maximum usage of nitrates in the soil per year (170 kg N/ha). § 10 prescribes that in order to limit the soil erosion and loss of organic matter, the period of no crops has to be eliminated and requires the farmer to change crops periodically. It also prohibits growing certain crops on the soil that is highly prone to erosion and limits the use of nitrates on these soils (§ 11).

Policy name		Scale	EU or MS level	Impact on SICS	Description of policy
Zákon 223/2015 Sb., kterým se mění zákon č. 185/2001 Sb., o odpadech a o změně některých dalších zákonů	Waste Act	National	EU	Nutrient management	In relation to soil, §33 deals with the obligations concerning the use of sewage sludge from waste water treatment facilities. It states that a person is only allowed to use treated sewage sludge which does not worsen the quality of soil and quality of underground and ground waters. The Act also spells out certain types of soils where the use of sewage sludge is forbidden e.g. on the agricultural land which is part of the protected area . Ministry of Environment together with the Ministry of Agriculture set, inter alia, legally binding limits for hazardous substances in the soil, sewage sludge and technical conditions for the use of sludge in the soil. This Act is supplemented by the Regulation No. 382/2001 Coll. of the Ministry of Environment which provides details on the application of treated sewage sludge into the soil (technical conditions, threshold values, analysis methods).

## 24.2 Analysis of shortcomings and opportunities

Table 24.2: SICS components addressed by key policies, Prague-Ruzyne (CZ)

Policies	Cover crops	Crop rotation	Mulching	Nutrient management	Tillage management	Landscape management
PPP and nutrient policy (chemical & organic)		X		X		X
Water policy		X		X		
Waste policy				X		
CAP	X	X	X	X	X	X

Table 24.3: Linking soil problems, appropriate SICS and existing policies, Prague-Ruzyne (CZ)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Erosion	Tillage/landscape/cover crop	<ul style="list-style-type: none"> <li>• Tillage - Addressed in CAP</li> <li>• Landscape management – addressed in PPP and nutrient policy and CAP</li> <li>• Cover crops - CAP</li> </ul>	<ul style="list-style-type: none"> <li>• CAP – highly influential; based on subsidies, enforcement issue</li> <li>• PPP and nutrient policy - bans and targets/regulatory category; EU-based</li> </ul>
Low SOM	Pest management/nutrient management/cover crops/mulching	<ul style="list-style-type: none"> <li>• Nutrient management - addressed in PPP and nutrient policy, water, waste policy and CAP</li> <li>• Cover crops- addressed in CAP</li> <li>• Mulching- addressed in CAP</li> </ul>	<ul style="list-style-type: none"> <li>• CAP – highly influential; based on subsidies, enforcement issue</li> <li>• PPP and nutrient policy - bans and targets/regulatory category; EU-based</li> <li>• Water policy- regulatory and also guidance instruments; direct impact on soil, MS and EU level</li> <li>• Waste policy – regulatory category; bans; direct impact on soil</li> </ul>
Soil compaction	Tillage management/machine use	<ul style="list-style-type: none"> <li>• Tillage management - addressed in CAP</li> </ul>	<ul style="list-style-type: none"> <li>• CAP – highly influential; based on subsidies, enforcement issue</li> </ul>

## 25 Almeria, ES

The study site is located in Almeria, Spain. There are two areas covered - Area A is located in the Sorbas-Tabernas Basin. The climate here is semiarid thermo-Mediterranean with an average annual temperature of 17.8 C and an average annual rainfall of 235 mm, which is among the driest areas in Europe. Area B is located in the Cabo de Gata Natural Park. Here the climate is semiarid warm Mediterranean. The mean annual temperature oscillates around 18-19C, and frosts are sporadic, occurring only on isolated days. Mean annual rainfall is approximately 220 mm per year, with prolonged summer droughts. 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.

High content of salts of Tabernas area soil is a common cause of yield reduction. Excessive nitrogen fertilization contributes to this problem, increasing also the sensitivity to pests and diseases and crop costs. Scarce water resources and applicable laws due to the protection of the environment in orchards sited in the Natural Park Cabo de Gata-Nijar might reduce yield and increase costs for stone fruit trees. Excessive watering has been occasionally linked to damages caused by soil fungus (Phytophthora in this case). Excessive nitrogen application also leads to higher damages caused by soil and airborne fungi. An adequate control of nitrogen level avoids some yield losses and improves fruit quality and enhances postharvest. High soil compaction can also be a problem and is commonly resolved by owners by tillage.

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 nitrogen (several applications per year) and potassium. Conventional or chemical control of pest and diseases is normally used. Area A - conventional and also some organic olive orchards with a tree density labelled as intensive for this crop are present on the site. 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). 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.

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. This is also being tested on the site.

### 25.1 Overview of key institutions and policies

The key institutions in the Almeria Study site

- Ministry of Agriculture, Fisheries, Nutrition and Environment (Ministerio de Agricultura y Pesca, Alimentación y Medio Ambiente)

- Advisory body of Agriculture and Fisheries (Consejería de Agricultura y Pesca)
- Advisory body of the Environment (Consejería de Medio Ambiente)
- Ministry of Presidency (Ministerio de la Presidencia)
- Ministry of Education and Science (Ministerio de Educación y Ciencia)
- Ministry of Environment (Ministerio de Medio Ambiente)
- Advisory body of the Environment and territorial planning (Consejería de Medio Ambiente y Ordenación del Territorio)

The vast majority of policies identified as the most relevant for shaping agricultural practices are the ones which transposed various EU Directives – namely Water Framework Directive, Nitrates Directive, Groundwater Directive, Pesticides Directive, Sewage Sludge Directive, Habitats and Birds Directive. In addition, both voluntary and compulsory CAP instruments together with the national laws reflecting Fertilizer and Organic Regulation have high relevance for impacting agricultural practices in Spain and the study site. With regards to legislation and policy stemming from national initiatives, there are two instruments identified as highly relevant - National Action Programme to Combat Desertification from August 2008 and III Andalusian Plan of Ecological Production Horizon 2020 from March 2016.

In terms of policy categories, the most frequent category is regulatory in addition to CAP implementing instruments which fall within the economic category and lastly planning instruments, which are represented by the National Action Programme to Combat Desertification and Andalusian Plan of Ecological Production. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans and/or targets, (2) subsidies in form of CAP instruments and, (3) action plans.

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Spain and/or Almeria study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having direct impact on farmers.<sup>157</sup>

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<sup>157</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 25.1: Overview of key policies, Almeria (ES)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Buenas condiciones agrarias y medioambientales de la tierra (BCAM)	CAP GAEC Cross-compliance Standards	National	EU	Plant cover, landscape management, tillage management,	'Cross compliance' is a set of rules which farmers and land managers must follow on their holding if they are claiming rural payments. The GAEC standards relevant for soil protection in Spain were No. 4,5,6 and 7: GAEC 4 prohibits a non-irrigated arable land on which winter crops are grown to be ploughed before 1 September. In addition, green cover at least 1m wide required for permanent crops grown on slopes greater than 15°. GAEC 5 restricts ploughing on certain slopes. GAEC 6 bans stubble burning. GAEC 7 requires that terraces, hedges, ditches, ponds, trees, field margins and stone walls are protected.
	CAP Greening payments requirements	National	EU	Agroforestry, fallow, plant cover, tillage management	Greening requirements were first introduced in 2015 and apply to direct payments under Pillar 1 of the CAP, although it is mainly arable farmers who will be affected. The list of EFA elements which Spanish farmers can choose from includes three of the seven elements that can protect soils and soil carbon: fallow, agroforestry and afforested areas.
Programa Nacional de Desarrollo Rural	CAP Rural Development Programme 2014 - 2020	National	EU	Tillage management, management techniques, crop sequences	Within the National Rural development programme of Spain, soil is not the primary focus; Priority 5E Carbon conservation / sequestration was not activated. However, FA 4C Soil erosion and management is activated with 1 000 hectares benefiting from forest fire restoration actions.
Real Decreto 1075/2014, de 19 de diciembre, sobre la aplicación a partir de 2015 de los pagos directos a la agricultura y a la ganadería y otros regímenes de ayuda, así como sobre la gestión y control de los pagos directos y de los	Royal Decree 1075/2014 of 19 December on the application of 2015 of direct payments to agriculture and livestock and other schemes assistance, as well as on the management and	national	EU	All	The purpose of this Royal Decree is to establish the basic regulations applicable for the period 2015-2020 to the Community aid schemes established in Regulation (EU) No. 1307/2013 of the European Parliament and of the Council of 17 December 2013, Regulations (EC) No. 637/2008 and have been approved by the Common Agricultural Regulations.

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
pagos al desarrollo rural.	control of direct payments and payments to rural development.				
Orden de 12 de marzo de 2015, por la que se establecen en la Comunidad Autónoma de Andalucía normas sobre la presentación de la solicitud única y de la solicitud de asignación de derechos de pago básico a partir del año 2015, así como disposiciones de aplicación a los pagos directos a la agricultura y a la ganadería, y a las ayudas del programa de desarrollo rural de Andalucía objeto de inclusión en la solicitud única.	Order of 12 March 2015, which establishes in the Autonomous Community of Andalusia rules on the submission of the single application and the request for the allocation of basic payment entitlements from 2015, as well as implementing provisions to direct payments to agriculture and livestock, and aid from the Andalusian rural development program to be included in the single application.	Regional	EU	All	The purpose of this Order is to establish the procedure for the presentation of the single grant application, the application for admission to the basic payment system, as well as to establish the procedure for the management of assignments and requests concerning the national reserve of basic payment rights.
REAL DECRETO 1852/93, de 22 de octubre, sobre producción agrícola ecológica y su indicación en los productos agrarios y alimenticios.	ROYAL DECREE 1852/93, of 22 October, on agricultural production and its indication in agricultural products and foodstuffs.	National	EU	Integrated management; crop rotation; restriction chemical inputs, tillage practices	It regulates the requirements assigned to organic products, creates a higher advisory body, the "Organic Agriculture Regulatory Commission", and establishes the mechanisms for the application of certain aspects of Regulation (EEC) 2092/91.
Decreto 166/2003 de 17 de junio, sobre la producción agroalimentaria ecológica en Andalucía.	Decree 166/2003 of 17 June, on organic agro-food production in Andalusia.	Regional	EU	Integrated management; crop rotation; restriction	The purpose of the Decree is to determine the legal regime applicable to agri-food products of Andalusian origin that may use standards referring to the method of organic production; the designation of the competent authority for the purposes set out in Articles 8 and 9 of Regulation (EEC) No. 2092/91 of the Council of 24

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
				chemical inputs, tillage practices	June 1991 on organic agricultural production , and in article 5 of Royal Decree 1852/1993, of October 22, on organic agricultural production and its requirements in agricultural and food products; the creation of the Andalusian Council of Ecological Production as a consultative and advisory body on ecological agri-food production; and the establishment of the authorization regime of private control agencies.
LEY 62/2003, de 30 de diciembre, de medidas fiscales, administrativas y del orden social.	LAW 62/2003, of 30 December, of measures fiscal, administrative and social order.	National	EU	Nutrient management; Irrigation; Drainage management; Pest management; Landscape management	It modifies the Law concerning the fiscal regime of cooperatives in relation to the organizations of producers in the sectors of fruit and vegetables and of fatty matters and incorporates the regulation of the applicable fiscal benefits in relation to the «XV Mediterranean Games. Almería 2005 ».
Real Decreto 261/1996, de 16 de febrero, sobre protección de las aguas contra la contaminación producida por los nitratos procedentes de fuentes agrarias	Royal Decree 261/1996 protecting waters from the pollution by nitrates derived of agricultural sources	National	EU	Nutrient management, crop rotations, crop sequences	The Royal Decree 261/1996 implements Directive 91/676/EEC (Nitrates Directive), and establishes definitions, actions and minimum requirements for the activities to be implemented by the Autonomous Communities (CC.AA.). The CC.AA. are responsible for defining good practice codes for all farmers (voluntary uptake), and programmes of measures for Nitrate Vulnerable Zones that include the good practice measures as well as a series of further measures obligatory in character. The CC.AA. can also go beyond these minimum requirements. In relation to soil protection, measures related to nitrate regulations in Spain may contribute to reducing soil pollution (e.g. by limiting the periods and amounts of manure and fertilisers allowed for application) and soil structure and erosion (e.g. buffer strips along watercourses, winter cover crops, management of crop residues).
Orden de 1 de junio de 2015, por la que se aprueba el programa de actuación	Order of 1 June 2015, approving the action program applicable in	Regional	EU	Nutrient management, crop	The purpose of this Order is the approval of the Action Program in areas vulnerable to contamination by nitrates from agricultural and

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
aplicable en las zonas vulnerables a la contaminación por nitratos procedentes de fuentes agrarias designadas en Andalucía.	areas vulnerable to nitrate pollution from designated agricultural sources in Andalusia.			rotations, crop sequences	livestock sources designated in Andalusia, which is contained in Annexes I and II of this Order.
Real Decreto 1075/2015, de 27 de noviembre, por el que se modifica el anexo II del Real Decreto 1514/2009, de 2 de octubre, por el que se regula la protección de las aguas subterráneas contra la contaminación y el deterioro.	Royal Decree 1075/2015 of 27 November, amending Annex II of Royal Decree 1514/2009 of 2 October, which regulates the protection of groundwater against pollution and deterioration.	National	EU	Nutrient management; Pest management	This Royal Decree modifies Royal Decree 1514/2009, of October 2, which regulates the protection of groundwater against pollution and deterioration; which in turn transposes into Spanish law the Directive 2006/118 / EC of the European Parliament and of the Council of 12 December 2006 on the protection of groundwater against pollution and deterioration.
Ley 9/2010, de 30 de julio, de Aguas para Andalucía.	Law 9/2010, of July 30, on Waters for Andalusia.	Regional	EU	Nutrient management; Pest management	This Law establishes principles and environmental objectives with a focus to establish policies not based solely on the treatment of water as an exclusive economic resource which have proven to have clear limitations and even contrary impact on the environmental conservation.
REAL DECRETO 1310/1990, de 29 de octubre, por el que se regula la utilización de los lodos de depuración en el sector agrario	Decree Regulating the Use of Sewage Sludge in the Agricultural Sector	National	EU	Nutrient management	The Decree transposes Council Directive 86/278/EEC (on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture). Its main objective is to regulate the application of sewage sludge on agricultural soil with regards to heavy metals (Cadmium, Copper, Nickel, Lead, Zinc, Mercury, Chrome). To this aim, the Decree establishes reporting requirements for the buying and selling of sewage sludge, which include quantity, use of sludge, composition (incl. heavy metal analyses) and characteristics, type of treatment in sewage treatment plant, areas where sludge will be used. It establishes national sludge registry.
Decreto 73/2012, de 22 de marzo, por el que se aprueba el	Decree 73/2012 of 22 March, which approves	Regional	EU	Nutrient management	The content of this Decree harmonizes the regulatory development foreseen in Law 7/2007, of July 9, with the context defined by the liberalization of services promoted by Law 17/2009, of November 23,

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Reglamento de Residuos de Andalucía.	the Waste Regulations of Andalusia.				on the free access of the activities of services and their exercise. At the same time, it implies an adaptation to the waste management policies developed by the specific regulations, applying an effective and coherent regulation that takes into account, not only the waste phase, but also the life cycle of the materials and products.
Real Decreto 1311/2012, de 14 de septiembre, por el que se establece el marco de actuación para conseguir un uso sostenible de los productos fitosanitarios	The Royal Decree 1311/2012 establishing the framework of action to achieve a sustainable use of fitosanitary products	National	EU	Integrated pest management	The Royal Decree 1311/2012 establishing the framework of action to achieve a sustainable use of phytosanitary products establishes the details of the National Action Plan for sustainable use of plant protection products. It uses a combination of different approaches to this purpose, inter alia fostering integrated pest management approaches (often non-chemical), increasing training/educational requirements for users applying plant protection products so that if options are available less toxic products are used, restrictions of application (buffer strips where no pesticides should be applied). In this multi-faceted approach, the overall aim is to reduce impacts on human health and the environment; whereas Chapter VII specifically addresses water, there are no specific provisions addressing soil. However, the overall approach of supporting integrated pest management, reducing unnecessary or excessive use through e.g. training, and the focus on less toxic products have positive impacts on soil pollution and on soil biodiversity.
Decreto 96/2016, de 3 de mayo, por el que se regula la prevención y lucha contra plagas, el uso sostenible de productos fitosanitarios, la inspección de equipos para su aplicación y se crea el censo de equipos de aplicación de productos fitosanitarios.	Decree 96/2016, of 3 May, which regulates the prevention and control of pests, the sustainable use of plant protection products, the inspection of equipment for its application and the creation of a census of equipment for the	Regional	EU	Integrated pest management	This Decree establishes, for the Autonomous Community of Andalusia, the regulatory framework for the application concerning phytosanitary products.

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
	application of phytosanitary products.				
Real Decreto 535/2017, de 26 de mayo, por el que se modifica el Real Decreto 506/2013, de 28 de junio, sobre productos fertilizantes.	Royal Decree 535/2017, of May 26, by which modifies the Royal Decree 506/2013, of June 28, on fertilizer products.	National	EU	Nutrient management	This Royal Decree modifies Royal Decree 506/2013, of June 28, on fertilizer products, which deals with the use of waste in the manufacture of fertilizer products and establishes the need to have the "corresponding authorization from the environmental authority".
Ley 42/2007, de 13 de diciembre, del Patrimonio Natural y de la Biodiversidad	Law of Natural Heritage and Biodiversity, Ley 42/2007	National	EU	Nutrient management, pest management, irrigation and drainage management, integrated landscape management	Law 42/2007 establishes the legal framework for protected areas of different types in Spain. The link with soil is only marginal: only in these protected areas can positive impacts on soil be expected. Article 77 states that the Spanish Autonomous Communities will develop and implement mechanisms to ensure positive environmental externalities from these protected areas, including soil conservation and the hydrologic regime as a means to combat desertification. The protection of natural heritage and of biodiversity in these areas will lead to improved soil protection and restoration activities in these areas. In general, activities associated with nature protection in the areas protected by this law will have positive impacts for soil purposes in these areas, for instance through measures such as reforestation of native species. The law transposes Habitats Directive which also applies to agricultural areas and so certain activities might not be allowed there.

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Programa de Acción Nacional contra la Desertificación	National Action Programme to Combat Desertification, August 2008	National	MS	Crop rotation, plant cover, pest management, nutrient management, landscape management, tillage management, machine management	The NAP to Combat Desertification is a cross-cutting instrument which evaluates the performance of different sectors (agriculture, forestry, water resources management), but whose actions are mainly restricted to information and demonstration projects. It creates an integrated system of evaluation and vigilance (monitoring) of desertification in Spain, Network of demonstration projects for restoration and sustainable management of areas affected by desertification.
III Plan Andaluz de la Producción Ecológica Horizonte 2020	III Andalusian Plan of Ecological Production Horizon 2020	Regional	MS	Crop rotation, plant cover, pest management, nutrient management, landscape management, tillage management, machine management	This Plan aims to consolidate the growth of organic production in Andalusia, maintaining it as a reference in the European field, as well as improving the competitiveness of farms and industries and promoting the consumption of organic food at home, as well as the presence of companies in international markets. It also strengthens the control system to attend to a growing production, so that the necessary trust and protection of the consumer population can be maintained.

## 25.2 Analysis of shortcomings and opportunities

Table 25.2: SICS components addressed by key policies, Almeria (ES)

Policies	Cover crops	Crop rotation management	Crop Sequences	Irrigation/drainage	Nutrient management	Pest management	Tillage management	Machine management	Agroforestry	Landscape management
Water protection policy				X	X	X				X
PPP and nutrient policy (chemical & organic)		X	X		X	X				
Agriculture (organic production)	X	X			X	X	X	X		X
Nature protection										
CAP	X		X				X		X	X
Cross-cutting (agri/forestry/water)	X	X		X	X	X	X	X		X

Table 25.3: Linking soil problems, appropriate SICS and existing policies, Almeria (ES)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Excessive nitrogen fertilization	Nutrient management	<ul style="list-style-type: none"> <li>Addressed in - Water protection policy, PPP and nutrient policy (chemical &amp; organic), agriculture and cross-cutting policy</li> </ul>	<ul style="list-style-type: none"> <li>Water protection policy - includes both national and regional regulatory instruments; regulatory category only</li> </ul>

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
			<ul style="list-style-type: none"> <li>• PPP and nutrient policy (chemical &amp; organic)- Legislation imposing bans and restrictions on use;</li> <li>• Introduction of voluntary measures/actions and training – positive impact on soil</li> <li>• Agriculture policy - Various types of instruments – legislation and action plans;</li> <li>• Positive perception of farmers</li> <li>• cross-cutting - Addresses many SICS; Weaker type of instrument – national action programme</li> </ul>
High soil compaction	Machine management /tillage management	<ul style="list-style-type: none"> <li>• Addressed in agriculture policy and CAP, cross-cutting policy</li> </ul>	<ul style="list-style-type: none"> <li>• Agriculture policy - Various types of instruments – legislation and action plans;</li> <li>• Positive perception of farmers</li> <li>• cross-cutting - Addresses many SICS; Weaker type of instrument – national action programme</li> <li>• CAP - Highly influential;</li> <li>• Positive perception of farmers</li> </ul>
Scarce water resources	Irrigation/drainage	<ul style="list-style-type: none"> <li>• Addressed in water and cross-cutting policy</li> </ul>	<ul style="list-style-type: none"> <li>• Water protection policy - includes both national and regional regulatory instruments; regulatory category only</li> <li>• cross-cutting - Addresses many SICS; Weaker type of instrument – national action programme</li> </ul>

## 26 Brittany, FR

The study site is located in Brittany, France and includes two catchment areas - Semnon catchment area and Oust-Ninian catchment areas. The main soil threats affecting soil quality in the study site region were identified as compaction; weed; and soil fertility.

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. The following SICS are currently used in both catchment areas and will be further tested in the field experiments:

- biological pest management,
- green manure,
- organic fertilizers

### 26.1 Overview of key institutions and policies

Key Institutions shaping agricultural practices in Brittany include the

- Ministère de l'agriculture (Ministry of Agriculture)
- regional scale: DRAAF, department scale: DDTM
- Conseil Régional de Bretagne (Regional Council of Brittany)

The most relevant policies for shaping agricultural practices in Brittany stem either from the EU Directives and CAP or national/regional legislation and funding with direct impact on soil protection (Law for the Future of Agriculture, Food and Forests, Investment support to farms). In terms of policy categories, the most frequent category is regulatory as seen in the table below. In terms of type of instruments, the following types were identified as the most frequent ones: (1) national legislation imposing bans/targets and (2) national legislation based on payments to farmers

The table below provides an overview of policies which were identified as most relevant for shaping the agricultural practices in Brittany study site. The table makes a distinction between national and regional scale policies, identifies the impact on various SICS and briefly describes each policy. All policies in the table below were identified as having direct impact on farmers.<sup>158</sup>

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<sup>158</sup> The full policy inventory is available at: <https://www.soilcare-project.eu/outputs>

Table 26.1: Overview of key policies, Brittany (FR)

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
Normes relatives aux bonnes conditions agricoles et environnementales des terres (BCAE)	CAP GAEC Cross-compliance Standards (Normes relatives aux bonnes conditions agricoles et environnementales des terres (BCAE))	National	EU	Cover crops; residue management; irrigation; nutrient management; tillage management; drainage management; landscape management	GAECs set out conditions for receipt of Direct Payments (CAP). The cross-compliance standards implement the EU wide standards. The standards relevant to cropping systems are: GAEC 1 - buffer strips, GAEC 2- Irrigation, GAEC 3 - groundwater protection, GAEC 4 - soil cover, GAEC 5 - erosion control, GAEC 6 - non-burning of crop residues, and GAEC 7 - maintenance of topographical features
	CAP Greening Payment Requirements	National	EU	Cover crops; agroforestry; buffer strips; landscape management	EFA elements which French farmers can choose from: all seven elements that can protect soils and soil carbon: fallow, terraces, buffer strips, catch crops/green cover, agroforestry, afforested areas and short rotation coppice (SRC). Covers EFAs and ESPGs (environmentally sensitive permanent grassland) France has designated 1,111,000ha of environmentally sensitive permanent grassland (ESPG) within Natura 2000 areas and but has not designated any ESPG elsewhere. Farmers are not allowed to plough or convert this grassland.
Code rural et de la pêche maritime	Rural and Marine Fishing Code	National	EU/MS	Nutrient management; pest management; weed control; cover crops; tillage management; residue management; irrigation; mulching; crop rotations/diversification; drainage management; landscape management	With regards to soils, a broad range of mechanisms are included which cover a variety of activities and agricultural practices. Most of them are the result of European Directives, regulations and policies. Since 2006, an important feature in this area is the possibility for a certain category of land owners to impose environmental practices when they sign a rural lease with the farmer (art. L. 411-27). Among the list of practices (16), the majority has a direct or an indirect impact on soil (art. R. 411-9-11-1).

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					<p>The agronomic value of soils is regularly evaluated, controlled and sanctioned in case of a reduced value due to bad practices (see articles L. 411-1 and following of the Rural Code).</p> <p>On the aspect of governance, soil can benefit from the creation of “pastoral land associations” which can set their own targets and regulations for local land. This is especially important for agricultural soils, which can target of preservation and remediation by these groups. Furthermore, many of the articles which make up the Rural Code are in line with other pieces of French legislation, such as the Environmental Code and the Land Planning Code. These cover issues related to erosion, contamination, as well as impact assessments.</p> <p>At last, the whole regime of the label “Appellation d’origine contrôlée” (designation of origin) gives a particular attention to soil in a sense that some products can’t be certified if the quality of the soil and the area of production is not in accordance with the local “savoir faire” (art. L. 641-5 and follow). It is particularly true for wine production. For example, agriculture “hors sol” (with no direct connection with soil) is automatically excluded from this type of quality label.</p> <p>Soil protection measures: Protection of agricultural soil from modification; protection of soil quality from diffuse source contamination; recognition of certain agricultural soils as having pastoral or intrinsic value; erosion control measures; consideration of soil quality in lease agreements; regulations on flooded agricultural land; regulations related to local land use planning documents.</p>

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					Implements EU legislation: CAP cross compliance; CAP direct payments; CAP rural development programme. Also incorporates national initiatives.
MAE Systèmes Polyculture Elevage (Plan de Développement Régional - FEADER)	GAEC mixed farming systems / polyculture systems (in Regional Development Strategy - FEADER)	Regional	EU	Crop rotations; Nutrient management; Weed control	The more farmers reduce maize in crop rotation, the more subsidies they get. Each level = one maize surface maximum. Farmers can choose "evolution" level or "maintaining" level.
MAE CAB - MAB (Plan de Développement Régional - FEADER)	GAEC Organic Farming (in Regional Development Strategy - FEADER)	Regional	EU	Intercropping (two or more crops in the same field) or strip-till (used in the CZ as anti-erosion GAEC 5 measure); Mixed crops; Crop rotations; Nutrient management; Pest management; Weed control	Subsidy that aims at supporting farmers who want to convert their practices in order to get the organic certification. The subsidy is linked to the surface of each field and depends on the crop. The objectives of the policy: increase water quality and soils quality (through getting rid of chemical farm inputs and limiting other types of farm inputs); maintain the soil organic matter content; respect the ecological balances; increase animal welfare. Beneficiaries: farms which convert or maintain one or several plots to organic agriculture practices and certification.
Règlementation sur les Nitrates	Nitrates Regulations	National	EU	Nutrient management; buffer strips; cover crops; crop residues; tillage management	Implements the Nitrates Directive. Regulates nitrate use on agricultural land, including 8 measures to be implemented in Nitrate Vulnerable Zones, regional action plans that reinforce these 8 national measures and establish specific requirements and a regional expert group on nitrates which establishes any necessary technical references. Measures related to nitrate regulations in France may contribute to reducing soil pollution (i.e. timing and amount allowed for the application of manure and fertilisers) and soil structure and erosion (i.e. buffer strips along watercourses, winter cover crops, management of crop residues). Additional measures that are proposed for regional action which can have benefits for soil protection plans include better soil management (i.e. modification of

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
					<p>ploughing of grasslands) and the obligation at farm level to export or treat nitrogen from manure. A monitoring program of nitrogen application is established in Nitrate Vulnerable Zones.</p> <p>Soil protection measures at national level: Timing and amount allowed for the application of manure and fertilisers; Buffer strips along watercourses; Winter cover crops; Management of crop residues; A monitoring program of nitrogen application</p> <p>Soil protection measures at regional level: Modification of ploughing of grasslands; Obligation at farm level to export or treat nitrogen from manure</p>
Loi d'avenir pour l'agriculture, l'alimentation et la forêt	Law for the Future of Agriculture, Food and Forests	National	MS	Pest management	<p>Modifies elements of the rural and environmental codes and is an update to the 2006 agricultural laws. With regard to soils, a number of relevant measures can be found. Firstly, there is an article which allows the option to include environmental clauses in leases between individuals. For example, a lease agreement could include clauses relating to the maintenance of the soil quality of the land. Furthermore, the law allows the creation of "groupements d'interet économique et environnemental" (GIEEs) which are economic and environmental interest groups. These can allow groups of farmers to collectively engage in agro-ecological practices. Additionally, there was some restructuring of regional farming schemes in order to ensure that both the economic and environmental impacts of newly authorized farms would be taken into account. Finally, there is a clause to monitor the impact of pesticides on a number of areas, including soils.</p>
Aides aux investissements	Investment supports for farms	Regional	MS	Nutrient, pest management, weed control, mulching,	<p>Subsidies given to support certain types of investment on farms (modernisation of farm buildings, energy savings on the farm, grass management orientated machines, pesticides</p>

Policy name	English translation	Scale	EU or MS level	Impact on SICS	Description of policy
matériels dans les exploitations agricoles				machine and traffic management	saving orientated machines). Base subsidy + bonus subsidies depending on some of the farm characteristics or features.
PLU (Plan Local d'Urbanisme) / SCOT (Schéma de Cohérence Territoriale)	SCOT: Territorial coherence scheme PLU Local Urbanism Plan	Sub-regional/Local	MS	Landscape management	<p>SCoT is the main tool for conception and implementation of an inter-communal strategic planification, in a wide living area or an urban area, as part of a planning and sustainable development project (PADD).</p> <p>SCoT aims at being used as reference framework for the different sector policies, more particularly the ones focused on urbanism and land use, housing, mobility, commercial development, environment. SCoT guarantees the coherence of these policies and the coherence of the different inter-communal sector documents: Inter-communal Local Urbanism Plans (PLUi) and communal Local Urbanism Plans (PLU), Local Housing programs (PLH), Urban mobility Plans (PDU) and all the maps designed at communal scale.</p> <p>SCoT should respect sustainable development principles: good balance between urban renewal, controlled urban development, rural areas development and natural areas and landscapes conservation; principle of diversity in urban functions and social diversity; respect of environment</p>

## 26.2 Analysis of shortcomings and opportunities

Table 26.2: SICS components addressed by key policies, Brittany (FR)

Policies	Cover crop	Crop rotation	Nutrient management	Pest management	Tillage management	Mulching	Machine management	Landscape management	Drainage	Agroforestry
CAP	X	X	X	X	X			X	X	
Agriculture policy	X	X	X	X	X	X	X	X	X	
PPP and nutrient policy (chemical & organic)	X		X	X	X					

Table 26.3: Linking soil problems, appropriate SICS and existing policies, Brittany (FR)

Soil problem	Appropriate SICS to address problems	Policy addressing SICS	Assessment of current policy framework
Compaction	<ul style="list-style-type: none"> <li>Tillage/machine management/landscape</li> </ul>	<ul style="list-style-type: none"> <li>Tillage addressed in all policies</li> <li>Machine management addressed in agriculture policy</li> <li>Landscape addressed in CAP and agriculture policy</li> </ul>	<ul style="list-style-type: none"> <li>CAP – regulatory category; EU based; subsidy based; high impact; direct impact on soil health</li> <li>Agriculture policy – direct impact on soil; EU and MS based; national subsidies to support soil health (SICS); regulatory category</li> <li>PPP and nutrient policy - regulatory category; bans; direct impact on soil health</li> </ul>
Soil fertility	<ul style="list-style-type: none"> <li>Nutrient/pest management/cover crops/mulching</li> </ul>	<ul style="list-style-type: none"> <li>Nutrient/pest management/cover crops in all</li> <li>Mulching addressed in agriculture policy</li> </ul>	<ul style="list-style-type: none"> <li>CAP – regulatory category; EU based; subsidy based; high impact; direct impact on soil health</li> <li>Agriculture policy – direct impact on soil; EU and MS based; national subsidies to support soil health (SICS); regulatory category</li> <li>PPP and nutrient policy - regulatory category; bans; direct impact on soil health</li> </ul>
Weed control	<ul style="list-style-type: none"> <li>Pest management</li> </ul>	<ul style="list-style-type: none"> <li>Pest management addressed in all</li> </ul>	As above

## 27 Synthesis of the country-level policy analysis

This section provides an overview of various attributes related to policies promoting SICS in the 16 study site countries. The intention was to characterise the assessed policies using the following attributes:

- European vs. MS-initiated policies
- Proportion of study sites with soil protection legislation
- Types of instruments: planning, economic etc.
- SICS most frequently addressed in policies
- Policy categories promoting SICS
- Type of instruments promoting SICS in 16 Study sites
- Policies addressing largest number of SICS

Figure 27.1 shows that the majority of policies which promote various SICS stem from the EU legislation (Directives/regulation). This included mainly nationally transposed directives such as WFD, SUPD, ND, FD and implementing instruments of CAP on national level. A significantly smaller proportion of SICS relevant instruments is based on legislation stemming from a national initiative. As highlighted further below, only a few MS have a designated soil protection laws and there is only a small number of MS-originating policies.

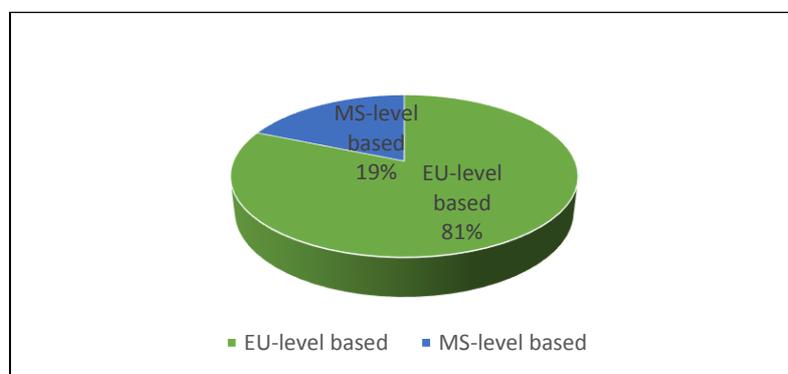


Figure 27.1: Share of EU-based and MS-specific policies in 16 study site countries

The next figure details the proportion of EU-origin v MS-origin of SICS relevant policies in each study site country individually.

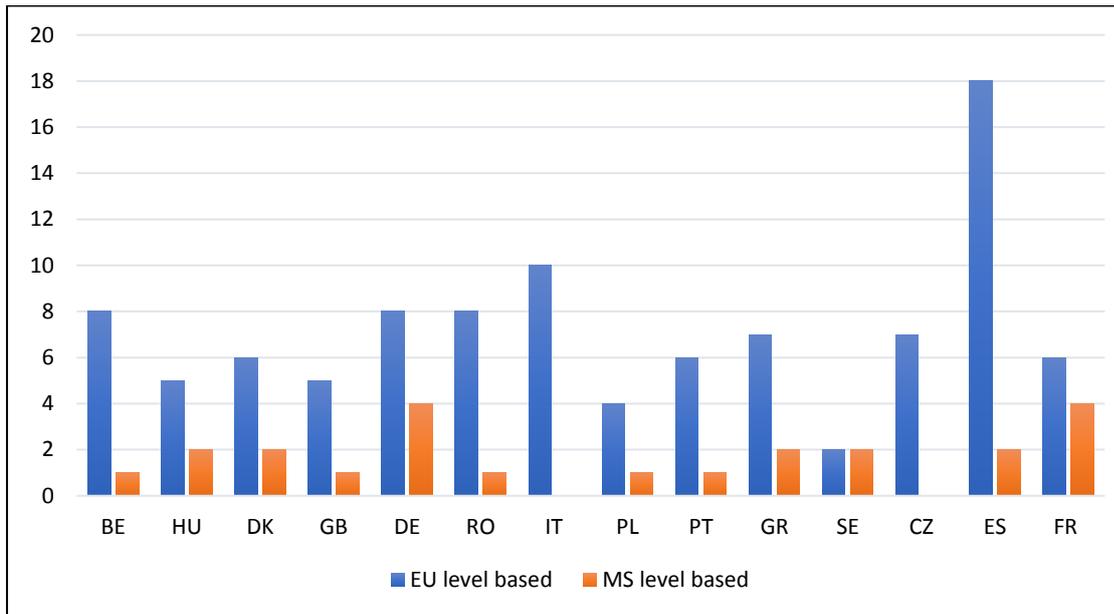


Figure 27.2: Share of EU-based and MS-specific policies in 16 study site countries broken down by country

Figure 27.3 details the proportion of study site countries with specific soil protection legislation in place. As can be seen, this includes only four countries: Hungary, Switzerland, Norway and Germany. In Hungary, these are two prominent pieces of soil-protection legislation namely a Ministerial Decree on Preparation of Soil Protection Plan and Act on the Protection of Cultivated Soil. Similarly, in Switzerland there is a Soil Damage Ordinance which promotes protection of soils, setting standards and introduces financial penalties for non-compliance. In Norway, the Government adopted a National Soil Protection Strategy which has provided for a conservation strategy aiming to ensure that the annual reassignment of fertile soil does not exceed 4000 hectares by 2020. In Germany, there is a regional Soil Protection Act for Baden-Wuerttemberg addressing vast number of SICS with direct impact on farming practices in the region.

However, the vast majority of countries lacks a specific legislative or policy instrument which would have soil protection as its primary objective. Soil protection as a direct/indirect objective is in these cases mainly covered by different policy instruments in the area of agriculture, water, nutrient or environmental policies.

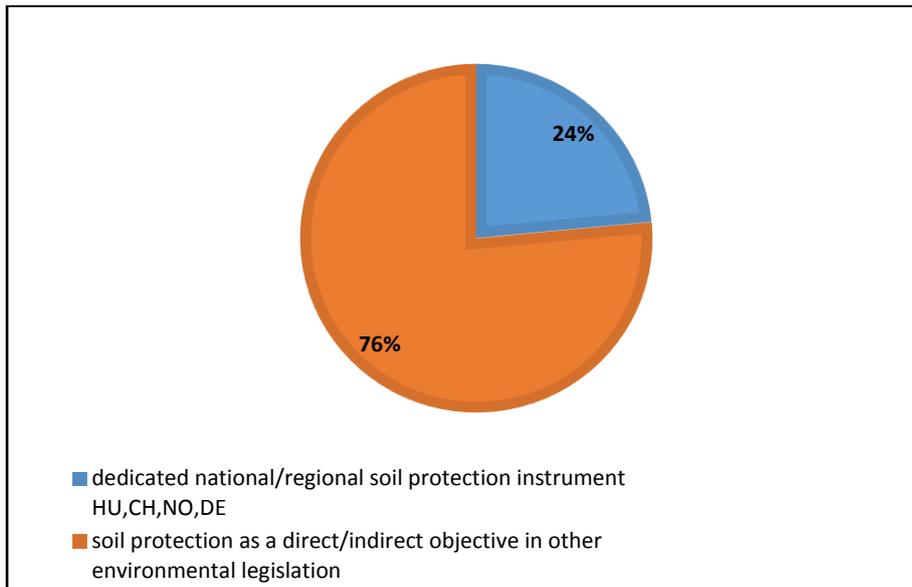


Figure 27.3: Proportion of study sites with soil protection legislation

Figure 27.4 highlights the most frequently addressed SICS in the selected highly relevant policies. As can be seen, nutrient management together with the pest management are the ones covered the most. These SICS are mainly addressed by water protection legislation as well as pesticides and fertilizers laws protecting primarily water sources, human health with the protection of soil as an indirect impact of their implementation.

Another frequent SICS is cover crops application. The need to use cover crops was frequently found as one of the compulsory greening requirement or GAEC as part of CAP implementation in the MS. It is also a very useful tool to deal with improving the SOM and erosion which is a significant problem in a number of countries.

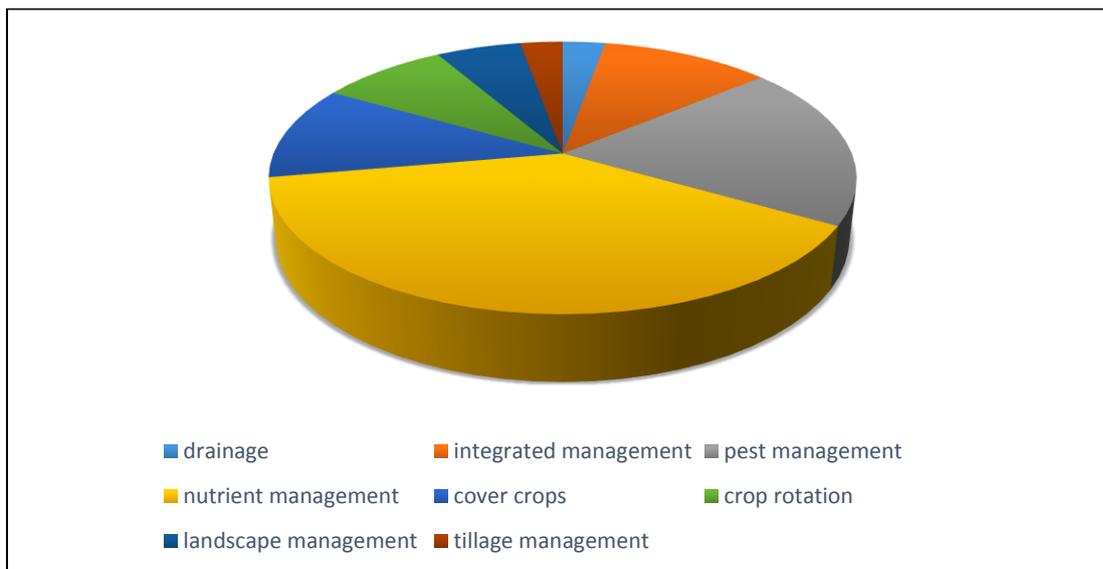


Figure 27.4: SICS components most frequently addressed by policies in 16 study site countries

Figure 27.5 demonstrates that SICS components are most frequently addressed by regulatory, closely followed by economic instruments. The regulatory category is primarily composed of national/regional or local legislative Acts imposing obligations, prohibitions or restrictions and/or introducing standards. The economic instruments are those sanctioning or rewarding behaviour through market mechanisms. These would traditionally include subsidies, national/regional funds, risk liability schemes, green public procurement or voluntary financial agreements.

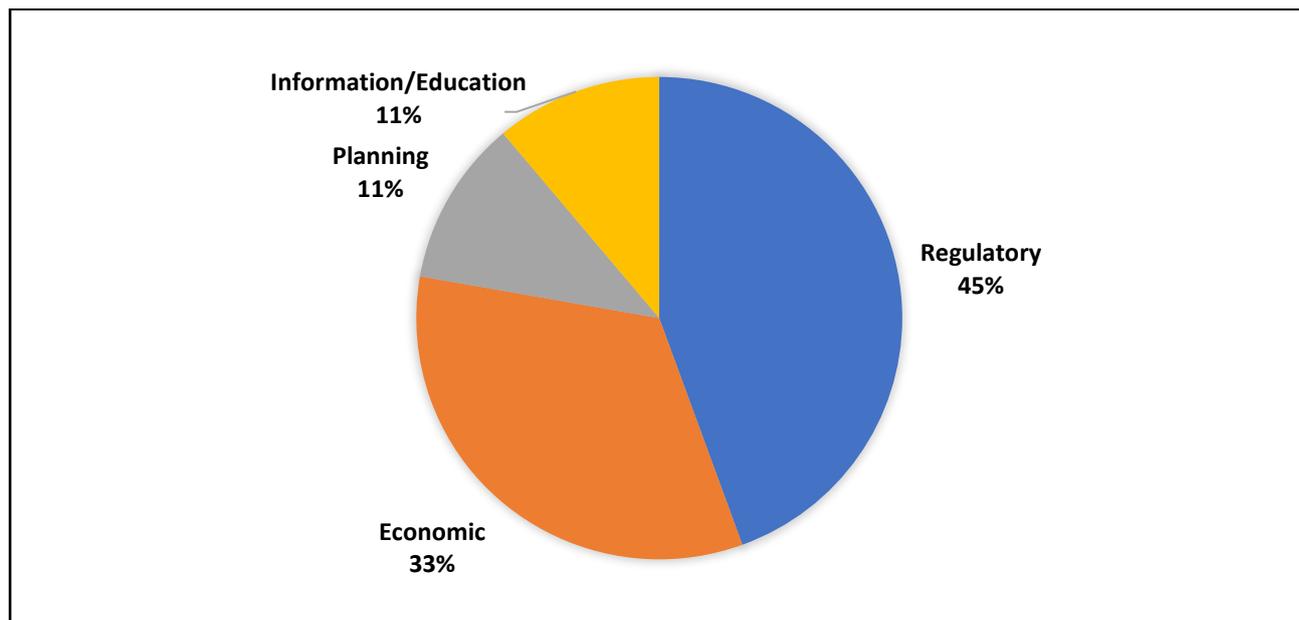


Figure 27.5: Policy categories promoting SICS components

Figure 27.6 shows the type of policy instruments that are used at national level to promote SICS (these include both national instruments transposing EU legislation or individual MS-level instruments) As can be seen, laws imposing bans and targets as well as subsidies linked to the implementation of the CAP form the largest share of policy categories used by the respective authorities. The laws imposing bans and targets are typically represented by the legislation transposing various EU Directives such as SUDP, WFD, ND, FD of SSD setting certain standards or permits. CAP subsidies are the ones stemming from the CAP GAEC Cross-compliance Standards and Rural Development Plans.

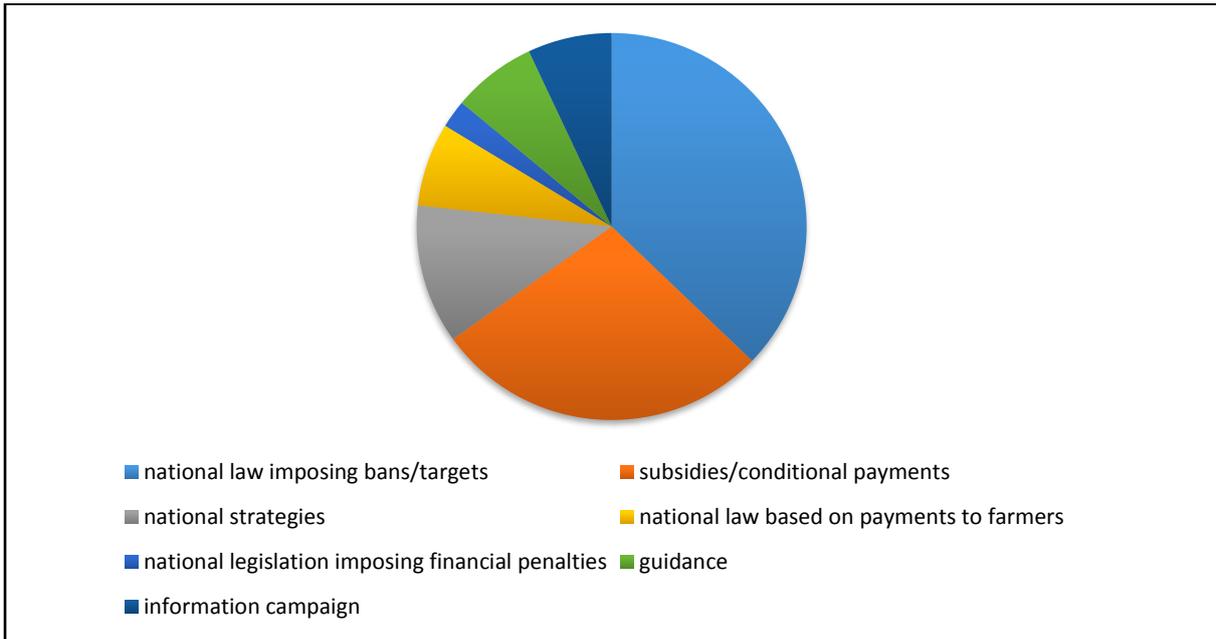


Figure 27.6: Type of instruments promoting SICS components in 16 study site countries

Figure 27.7, confirming findings presented in the previous figure, shows that SICS components are mostly targeted by agricultural sector policies, including both CAP policies as well as national and regional agricultural policies. the overall share of which is 72% of all SICS-relevant policies.

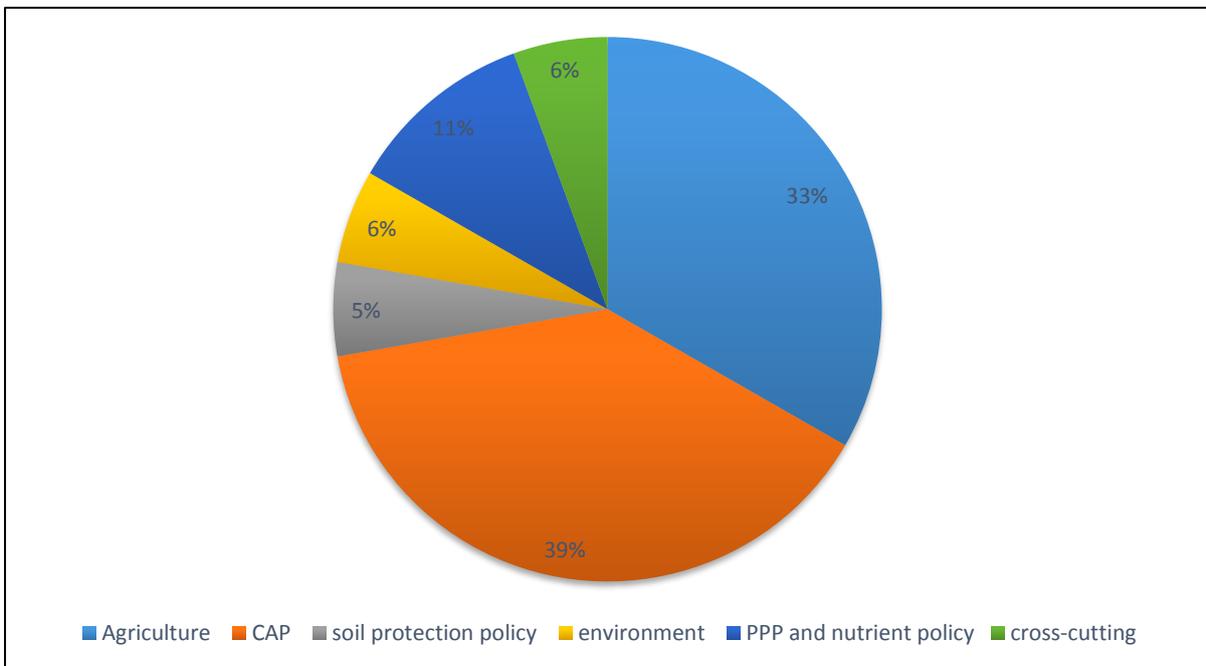


Figure 27.7: Extent to which policy areas address SICS components

The following overview table provides a preliminary response to the question of the intended mechanisms and impacts of existing policies and instruments and practices at study site level. It organises policies and policy instruments by soil threats and SICS, thereby highlighting opportunities and gaps in the existing policy framework in terms of coverage.

Table 27.1: Synthesis of shortcomings and opportunities in the existing policy framework in 16 study site countries\*

Soil threats	Erosion	Compaction	SOM decline	Pollution/ contamination
SICS				
Cover crops	GAEC (BE, DE, RO, CZ) Water policy (BE) RDP (BE, DE, RO) Agriculture (DE) Environment (DE) Soil policy (DE) PPP and nutrient policy (RO) CAP Greening payments requirements (CZ)		GAEC (BE, HU, UK, IT, PT, CZ, FR) Water policy (BE, RDP (BE, UK, IT, PT) Environment (CH, UK) Agriculture (CH, UK, FR) Soil policy (CH) PPP and nutrient policy (IT, FR)	
Crop rotation	CAP Greening payments requirements (DK, DE) RDP (DK, DE) Agriculture (DK, DE) Environment (DE) Soil policy (DE)	GAEC (RO) PPP and nutrient policy (RO)	GAEC (HU, UK, IT, PT) Environment (CH, UK) Agriculture (CH, UK) Soil policy (CH) RDP (UK, IT, PT, PPP and nutrient policy (IT)	
Nutrient management	PPP and nutrient policy (NO) Agriculture (NO)	PPP and nutrient policy (NO) Agriculture (NO)	GAEC (BE, UK, IT, PT, CZ, FR) Water policy (BE, PL, CZ) Soil policy (HU, CH) PPP and nutrient policy (HU, CH, IT, PL, PT, CZ, FR) Environment (CH, UK, PL) Agriculture (CH, UK, PL, FR) RDP (IT, PT) Waste (CZ)	PPP and nutrient policy (NO, DK, PL, PT, ES, GAEC (DK, PT) RDP (PT) Agriculture (NO, DK, PL, ES) Water policy (DK, PL, ES) Environment (PL, ES)
Pest management			PPP and nutrient policy (BE, CH, UK, IT, PT, FR) CAP Greening payments requirements (BE) Agriculture (CH, UK, PL)	GAEC (PT) RDP (PT) PPP and nutrient policy (PT)

Soil threats	Erosion	Compaction	SOM decline	Pollution/ contamination
			<p>Environment (CH, UK, PL, FR)</p> <p>Soil policy (CH)</p> <p>RDP (IT, PT)</p> <p>GAEC (IT, FR)</p> <p>Water policy (PL, PT)</p>	
Tillage management	<p>GAEC (BE, GR, CZ)</p> <p>RDP (BE, DK, RO, GR)</p> <p>Agri/envi (BE, DE, GR)</p> <p>CAP Greening payments requirements (DK)</p> <p>Water policy (DE)</p> <p>Soil policy (DE)</p> <p>PPP and nutrient policy (RO, GR)</p>	<p>GAEC (BE, UK, ES, FR, RDP (BE, DK, RO, ES, Agri/envi (BE, CH, SE, ES, FR, Soil policy (HU, CH) CAP Greening payments requirements (DK) PPP and nutrient policy (RO, FR)</p>	<p>GAEC (BE)</p> <p>Agri/envi (BE, PL)</p> <p>RDP (DK)</p> <p>CAP Greening payments requirements (DK)</p> <p>PPP and nutrient policy (IT)</p>	
Landscape management	<p>PPP and nutrient policy (CZ)</p> <p>GAEC (CZ)</p> <p>CAP Greening payments requirements (CZ)</p>	<p>Soil policy (HU)</p> <p>GAEC (HU, FR)</p> <p>Agriculture (CH, FR)</p>		
Drainage/irrigation	<p>Water policy (BE)</p> <p>GAEC (GR)</p> <p>RDP (GR)</p>			
Integrated management	<p>PPP and nutrient policy (NO)</p> <p>agriculture (NO)</p>	<p>PPP and nutrient policy (NO)</p> <p>Agriculture (NO,</p>		
Mulching		<p>Environment (CH)</p> <p>Agriculture(CH)</p> <p>Soil policy (CH)</p>	<p>GAEC (UK, CZ)</p> <p>Agriculture (FR)</p>	
Machine management		<p>Environment (CH, ES)</p> <p>Soil (CH)</p> <p>Agriculture (CH, ES, FR)</p> <p>GAEC (ES)</p>		

\*colours denote policy areas

## Part IV

# Overall synthesis and conclusions

The primary aim of this research was to analyse the role, benefits and shortcomings of EU policies and policy instruments in 16 European countries practices as drivers for the adoption of soil-improving cropping systems. This part of the report provides a synthesis of our findings and offers conclusions in response to the research questions stated at the outset of this report:

1. Which existing policies and policy instruments shape agricultural practices?
2. What are the intended mechanisms and impacts of existing policies, instruments and practices
3. To what extent do existing policies facilitate adoption of soil-improving practices?
4. Which factors shape success or failure of a policy instrument?

## 28 Summary and conclusions

Despite a lack of any legislation targeting the protection, maintenance and improvement of soil at EU-level, and indeed the majority of European countries covered by this study, there is a multitude of sectoral and environmental policies that may shape the impact of agricultural practices on soil quality. Yet, while there is already a wealth of knowledge available on the benefits and drawbacks associated with different categories and types of policy instruments, as demonstrated by the literature review presented in 1.2, assessments which analyse the shortcomings and opportunities of the current policy framework at EU-level and across Europe are only starting to emerge. Against this background, the research presented here aimed to analyse the role, benefits and shortcomings of existing policies and policy instruments, guided by the following specific questions:

1. Which existing policies and policy instruments shape agricultural practices?
2. What are the intended mechanisms and impacts of existing policies, instruments and practices
3. To what extent do existing policies facilitate adoption of soil-improving practices?
4. Which factors shape success or failure of a policy instrument?

The following sections will summaries our findings in response to each research question, bringing together insights gained from the analysis carried out EU-level and across the 16 study site countries and comparing and contrasting these lessons learned to the knowledge presented in the literature review.

### 28.1 Which existing policies and policy instruments shape agricultural practices?

With the withdrawal of the Soil Framework Directive, EU soil policy remains fragmented with no framework legislation to address the issue of soil in its own right. The protection, maintenance and improvement therefore rely on a number of sector and environmental policies that address different aspects of soil management and softer policy initiatives and non-binding targets both at EU and international levels. This study has identified a number of policies and their specific instruments that explicitly and implicitly impact on farming practices and management in relation to improving soil quality. At EU-level, these include:

- **Agricultural policies:** Greening measures, Cross-compliance and Rural Development Policy, under the broader framework of CAP, potentially impact on farmers adoption of cropping systems and several of the instruments have explicit links to maintaining or improving soil quality. Under greening measures or payments MS are required to reserve 30% of their national ceilings for direct payments to grant an annual payment, in addition to the basic payment for compulsory practices to be followed by farmers addressing, as a priority, both climate and environment policy goals. The requirements

under greening measures, although they are perhaps more specifically targeting biodiversity, are explicitly linked to soil quality. EFAs target components of cropping systems such as buffer strips and green cover. The permanent grassland component focuses on carbon sequestration and restricts conversion of permanent grassland to arable crops, and re-conversion to grassland can be required of individual farmers. The third greening requirement, crop diversification requires holdings over then hectares to have more than one crop, so this in theory will influence farmers cropping system decisions i.e. moving from intensive mono-culture practices to crop diversity and rotation. Cross-compliance specifically targets soil and carbon stock through three GAECs. In addition, there are several RDP aspects that could have substantial impact on adoption of cropping systems. Two priorities and focus areas defined by the policy specifically address soil quality and several measures have been identified that could potentially address cropping system components. RDP funding can potentially impact on adoption of cropping system components by reducing the transaction costs of adopting practices that in the short term have higher associated costs. Funding available under EARDF can also be used for tangible and intangible investments for agri-environmental climate objectives, including components of cropping systems.

- **Water policies:** Agricultural management and practices impact on nutrients, water use and pollution, and maintaining or enhancing soil quality can impact or is impacted on by all of these management areas. With the exception of the Nitrates Directive, EU water legislation does not explicitly address agricultural policies or practices. However, these Directives do have a (mostly) indirect impact on cropping systems, through objectives, standards and instruments aimed at either protecting, maintaining and improving water quantity or water quality. The Nitrates Directive is the legislation that most directly influences agricultural practices and management, requiring standards on management of nutrients and physical features such as buffer strips and storage of manure. However, other water Directives that set out specific chemical standards (the Groundwater and EQS Directives in particular) may greatly impact cropping practices by placing restrictions on what chemicals can be used for pest control or fertiliser. In addition, the WFD explicitly uses economic tools to ensure users pay the real costs of the water they use. This is expected to provide incentives to stop users (for example, farmers) from wasting water. In addition, both the WFD and the Nitrates Directives set out voluntary measures. These measures, while voluntary on the part of the Member State (for the WFD) or on the part of the farmer (for the Nitrates Directive), may influence a farmer's decision with regard to, nutrient management, efficient irrigation, or crop rotation and decisions on crop types.
- **Nature policies:** The Birds and Habitats Directives comprise the main policies in relation protection, conservation and improvement of biodiversity in relation to farming. Instruments under these measures impact on farmers and their decisions in relation to management practices, mainly at a landscape level, but in some cases on

farmer's specific management practices such as cropping patterns, timing of tillage and crop rotation in relation to preserving wildlife.

- **The Sewage Sludge Directive** promotes the use of sewage sludge in agricultural areas by providing a legal framework to administer potential risks mainly due to sludge content of heavy metals that can accumulate in soil. Use of sewage sludge in agriculture could be an important part of a strategy to close nutrient loops in line with the circular economy strategy. The main way in which the SSD could influence agricultural practices relates to fertilisation and nutrient management.
- The **Sustainable Use of Pesticides Directive** is designed to achieve more sustainable use of pesticides by requiring MS to develop clear, measurable targets to reduce risks from pesticides. The SUPD affects farmer's decisions and practices relating to pest management and weed control, because MS are required to develop and in put in place NAPs to reduce pesticide use. Provisions relating to Integrated Pest Management (IPM) are perhaps the most promising in relation to promoting agricultural practices that improve soil quality and synergies exist i.e. crop rotation and reduction of pests.
- The **Fertilisers Directive** mainly impacts on the market for fertilisers i.e. producers of fertilisers, however indirectly impacts on farmers and their practices, because it affects the range of fertilisers that are accessible. This may not be coherent with efforts to promote soil organic matter under other policies such as CAP because current regulation focuses on inorganic fertilisers and does not adequately cover organic fertilisers or potential new fertiliser products derived from animal waste streams. A new regulation on fertilisers under the circular economy package, although still in process, will potentially make a wide range of organic fertilisers accessible and eliminate obstacles in developing new organic fertilisers or products.

In conclusion, agriculture, biodiversity, environment, resource and water related regulations have all an impact on the soil, but none succeeds to comprehensively address the issues.

At country-level, the policy landscape largely mirrors that at EU-level with only a few countries having a specific legislative or policy instrument with soil protection as its primary objective. Soil protection as a direct/indirect objective is in these cases mainly covered by different policy sector and environmental instruments, of which the majority stem from the EU policy framework. This includes mainly nationally transposed directives such as WFD, SUPD, ND, FD and implementing instruments of CAP on national level. A significantly smaller proportion of instruments potentially impacting on SICS adoption is based on nationally-initiated policy initiatives.

In terms of coverage, nutrient management together with the pest management are the two SICS components most frequently addressed by policies in the 16 study site countries. These SICS are mainly addressed by water protection legislation as well as pesticides and fertilizers

laws protecting primarily water sources, human health with the protection of soil as an indirect impact of their implementation. Another frequent SICS is cover crops application. The need to use cover crops was frequently found as one of the compulsory greening requirement or GAEC as part of CAP implementation in the MS and may potentially contribute to improving SOM and preventing erosion in the covered countries.

## **28.2 What are the intended mechanisms and impacts of existing policies, instruments and practices**

Our analysis shows that, both at EU as well as country-level, SICS components are most frequently addressed by regulatory and economic instruments. Regulatory instruments primarily include directives, and national/regional or local legislative acts imposing obligations, prohibitions or restrictions and /or introducing standards. Many of the identified regulatory policies use a mix of instruments, often including both mandatory and voluntary elements. This is illustrated by the country-level analysis where the policy landscape is largely characterised by legislation transposing EU policy or nationally-initiated regulations which in turn establish bans and targets as well as subsidy systems linked to the implementation of the CAP. The laws imposing bans and targets are typically related to various EU Directives such as SUDP, WFD, ND, FD of SSD setting certain standards or permits. The Nitrates Directive, the Groundwater and EQS Directives for example place restrictions on what chemicals can be used for pest control or nutrient management. These standards therefore directly impact on and restrict the agricultural practices farmers may adopt.

The economic instruments are those sanctioning or incentivising behaviour through market mechanisms. The CAP's greening measures or payments, for example, are an attempt to incentivise agricultural practices that go above and beyond standards and regulations covered under cross-compliance. Whether farmers view this as incentive to adopt practices with climate and environment goals or view it as a penalty for not doing things differently will be an interesting question to explore as the measures are evaluated. Several elements under Cross-compliance, which essentially defined conditions to be met to qualify for payments, specifically targets soil and carbon stock through three GAECs. From a theoretical perspective cross compliance should be an effective tool for promoting agricultural practices that maintain environmental standards, in this case soil quality. The threat of non-compliance and reduction of area-based payments should in theory be an effective tool for implementing regulations and standards. In addition, funding available under the RDP compensates farmers for transaction costs in relation to providing public goods or ecosystem services. The economic instruments under the WFD which aims to establish pricing systems reflecting real economic costs, may motivate farmers to reduce their irrigation programmes, and plant crops more suited to the natural environment.

### 28.3 To what extent do existing policies facilitate adoption of soil-improving practices?

The analysis shows that agricultural practices and by extension soil quality in Europe are shaped by different policy areas and instruments implemented at various scales of governance. Some instruments address soil improving agricultural techniques directly, most of them indirectly. The existing policy framework is largely characterised by regulatory and economic policy approaches, with more than 80% of all policies in the covered countries formulated at EU level. Since many of these Directives and Regulations are subject to implementation and, as such, further definition at national and regional scale, impacts are bound to vary across countries.

- Evaluation of the different CAP instruments, especially greening measures, is early in the process of implementation, and because of this difficult to evaluate. Concerns expressed by stakeholders over the impact of CAP on the environment and sustainable farming systems, include: the system of payments under the CAP may potentially encourage farmers to engage in practices that are hazardous for the environment in order to obtain or maximise their payments; CAP instruments may actually support current industrial farming practices rather than promote a transition to more sustainable agricultural systems; the established system of payments may create a sense of entitlement that creates resentment when rules for payments are changed.
- Studies examining the actual impact of water policy on agricultural management and practices are equally scarce. Although relevant literature shows that the objectives of EU water policy are integrated into agricultural policy at the strategic level, the impact of this integration depends on the effective implementation of the agricultural policies. Some stakeholders have indicated that the ND has certainly changed the way manure is handled, specifically establishing facilities to store manure to prevent problems with runoff, and that this would not have been done if not for the WFD and its respective legislation.
- Assessments of the Nature Directives show that outside Natura 2000 habitat sites, obligations set on farmers to protect threatened habitats, as well as species of Community importance, were often poorly defined, and the legislation was not enforced. It seems that even within Natura 2000 sites, management plans drawn up for each site have little impact on farmers' decisions. Voluntary efforts made by farmers, as well as funded efforts under CAP (agri-environment schemes) and LIFE+, were found to have a greater impact.
- Member States have largely implemented stricter limits than those recommended by the Sewage Sludge Directive, but there is substantial variation between Member States, with a number of Member States using practically no sewage sludge in agriculture, preferring to incinerate it. Recent evaluation of the SSD suggest that implementation

of the directive remains unproblematic and that although the generation of sludge was reduced by 2 % between 2010 and 2012 compared to between 2007 and 2009, the Member States reported that almost the same amount of sludge was used in agriculture as in the previous period. This corresponds to approximately 45 % of the amount of sludge produced.

- No evidence of the SUPD's impacts on agricultural practices exists. However, recent reviews provide a somewhat mixed result: on the one hand, there is a high level of training and certification of professional users, distributors and advisors; the provision on information and awareness raising is used comprehensively in some Member States; Member States have taken a range of measures to protect the aquatic environment from pesticide use and have put extensive measures in place for the reduction of pesticide use in specific areas; and aerial spraying is widely banned, with strict conditions on its use. On the other hand, the overall rate of compliance and an assessment of tangible results is missing in the absence of measurable targets in most national action plans.
- Evidence shows that many of these fertilisers sold under national legislation comply with the technical standards specified in the Fertilisers Regulation. However, there is no evidence supporting the argument that the Regulation has led to improvements regarding fertilisers' impacts on the environment, particularly regarding the presence of heavy metals in fertilisers, which may leach into soils.

#### **28.4 Which factors shape success or failure of a policy instrument?**

The documentary and analysis and stakeholder interviews point to the conclusion that the existing policy framework appropriately addresses the soil issues at stake. However, from an EU-level perspective, the evidence demonstrates that policy impact is largely defined by how these are implemented at national and regional level.

It is acknowledged that, whilst the CAP has the potential of delivering real impact, it is undermined by lack of proper implementation, control and sanctions or penalties for non-compliance. For instance, greening payments may only be fully effective if infringement is penalised by withdrawing or paying back direct payments. This is consistent with findings reported in the literature highlighting the role of monitoring and effective sanctions in cases of non-compliance to successfully promoting adoption, (e.g. Nuffield Council on Bioethics, 2012). In the context of the CAP, monitoring is hampered by the absence of specified indicators on compliance and clearly defined cross-compliance objectives (ECA 2016).

Reported research suggests that the financial incentives established by the CAP may be less effective than other types of instruments such as provision of information and advisory services, as they do not take into account nor can be tailored to other factors relating to farmer views and attitudes (e.g. Duesberg et al., 2014). In contrast, a study providing input to a regulatory fitness check (Milieu et al., 2016) of the Birds and Habitats Directives, concluded

that the availability of funding had the biggest influence on implementation of the Nature Directives. Various studies have found that financial incentives are best combined with regulatory policies, with the mix being adapted to specific circumstances (e.g. Posthumus & Morris, 2010; Ring et al., 2010; Barnes et al., 2013; OECD, 2012; Gunningham, 2004; Johnstone & Sarre, 2004).

A recurring theme in our analysis is the need for better integration and policy coherence, a factor which has been identified as an important pre-requisite for success by the literature (e.g. OECD, 2001). Cross-compliance addresses soil quality through GAECs which are not necessarily integrated with other cross-compliance measures such as SMRs related to the Nitrates, and Birds and Habitats directives. Whilst commentators agree that the coherence of agricultural and environmental policies has improved over the past decades (e.g. Turpin et al., 2015), it is evident that a coherent, well integrated policy framework with clear objectives, targeted policy measures, and a well-defined monitoring process is needed to promote a transition towards agriculture systems and practices which support the protection, maintenance and improvement of soil resources across Europe.

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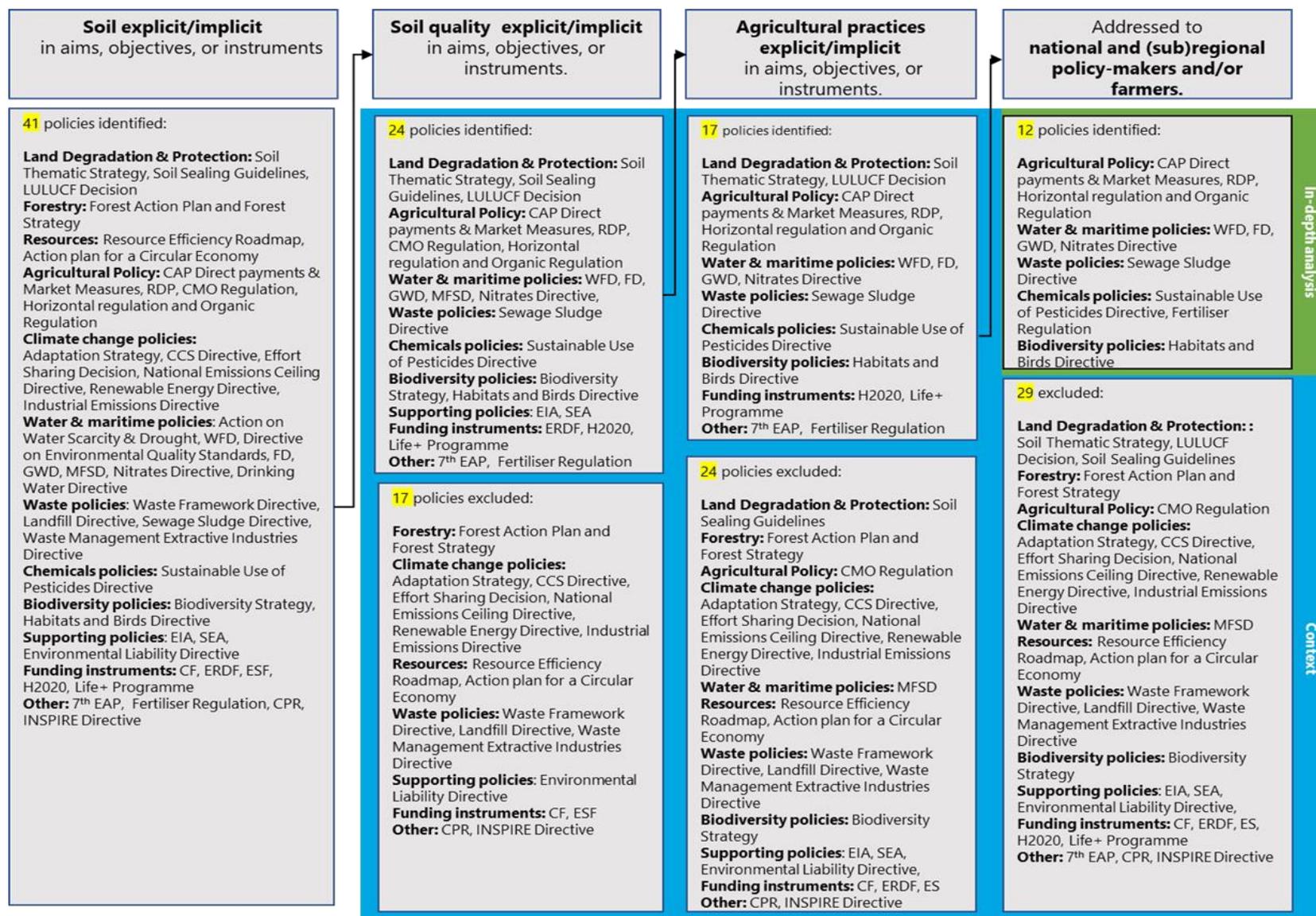
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## Annex I: EU-level policy scoping map

The figure below illustrates the pool of policies assessed for its relevance to this study. Evaluation questions were applied at each step of the selection process to arrive at a set of policies deemed to have a direct or indirect impact on farmer uptake of SICS.



D7.1: Inventory of opportunities & bottlenecks in policy to facilitate the adoption of soil-improving techniques

# Annex II: Materials for data collection at EU level

## *EU-level Expert Interviews — Information sheet*

### **Invitation to take part in research on policies that influence the uptake of soil-improving agricultural practices by European Farmers**

We are contacting you as we would like you to be involved in our research project called SoilCare (<https://www.soilcare-project.eu/>), a Horizon2020 project, which aims to identify and evaluate agricultural techniques that can improve soil quality<sup>159</sup>, and at the same time maintain and even increase the profitability and sustainability of EU agriculture. It is a 5-year project that brings together 28 partners from 18 EU countries, spanning several universities, research institutes and SMEs.

SoilCare is structured into seven Work Packages, with Milieu leading the work on policy analysis (Work Package 7). The interviews are being conducted jointly with Work Package 6 (led by the Research Institute for Knowledge Systems, RIKS) who are developing future scenarios and policy alternatives as a basis for policy impact assessment modelling.

Please read this information sheet carefully as it explains what participation involves. If you have any questions, please contact us by email at [harriet.bradley@milieu.be](mailto:harriet.bradley@milieu.be), or phone on +32 2 506 1000.

#### **What is this study about?**

The degradation of agricultural soils—which has increased over the past decade—is a major problem for European farmers, as well as for Europe's environment. Intensive agricultural practices, such as heavy tillage (ploughing), monocropping, insufficient crop rotations, the use of heavy machinery and the unsustainable use of agro-chemical inputs are all key drivers of soil degradation. Furthermore, while there are many well-known agricultural management techniques that can help to improve soil quality such as crop rotations, crop diversification, low or no tillage, mulching and cover crops are well known, uptake of these techniques generally remains low in Europe, despite various policy incentives.

The work led by Milieu and RIKS aims to analyse the policies and contextual factors that can facilitate or hinder the uptake of these practices by farmers, along with developing policy options and scenarios related to the uptake of these practices.

#### **What is the aim of the interviews?**

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<sup>159</sup> See the attached Annex for a list of soil-improving agricultural practices that are being investigated by the project

The aim of the interviews is to gather knowledge from policy experts about the factors that facilitate or hinder adoption of agricultural practices that improve soil agricultural and how these might change over time, based on environmental and socio-economic developments. We will be interviewing policymakers at the EU level, farmers' associations, environmental NGOs and researchers (academics and think tanks). The data gathered will feed into a report on the impact of policies on the uptake of agricultural practices that improve the soil and will also provide the basis for modelling the impacts of future policy options.

### **What will my participation involve?**

The interview should last approximately one hour, although this can be adapted to suit your preferences. The interviews will focus on your area of policy expertise, specifically addressing its impact on farmers' agricultural practices, how they work (in theory and in practice), relevant contextual factors and future scenarios.

Your participation in this research is voluntary. If you decide, at any point, that you wish to withdraw from this research you are free to do so.

Interviewees will be referred to by stakeholder group (e.g. "A Commission representative", "A farmers' association representative"), with no further attributes in any material published. The information will be used to inform a report that will be publicly available, which may include direct quotes that are attributed to a stakeholder group.

### **Benefits of taking part**

By taking part, you will be helping to develop knowledge in an under-studied, but critically important, policy field. The information provided will feed into policy recommendations which will aim to improve the policy framework to better integrate soil quality concerns, with the ultimate aim of reversing the decline of soil quality in Europe. The study is interested in moving beyond identifying and assessing agricultural practices that effectively maintain and improve soil quality, to understanding how they can be successfully implemented to achieve a long-term positive impact on soil quality.

### **How to contact the researchers**

You can contact us by email at [harriet.bradley@milieu.be](mailto:harriet.bradley@milieu.be), or phone on + 32 2 506 1000 if you would like any more information about the study at any point.

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## Introduction

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### What the project is about

- *WP7 Policies (and other factors) that impact which what agricultural practices farmers adopt (especially SICS – refer to SICS table attached to the information sheet)*
- *WP6 – future scenarios (policies and contextual factors) for rural Europe affecting adoption of soil-improving agricultural practices*

### Aims of the interviews

- *Deeper insight from experts in the field of policy aims and practices that impact which practices farmers adopt (especially those affecting soil), and other factors that condition the impact these policies have*

### Structure of the interviews

- *Semi-structured*
- *3 parts: 1) your background and expertise, 2) policies and practices, 3) future scenarios (policy and wider factors)*
- *Focusing on their area of expertise (but touching on others as appropriate if they crop up)*

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## Consent

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### **1. Do you have any questions regarding our research or the interview?**

### **2. Are you happy for the interview to be recorded?**

- For researcher's personal information only – so that we can concentrate on the interview

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## Background questions

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### **3. Can you tell us a little but about the main areas that you work on in your current role?**

### **4. What is the nature of that work?**

- e.g. economic analysis, research, implementation

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## Current policies and other factors

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- 5. In your opinion what are the main factors that influence farmers' agricultural practices?**
  - E.g. economic incentives/ profitability, global markets, supply chains, cost of land, personal beliefs; geographical location
- 6. Which policy areas in general you think have the biggest impact on farmers' agricultural practices?**
  - e.g. CAP, Water (Nitrates, Floods), Nature protection/biodiversity, Climate, Food Safety, IT/Tech
  - Programs e.g. LIFE, AIPs (CAP), Research e.g. Horizon 2020, Cohesion policy funding
- 7. And can you tell us about the ways in which the policies you work on affect farmers' agricultural practices?**
  - Do they place mandatory requirements on farmers?
  - Do they provide any economic incentives?
  - Do they change attitudes?
- 8. Do you think that the policies are having the above impacts in practice?**
  - Can you think of any examples?
  - Are they being properly enforced?
  - What evaluations of the policies have been carried out and what were the main results?
  - Is there variation across regions/MS?
- 9. Do you think that there are any other policies that affect how the policies that you work on impact on farmers' agricultural practices?**
  - Are their synergies between policies?
  - Are there any conflicting requirements or incentives placed on farmers?
- 10. Which other wider contextual factors do you think also affect the implementation of these policies and their impact on practices?**
  - E.g. farmers' beliefs; institutions (e.g. finance, property rights); geographical location
  - Any practical examples?
  - Variation across regions/MS?

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#### Future developments

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- *Having talked about current drivers of farmers' agricultural practices, we would now like to think about future policies and wider contextual factors that will be influencing the uptake of soil-improving practices in the future*

**11. Do you think that we need to change existing policies/ instruments?**

- If so which policies and which instruments?
- Do we need completely new policies?
- What other factors would need to change to ensure better implementation of the policies in question?

**12. What do you see as the key drivers of change in rural Europe over the next 50 years?**

- What are the impacts of these drivers?
- Where do they lead to?

**13. What are the main uncertainties over the next 50 years that could affect Europe's ability to have a sustainable and profitable agricultural sector?**

- How do these impact on:
  - a) the adoption potential,
  - b) the need and effectiveness of current and future policies, instruments and practices related to soil-improving agricultural practices, and
  - c) sustainable agriculture in general

**14. What type of information and tools do you currently use to support your work? And in your organisation/division/sector?**

- Are there specific types of information or tools you feel could facilitate or enhance your work?

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Conclusion

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**15. Are there any other issues that you would like to raise?**

**16. Are there any other people you feel we should talk about this topic?**

- *Are you happy to be contacted for follow up questions or to clarify anything?*
- *We will send you a copy of the research*

**ANNEX**

What are Soil Improving Cropping Systems (SICS)?

Soil Improving Cropping Systems (SICS) refer to both crop type, crop rotation, and associated agronomic management techniques. SICS are understood to improve soil quality (and hence its functions), and have positive impacts on the profitability and sustainability of cropping

systems. Based on a review of available literature and empirical evidence, the project has identified the following SICS<sup>160</sup>:

Component*	Specific examples (non-exhaustive)	Expected impact
Crop rotation	Rotation with diversified crops; use of legumes and nitrogen-fixing crops in rotations; in-field rotation; fallow periods; intercropping; mixed farming (integrating livestock in rotations)	Improves crop productivity, soil biodiversity and system sustainability; decreases need for pesticides and risk of erosion
Soil cover	Green manures, cover crops, catch crops; intercropping; mulching	Improves SOM content, soil structure, soil biodiversity, nutrient use efficiency; decreases nutrient leaching, run-off, erosion
Integrated nutrient management	Use of crop residues; composting; use of animal manures in mixed farming systems	Improves crop productivity, soil nutrient status and resource use efficiency;
Enhanced efficiency irrigation	Drip irrigation; use of crops adapted to local conditions (e.g. water conserving or non-water intensive crops in arid areas); timing irrigation to reduce surface evaporation; intercropping to reduce evaporation	Improves crop productivity and resource use efficiency; minimizes risks of salinization and desertification
Controlled drainage	Re-use of water on farm; ditches etc to allow run-off; afforestation to reduce waterlogging	Improves crop productivity and resource use efficiency; minimizes the risk of waterlogging
Reduced or zero tillage	Conservation agriculture; use of winter cover crops or intercropping (with attention to reduced herbicide use)	Reduces energy cost and may enhance SOM content and soil structure; may increase the need for herbicides/pesticides
Integrated pest management	Companion planting; organic fertilisers; natural predators; margins/buffers	Improves crop productivity and resource use efficiency; minimizes the loss of biodiversity.
Weed control	Mechanical weeding; hand weeding	Improves crop productivity and resource use efficiency; may decrease the need for herbicides
Residue management	Mulches; use of residues; rotations with animals	Reduces evaporation and soil temperature; may increase/decrease the success of germination
Controlled trafficking	Timing of vehicle traffic (ie not when soil is waterlogged); reduced use of heavy machinery; drive corridors	Reduces energy cost and the risk of soil compaction
Integrated landscape management	Mixed farming and rotations; water harvesting e.g. through dams, reservoirs	Improves biodiversity and cropping systems sustainability

<sup>160</sup> A preselection of soil-improving cropping systems, WP2 Summary report (Draft), dated 30 Nov 2016).

# Annex III: Materials for data collection in study site countries

## *Guidance to completing the country-specific policy inventory*

### **About this document**

This is a guidance document which is intended to be used when populating and amending the country specific policy inventory (Step 1). The inventory is the basis for identifying relevant policy-makers to be interviewed (Step 2) as well as key policies for in-depth review (Step 3)<sup>161</sup>.

The Milieu team has prepared 16 country-specific policy inventories which is presented to the Study Site Researchers (SSRs) in the form of an excel file. Each country-specific inventory folder contains the following worksheets:

- Title page
- Profile
- Definitions
- EU policies
- MS policies

The purpose of the SSRs' review of and contribution to the country-specific policy inventories is as follows:

1. To validate the initial findings and to identify any gaps or misrepresentations in relation to national and (sub-) regional policies;
2. To identify and describe strategies, policies and instruments not related to EU policy and relevant for agricultural practices in the study sites locations;
3. To identify potential interview respondents to collect additional data to feed into the policy analysis;
4. To identify policies for in-depth analysis (on the ground that not all policies will be equally influential when it comes to adoption of Soil-improving cropping systems (SICS).



The subsequent sections provide a step-by-step guidance on how to complete the country specific policy inventories. We hope it provides practical and comprehensive advice on how to complete this task. Should there be any questions, please do not hesitate to contact *Zuzana Lukacova* or *Melanie Muro* by email, phone or skype. All contact details are provided above.

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<sup>161</sup> See the document titled *Overview of key steps and methods* for a detailed description of the complete process for data collection and analysis in the study sites.

## How to complete the country specific policy inventory

This section describes each worksheet and details the input that is required from the SSRs.



Before getting started, please save a new version with your name and the current date to the filename of the inventory and highlight your input by working in track change mode.

### Title

This sheet provides some identifying details for each inventory, such as study site name, issue date, version number etc.



Please update the issue date, project partner (your institution) and version number once you have completed the inventory, so we can better keep track of the various updates.

### Profile

The PROFILE part contains a basic description of the Study Site in your country. The information currently provided in this worksheet was taken from the official SoilCare website.



You are invited to review the information to ensure that is correct and up-to-date. Please add any missing and amend any inaccurate information This relates to all elements in the table (soil problems, current practices, key policies, SICS to be tested).

### Definitions

This tab provides definitions and explanations of key terminology and concepts used in the inventory.



Please carefully read the information provided here as you will be using these categorisations when completing the inventory. You are not required to make any changes to this worksheet.

### Policies

There are *two worksheets* to capture and describe the current policy framework impacting on agricultural practices in your study site region.

1. The first sheet titled EU POLICIES lists all national policies implementing or partially implementing EU policy instruments.
2. The second sheet titled MS POLICIES is dedicated to national, regional or sub-regional policies and instruments specific to your country, meaning that there is no link to EU-level policy documents.

Each worksheet provides a preliminary list of policies for your country which was compiled by Milieu. Each policy is described briefly using a pre-defined set of attributes. Table 1 below lists and describes each attribute and details the type of information to be provided. Table 2 uses the example of the WFD in Germany to highlight key points for completing the inventory, followed by detailed instructions on how to complete both worksheets. Useful sources for information on relevant policies in your country may include:

- The websites of agricultural and environmental ministries and associated regional, local or technical authorities and agencies,
- The SoilWiki website at <https://webgate.ec.europa.eu/fpfis/wikis/pages/viewpage.action?spaceKey=SOIL&title=Home>;
- A simple google search using e.g. the following key words: the names of the selected EU-level policies in your national language; agricultural policy or soil policy.

#### List of pre-defined attributes to describe policies

Attribute	Description	Information required/response options
<b>Scale</b>	Policies may be located at various scales of governance, such as European, national, regional or sub-regional, where instruments at lower levels often (not always) implement those at a higher level.	<i>Please organise policy instruments according to the governance scale at which they operate. At regional and sub-regional level, only list those policy instruments that are relevant to the federal state, region or locality where your study site is situated.</i>
<b>Name of policy</b>	The name of the policy in the national language.	<i>Please insert the name of the policy in its original language.</i>
<b>Translation (EN)</b>	English translation of the policy.	<i>Please insert the English translation of the policy if applicable.</i>
<b>Date</b>	Date of entry into force of the policy.	<i>Please insert the year the policy entered into force.</i>
<b>Link to policy document</b>	Link to the policy text.	<i>Please copy in the link to the policy document in its original language. If there is an English-language version available, please include this link as well.</i>
<b>Link to supporting information</b>	Link to relevant supporting information, such as dedicated websites, guidance documents, handbooks etc.	<i>If applicable, copy in the link to websites providing additional information about this policy or to relevant supporting documents.</i>
<b>Institutions</b>	List key institutions involved in implementing the policy at the various scales of governance.	<i>Please identify here the main competent authorities for the implementation of</i>

		<i>these policy instruments taking into account regional and local competences.</i>
<b>Policy category</b>	Policy instruments can be grouped into the following four broad categories: economic, regulatory, planning and informational/educational instruments. TABLE B on the DEFINITIONS sheet of the policy inventory list possible types of instruments under each category.	<i>Please consult TABLE B on the DEFINITIONS page and select one of the following categories: (1) Regulatory instrument, (2) Planning instrument, (3) Economic instrument, (4) Informational/educational instrument. If a policy combines several categories, please explain.</i>
<b>Type of instrument</b>	Within each policy category, there a number of different policy instruments authorities may use, e.g. pricing, subsidies or funds all fall under the category of economic instruments. The various approaches under each policy category are here referred to as types of instruments	<i>Please check the types of instruments listed in TABLE B on the DEFINITIONS page. If an instrument does not fit the typology provided, please explain briefly.</i>
<b>Policy measures</b>	A policy instrument, such as a European Directive or a National Law may contain a sub-set of voluntary and/or mandatory instruments, such as Action Plans, Information Campaigns or Targets. These are here referred to as policy measures, defined as a sub-set of instruments contained within one policy instrument.	<i>Please consult the types of instruments in TABLE B on the DEFINITIONS page to identify any measures foreseen by the main policy instrument. If an instrument does not fit the typology provided, please explain briefly.</i>
<b>Relevance for SICS (components)</b>	Different policies will impact different SICS or components of SICS. Some will address several components and some will only be relevant for one. Using the list of SICS components provided on the DEFINITIONS sheet, those affected by the policy should be listed here.	<i>Please check the SICS components listed on the DEFINITIONS page and identify those which are directly (D) and indirectly (I) impacted on by the policy.</i>
<b>Impact on farmers</b>	Depending on the nature of the policy, it will directly or indirectly impact on their decisions and the agricultural practices they adopt.	<i>Please describe how the policy directly (D) or indirectly (I) impacts the agricultural practices adopted by farmers.</i>
<b>General description of the policy</b>	A general description of the policy as well as a summary of its impacts on agricultural practices.	<i>Please provide a brief summary of the policy, its objectives, key instruments or measures as well as links to other instruments. Briefly summarise how the policy may impact on farming practices; if possible, identify and comment on any evidence illustrating policy impacts and challenges on the ground.</i>
<b>Relevance of policy</b>	An assessment of the relevance of the respective policy for shaping agricultural practices in the study sites assuming that not all policies will be equally relevant.	<i>Based on your preliminary analysis, please rate the relevance of the policy instrument for shaping agricultural practices in your study site. (1) Not relevant, (2) Relevant, (3) Highly relevant</i>

Template for describing and analysing policies implementing or partially implementing EU POLICIES

Scale	Name of policy	Translation (EN)	Date	Link to policy document	Link to supporting information	Institutions (EN translation)	Policy category	Type of instrument	Policy measures	Relevance for SICS (components)	Impact on farmers	General description of policy	Relevance of policy
EU	Water Framework Directive 2000/60/EC (WFD)	n.a.	2000	<a href="http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060">http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060</a>		DG ENV	Regulatory	Directive	Plans, Targets/standards, Public stakeholder participation, Pricing	Nutrient management; Irrigation; Drainage management; Pest management; Landscape management	Quality standards may indirectly impact on fertiliser use since diffuse pollution is a key pressure on water quality.	The Directive establishes a framework for the protection of inland surface waters, (...)	Relevant
National	Gesetz zur Ordnung des Wasserhaushalts (Wasserhaushaltsgesetz)	Federal Water Act	2009	<a href="http://www.gesetze-im-internet.de/whg_2009/">http://www.gesetze-im-internet.de/whg_2009/</a>		Bundesministerium fuer Umwelt, Naturschutz, Bau und Reaktorsicherheit (Federal Ministry of the Environment)	Regulatory	National law	Plans, Targets/standards, Public stakeholder participation, Pricing	Nutrient management; Irrigation; Drainage management; Pest management; Landscape management	Quality standards may indirectly impact on fertiliser use since diffuse pollution is a key pressure on water quality.	In accordance with the Water Framework Directive, the river basin management plans set management objectives and programmes of measures guide individual administrative decisions (...)	Relevant
	Oberflächengewässerordnung	Surface Water Ordinance	2016			See above	Regulatory	Ordinance					
	Grundwasserordnung	Groundwater Ordinance	2010			See above	Regulatory	Ordinance					

The EU POLICIES worksheet is pre-filled with the EU-level policies selected for analysis by Milieu as well as national level policies implementing the respective EU instrument (where this information was available)

Names of institutions do not need to be translated literally as long as we understand their mandate/general role from the name.

Enter the date when the latest version entered

<b>Regional</b>	Wassergesetz für Baden-Württemberg		2017			Ministerium fuer Umwelt, Klima und Energiewirtschaft (Ministry of the Environment of the Federal State of Baden-Wuerttemberg)							
<b>Sub-regional/ Local</b>	Bewirtschaftungsplan Bearbeitungsbereich Neckar (FGE Rhein)	Management plan for the workarea Neckar (RBD Rhine)	2015			Regierungspraesidium Stuttgart (District government)							

Policy instruments at the regional and sub-regional level should focus on areas where study sites are



## Reviewing and completing the list of policies implementing EU legislation

### Step 1

We have populated the worksheet titled **EU POLICIES** with those policies we identified as relevant for influencing agricultural practices on the ground. Each policy is described briefly using a pre-defined set of attributes. Please review this list and let us know whether you feel relevant EU-level policy instruments have been omitted and should be included in the analysis. Please bear in mind that we focus explicitly on the link between policy instruments and the adoption of practices/decisions taken by farmers.

### Step 2

The team at Milieu has already identified a number of relevant policies at national level which are included in your country-specific inventory. Please review this list of national policies, fill any information gaps, and, if necessary, correct the information already provided.

### Step 3

If applicable, please identify policy instruments implementing the respective EU instrument at regional and/or local level. Please note:

- We are only looking at those sub-national policies relevant for the region where your study site is located in. We do not intent to generate an overview of the policy framework of the whole country.
- We are interested in identifying all categories and types of instruments, not just regulatory policy instruments.
- If you need to add rows to the worksheets to capture multiple instruments at one scale, please do so. You might also find it useful to add a column for notes to document any difficulties experienced when completing the inventory or to provide additional information.

### Step 4

Once all policies have been identified, describe and analyse them along the pre-defined attributes detailed in Table 1. The team at Milieu has carried out a preliminary description and analysis for the national policies we identified during the preparatory stages; please review and amend this information if necessary before completing the information for the regional- and local-level policies you identified. To fill in the necessary information, please consult Table 1 and the DEFINITIONS worksheet in your inventory.

### Step 5

We do not expect all policies to be equally relevant in all study sites since soil quality challenges, current agricultural practices and natural as well as socio-economic conditions vary greatly between sites. In order to select those for in-depth analysis (through interviews with policy-makers and desk-based research), please carry out a preliminary assessment of the relevance of the identified policies for shaping agricultural practices using a simple rating system ranging from not relevant (1), to relevant (2) and finally to (3) highly relevant



## Reviewing and completing the list of country-specific policies

### Step 1

The worksheet named **MS POLICIES** has also been populated with those policies we identified as relevant for influencing agricultural practices on the ground. Again, most policies currently included are located at the national level. Please review this list, fill any information gaps and correct the information provided, if necessary.

### Step 2

If applicable, list policy instruments implementing the identified national policy at regional and/or local scale. Please add any national, regional or local level policy instrument that might have been omitted and that you consider relevant for influencing agricultural practices adopted by farmers on the ground in your Study Site. Please note:

- We are only looking at those sub-national policies relevant for the region where your study site is located in. We do not intend to generate an overview of the policy framework of the whole country.
- We are interested in identifying all categories and types of instruments, not just regulatory policy instruments.
- If you need to add rows to the worksheets to capture multiple instruments at one scale, please do so. You might also find it useful to add a column for notes to document any difficulties experienced when completing the inventory or to provide additional information.

### Step 3

Once all policies have been identified, describe and analyse them along the pre-defined attributes detailed in Table 1. The team at Milieu has carried out a preliminary description and analysis for the national policies we identified during the preparatory stages; please review and amend this information if necessary before completing the information for the regional- and local-level policies you identified. To fill in the necessary information, please consult Table 1 and the DEFINITIONS worksheet in your inventory.

### Step 4

We do not expect all policies to be equally relevant in all study sites since soil quality challenges, current agricultural practices and natural as well as socio-economic conditions vary greatly between sites. In order to select those for in-depth analysis (through interviews with policy-makers and desk-based research), please carry out a preliminary assessment of the relevance of the identified policies for shaping agricultural practices. Please apply a simple rating system ranging from not relevant (1), to relevant (2) and finally to (3) highly relevant.

*Guidance for completing stakeholder interviews and in-depth policy analysis*

## About this document

Once the relevant policies impacting the adoption of agricultural practices in your study site have been identified and described (see **Inventory of policies and actors for your Study Site**), you may proceed to carrying out the next steps of the policy analysis under Task 7.1: (1) interviews with key policy-makers and (2) an in-depth policy analysis using desk-based research. The order in which you wish to carry out these two tasks is up to you depending on your specific situation in the Study Site, available information and your preference as the Study Site Researcher. The next two sections provide a brief guidance on how to carry out these two tasks. Please refer to the document KEY STEPS AND METHODS sent to you in August 2017 for a more detailed description of these tasks.

### **Stakeholder interviews in your country/study site**

**Objective of the interviews** - The aim of the interviews is (1) to identify the most important national and regional policies impacting on agricultural practices (using the policy inventory as a starting point), (2) to develop an understanding of how national and regional policies promote or hinder the uptake of Soil Improving Cropping Systems (SICS), and (3) to explore factors hindering or enabling the uptake of SICS in the study site regions.

The materials you will need to carry out this step have been compiled into one document titled *WP7\_Task7.1\_material for interviews* and include:

- An information sheet to be used when contacting potential interview partners;
- The interview script designed to help you conduct the interview;
- An interview analysis template to be used to record the information obtained during the interviews.

### **Steps to carry out the interviews:**

**Step 1:** Based on the policies identified and described during the compilation of the policy inventory, you are now asked to identify 4 to 6 policy-makers to interview. These should include both national and regional level policy-makers, with emphasis on the latter. Ideally, selected policy-makers should have a good understanding of and practical experience with policy implementation, for example through working in an agency responsible for implementing Rural Development Programms. Respondents can come from a multitude of policy areas, such as agriculture, water, environment. Note – the focus should be on policy-makers as we are planning on collecting additional data from other stakeholder groups during the integrated assessment of the SICS. However, if you feel that it would be beneficial to talk to other groups, such as farmers organisations/associations or NGOs, please feel free to include them.

Please take into account your specific study site context when identifying interview partners. Key questions you may ask to identify important policy-makers : How do current agricultural practices affect soil quality? Which policies currently impact on the practices farmers adopt? Which policies may promote a change in practices and thus an uptake of SICS? Thinking about these questions should lead you to relevant policy areas and policy-makers to interview.

**Step 2:** Contact and schedule the interviews -please find the **Information sheet** in the materials we sent you which you should translate and amend according to your selected interviewees and send it as a background information with the invitation to interview.

**Step 3:** Interview questions – please find the **interview script** in the attachment. It includes all questions/areas the policy analysis will focus on. Please modify/amend it and translate it to your national language according to your specific needs and the type of interviewed stakeholder<sup>162</sup>.

**Step 4:** Carry out the interview in person or via telephone and record the interview.

**Step 5:** The information gathered through the interviews should then be summarised (in English) using the **interview analysis template** included in the materials we sent you. Please note that it is not necessary to transcribe the interview but only to summarise the key points per question. Please consult the analysis template for more detailed guidance.

The interviews should start as soon as possible – the deadline for each Study Site will be agreed on an individual basis but please bear in mind that the cut-off date to use this information for the deliverable (D7.1, due in Feb 2018) is **30 November 2017**. Any data collected after this date will still be used and very relevant as it forms the basis for the drafting of alternative policy options under Task 7.2.

### **In - depth policy analysis**

**Objective:** The aim of the in-depth analysis is to describe and analyse those national and regional policies/instruments which were identified as the *most relevant* for the adoption of SICS in your Study Site through the compilation of the policy inventories and the interviews. This means that we do not expect all policies included in the policy inventory to be analysed in detail. The material you will need to carry out this step has been compiled into one document titled *WP7\_Task7.1\_material for in-depth analysis*.

In order to carry out this task, please use the **In-depth analysis template** included in the material. It contains the examples illustrating the detailed analysis of two policies from the Czech Republic, one transposing the Nitrates Directive while the second one concerns the national legislation - Act Concerning the Protection of Agricultural Soil. Please refer to the OVERVIEW OF KEY STEPS AND METHODS document for more details about this task. The main sources of information for the in-depth analysis should be the key policy documents, evaluation studies, grey or academic literature, and other online sources such as websites of agricultural and environmental ministries and associated regional, local or technical authorities and agencies. The information you need to collect is in some ways similar to the one you gathered for the inventories (which can be used as a starting

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<sup>162</sup> In our initial description of the overall research (see document Overview of KEY METHODS and STEPS), we stated that each interview should be transcribed in English and that a summary analysis should be conducted. To reduce your workload, we have decided that it will not be necessary to transcribe interviews and translate them into English. Please proceed directly to completing the summary analysis detailed in the interview analysis template.

point to complete the analysis template) with the difference being that we are asking you to focus on a few select policies and explore them in more detail.

You do not need to integrate the interview findings into this document. However, if you fill in the in-depth analysis template after the interview, you may add the relevant information in the document or refer to the interview analysis where you feel it may complement the desk-based analysis.

The deadline for each Study Site will be agreed on an individual basis but please bear in mind that the cut-off date to use this information for final deliverable is **30 November 2017**. As explained under the previous task, data sent to us after this date will not be integrated into D7.1 but we will still need it as a basis for the upcoming Task 7.2.

### *Information sheet for interviews in study site countries*

#### **Invitation to take part in research on policies that influence the uptake of soil-improving agricultural practices**

We are contacting you as we would like you to be involved in our research project called SoilCare (<https://www.soilcare-project.eu/>), a Horizon2020 project, which aims to identify and evaluate agricultural practices that can improve soil quality<sup>163</sup>, and at the same time maintain and even increase the profitability and sustainability of EU agriculture. It is a 5-year project that brings together 28 partners from 18 EU countries, including universities, research institutes and SMEs.

A core ambition of the project is to develop a better understanding of how policy measures should be designed to encourage farmers to adopt effective soil improving practices. We are therefore conducting an analysis of the role, benefits and shortcomings of policies and policy instruments currently shaping agricultural practice. This work involves the review of policy documents, evaluation studies and interviews with selected national regional and local policy-maker. As one of the SoilCare Study Sites is located in **INSERT YOUR STUDY SITE LOCATION**, we are contacting you with a request for an interview.

Please read this information sheet carefully as it explains what your participation involves. If you have any questions, please contact us by email at **INSERT YOUR E MAIL**.

#### **What is this study about?**

The degradation of agricultural soils—which has increased over the past decade—is a major problem for European farmers, as well as for Europe's environment. Intensive agricultural practices, such as heavy tillage (ploughing), monocropping, insufficient crop rotations, the use of heavy machinery and the unsustainable use of agro-chemical inputs are all key drivers of soil degradation. Furthermore, while there are many well-known agricultural management techniques that can help to improve soil

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<sup>163</sup> See the attached Annex for a list of soil-improving agricultural practices that are being investigated by the project

quality such as crop rotations, crop diversification, low or no tillage, mulching and cover crops , uptake of these techniques generally remains low in Europe, despite various policy incentives.

The objective of the policy analysis work is to analyse the policies and contextual factors that can facilitate or hinder the uptake of these practices by farmers, along with developing policy options and scenarios related to the uptake of these practices.

### **What is the aim of the interviews?**

The aim of the interviews is to gather knowledge from policy experts at national, regional or local level about the factors that facilitate or hinder adoption of agricultural practices that improve soil and how these might change over time, based on environmental and socio-economic developments. We will be interviewing national and regional policymakers in **INSERT YOUR COUNTRY/REGION**. The data gathered will feed into a report on the impact of policies on the uptake of agricultural practices that improve soil quality and will also provide the basis for modelling the impacts of future policy options.

### **What will your participation involve?**

The interview should last approximately one hour, although this can be adapted to suit your preferences. The interviews will focus on your area of policy expertise, specifically addressing its impact on farmers' agricultural practices, how they work (in theory and in practice), relevant contextual factors and future scenarios in **INSERT YOUR COUNTRY/REGION**.

Your participation in this research is voluntary. If you decide, at any point, that you wish to withdraw from this research you are free to do so.

Interviewees will be referred to by stakeholder group from **INSERT YOUR COUNTRY/REGION** (e.g. Ministry of Agriculture representative/representative from Farmers' association in **INSERT YOUR COUNTRY/REGION** ), with no further attributes in any material published. The information will be used to inform a report that will be publicly available, which may include direct quotes that are attributed to a stakeholder group.

### **Benefits of taking part**

By taking part, you will be helping to develop knowledge in an under-studied, but critically important, policy field. The information provided will feed into policy recommendations which will aim to improve the policy framework to better integrate soil quality concerns, with the ultimate aim of reversing the decline of soil quality in Europe. The study is interested in moving beyond identifying and assessing agricultural practices that effectively maintain and improve soil quality, to understanding how they can be successfully implemented to achieve a long-term positive impact on soil quality.

### **How to contact the researchers**

You can contact us by email at **INSERT YOUR E MAIL** or or by phone at **INSERT YOUR PHONE NUMBER** if you would like any more information about the study at any point.

## ANNEX

What are Soil Improving Cropping Systems (SICS)?

Soil Improving Cropping Systems (SICS) refer to both crop type, crop rotation, and associated agronomic management techniques. SICS are understood to improve soil quality (and hence its functions), and have positive impacts on the profitability and sustainability of cropping systems. Based on a review of available literature and empirical evidence, the project has identified the following SICS<sup>164</sup>:

Component*	Specific examples (non-exhaustive)	Expected impact
<b>Crop rotation</b>	Rotation with diversified crops; use of legumes and nitrogen-fixing crops in rotations; in-field rotation; fallow periods; intercropping; mixed farming (integrating livestock in rotations)	Improves crop productivity, soil biodiversity and system sustainability; decreases need for pesticides and risk of erosion
<b>Soil cover</b>	Green manures, cover crops, catch crops; intercropping; mulching	Improves SOM content, soil structure, soil biodiversity, nutrient use efficiency; decreases nutrient leaching, run-off, erosion
<b>Integrated nutrient management</b>	Use of crop residues; composting; use of animal manures in mixed farming systems	Improves crop productivity, soil nutrient status and resource use efficiency;
<b>Enhanced efficiency irrigation</b>	Drip irrigation; use of crops adapted to local conditions (e.g. water conserving or non-water intensive crops in arid areas); timing irrigation to reduce surface evaporation; intercropping to reduce evaporation	Improves crop productivity and resource use efficiency; minimizes risks of salinization and desertification
<b>Controlled drainage</b>	Re-use of water on farm; ditches etc to allow run-off; afforestation to reduce waterlogging	Improves crop productivity and resource use efficiency; minimizes the risk of waterlogging
<b>Reduced or zero tillage</b>	Conservation agriculture; use of winter cover crops or intercropping (with attention to reduced herbicide use)	Reduces energy cost and may enhance SOM content and soil structure; may increase the need for herbicides/ pesticides
<b>Integrated pest management</b>	Companion planting; organic fertilisers; natural predators; margins/buffers	Improves crop productivity and resource use efficiency; minimizes the loss of biodiversity.
<b>Weed control</b>	Mechanical weeding; hand weeding	Improves crop productivity and resource use efficiency; may decrease the need for herbicides
<b>Residue management</b>	Mulches; use of residues; rotations with animals	Reduces evaporation and soil temperature; may increase/decrease the success of germination
<b>Controlled trafficking</b>	Timing of vehicle traffic (ie not when soil is waterlogged); reduced use of heavy machinery; drive corridors	Reduces energy cost and the risk of soil compaction
<b>Integrated landscape management</b>	Mixed farming and rotations; water harvesting e.g. through dams, reservoirs	Improves biodiversity and cropping systems sustainability

<sup>164</sup> A preselection of soil-improving cropping systems, WP2 Summary report (Draft), dated 30 Nov 2016).

*\*based on main crop rotations in Europe and combinations of agro-management techniques, which have to be optimised for site specific environmental, and socio-economic conditions*

## *Script for interviews in study site countries*

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### Introduction

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#### **What the project is about**

- *We are part of WP7 concerned with policy analysis. As Study Site Researchers (SSRs) we are supporting the Study Site level analysis in **INSERT YOUR COUNTRY/REGION/STUDY SITE** – looking into what policies impact agricultural practices adopted by farmers (especially SICS – refer to the Annex of the Info sheet with the SICS table)*

#### **Aims of the interviews**

- *Deeper insight from experts in the field of policy aims and practices that impact which practices farmers adopt in **INSERT YOUR COUNTRY/REGION/STUDY SITE** (especially those affecting soil), and other factors that condition the impact these policies have*

#### **Structure of the interviews**

- *Semi-structured*
- *3 parts: 1) short intro to expert's background and expertise, 2) policies and practices, 3) future developments (policy and wider factors)*
- *Focusing on their area of expertise (but touching on others as appropriate if they crop up)*

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### Consent

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**17. Do you have any questions regarding our research or the interview?**

**18. Are you happy for the interview to be recorded?**

- For researcher's personal information only – so that we can concentrate on the interview

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### Background questions

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**19. Can you tell us a little but about the main areas that you work on in your current role?**

**20. What is the nature of that work?**

- e.g. economic analysis, research, implementation, policy maker

- 21. What are the main soil threats/soil management problems in *INSERT YOUR COUNTRY/REGION/STUDY SITE?***
- 22. How are current agricultural practices contributing to these threats/problems?**
- 23. What type of SICS do you promote through the policies and instruments you are working with?**
- To what extent are farmers adopting these practices?
  - What are barriers/incentives to their uptake?

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Current policies and other factors

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- 24. Which policy areas in general you think have the biggest impact on farmers' agricultural practices in *INSERT YOUR COUNTRY/REGION/STUDY SITE?***
- e.g. EU level instruments – CAP or national legislation/policy concerning Water (Nitrates, Floods), Nature protection/biodiversity, Climate, Food Safety, IT/Tech
  - Funding Programs e.g. LIFE, AIPs (CAP), Research e.g. Horizon 2020, Cohesion policy funding
- 25. Can you tell us about the ways in which the policies and instruments you work on affect farmers' agricultural practices *in INSERT YOUR COUNTRY/REGION/STUDY SITE?***
- Do they place mandatory requirements on farmers?
  - Do they provide any economic incentives?
  - Do they change attitudes?
- 26. Do you think that the policies and instruments are having the above impacts in practice?**
- Can you think of any examples?
  - Are they being properly enforced?
  - What evaluations of the policies have been carried out and what were the main results?
  - Is there variation across regions in *INSERT YOUR COUNTRY/REGION/STUDY SITE?*
- 27. Do you think that there are any other policies and instruments that affect how the policies that you work on impact on farmers' agricultural practices?**
- Are their synergies between policies?
  - Are there any conflicting requirements or incentives placed on farmers?
- 28. Which other wider contextual factors do you think also affect the implementation of these policies and instruments and their impact on practices in *INSERT YOUR COUNTRY/REGION/STUDY SITE?***
- E.g. farmers' beliefs; institutions (e.g. finance, property rights); geographical location
  - Any practical examples?

- Variation across regions?

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Future developments

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- *Having talked about current drivers of farmers' agricultural practices, we would now like to think about future policies and wider contextual factors that will be influencing the uptake of soil-improving practices in the future*

**29. Do you think that we need to change existing policies/ instruments in *INSERT YOUR COUNTRY/REGION/STUDY SITE*?**

- If so which policies and which instruments, and at which level?
- Do we need completely new policies?
- What other factors would need to change to ensure better implementation of the policies in question?

**30. What do you see as the key drivers of change in *INSERT YOUR COUNTRY/REGION/STUDY SITE* over the next 50 years?**

- What are the impacts of these drivers on agriculture?
- Where do they lead to?

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Conclusion

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**31. Are there any other issues that you would like to raise?**

**32. Are there any other people you feel we should talk about this topic?**

- *Are you happy to be contacted for follow up questions or to clarify anything?*
- *We will send you a copy of the research*

*Analytical template for interviews in study site countries*

- *Please complete this template (table 1 and table 2 below) for each interview that you have conducted.*
- *The first column lists the main questions of the interview script and you can use the second column to record the interviewee's responses to each question; if you would like to note down any comments from your side, observations and additional information which might complement the interviewee's responses, please use the last column. This might include your assessment of the*

relevance of a particular response, an idea on how this relates to any documents you have read or your view on that particular response.

- There is no need to transcribe the interviews to fill in the template; a summary of the interviewees' answer to the questions asked will suffice.
- If you feel that some of the topics covered during the interview are not reflected in the template, please feel free to insert additional rows.

### Interview analysis **(TO BE COMPLETED FOR EACH INTERVIEW)**

**Study Site**  
**Interviewed stakeholder**  
**Institution**  
**Date**  
**Completed by**

**PLEASE INSERT** NAME AND INSTITUTION OF STAKEHOLDER, COUNTRY/REGION/STUDY SITE

No.	Question	Interviewee's response (Summary of key points)	Your comment/observations (not obligatory to fill this in)
3/4	Areas of work/role		
5	Main soil threats/management problems		
6	Contribution of agricultural practices to main soil threats/management problems		
7	SICS promoted <ul style="list-style-type: none"> <li>• uptake by farmers</li> <li>• barriers/facilitators of adoption</li> </ul>		
8/9	Identification and description of policies with biggest impact on farmers' agricultural practices		
10	Assessment of policy impacts in practice <ul style="list-style-type: none"> <li>• positive and negative impacts</li> <li>• examples</li> <li>• regional differences</li> <li>• available evidence, e.g. evaluation studies</li> </ul>		

- 11 *Synergies and conflicts with other policies impacting on agricultural practices*
- 12 *Contextual factors impacting policy implementation*
- 13 *Need for change of existing policies*
- 14 *Key drivers of change and impact on agriculture*
- 15 *Other issues raised*
- 16 *Suggestion for additional interview partners*

### *In-depth analysis template*

#### **Instructions to fill in the in-depth analysis template<sup>165</sup>**

- **Information sources**- desk research including policy documents, evaluation studies, the wider academic literature, grey literature (e.g. published by environmental NGOs), on-line sources (e.g. Ministry of Agriculture website, national institutes/agencies relevant for agriculture and soil, national/regional/local media), your expert knowledge
- **NOTE** – you are not expected to use the interview findings for the in-depth analysis, this will be done by Milieu at the synthesis stage (however, you may refer to any relevant insights if you wish)
- Please note down any gaps in the research in the comments
- Send back to [Zuzana.lukacova@milieu.be](mailto:Zuzana.lukacova@milieu.be) by 30 November

<b>Study Site</b>	
<b>Completed by</b>	
<b>Date</b>	
<b>Policies analysed</b>	

#### **In-depth analysis of insert the name of your analysed policy**

Analytical framework component	Key questions	Policy XYZ – <u>Insert the name of policy</u>
<b>Rationale/context</b>	<ul style="list-style-type: none"> <li>• Brief description of key challenges, initiatives/developments in the policy area.</li> </ul>	
	<ul style="list-style-type: none"> <li>• What are the key policy needs addressed by the policy (problems/challenges in this policy area)?</li> </ul>	
<b>Policy objectives</b>	<ul style="list-style-type: none"> <li>• Brief policy description.</li> </ul>	
	<ul style="list-style-type: none"> <li>• What are the overall objectives of the policy?</li> </ul>	

<sup>165</sup> This guidance and the template was accompanied by two illustrative examples.

	<ul style="list-style-type: none"> <li>Do policy aims and objectives explicitly/implicitly target agricultural practices (if yes, have specific targets been defined)?</li> </ul>	
<b>Policy instruments</b>	<ul style="list-style-type: none"> <li>What policy instruments are used?</li> </ul>	
	<ul style="list-style-type: none"> <li>How is the policy implemented (Responsible authorities, planning process and outputs, link to other policies)?</li> </ul>	
	<ul style="list-style-type: none"> <li>How may instruments explicitly/implicitly address agricultural practices?</li> </ul>	
<b>Policy impacts</b>	<ul style="list-style-type: none"> <li>What are the main impacts of implementation that could influence agricultural practices?</li> </ul>	
	<ul style="list-style-type: none"> <li>What have been the direct and indirect impacts on agricultural practices, to the extent that evidence is available?</li> </ul>	
	<ul style="list-style-type: none"> <li>How do these impacts interact with those related to other policies?</li> </ul>	
	<ul style="list-style-type: none"> <li>How do contextual factors (such as institutional settings, quality of advisory services available, farm type/size etc.) affect the impacts from the EU policy?</li> </ul>	
	<ul style="list-style-type: none"> <li>Uncertainties/data gaps in the assessment of impacts?</li> </ul>	

## Annex IV: Overview of European level interviews

<b>Date</b>	<b>Organisation / unit</b>
27-07-2017	DG ENV Water Unit
22-08-2017	DG ENV Biodiversity Unit
22-08-2017	DG ENV Land Management Unit
23-08-2017	DG SANTE
08-09-2017	Birdlife
25-09-2017	European Landowners Organisation (ELO)
26-09-2017	DG AGRI Greening Cross-compliance and POSEI
26-09-2017	Copa Cogeca
27-09-2017	WWF
11-10-2017	IFOAM
11-10-2017	EEB
25-10-2017	DG AGRI Research and Innovation