

Policy analysis:

Promoting SICS adoption in Almeria, Spain

Authors: Alicia McNeill, Melanie Muro, Tugce Tugran, Zuzana Lukacova, Milieu and Emilio Galdeano-Gómez, José A. Aznar-Sánchez, University of Almeria

Report number: **20**

Deliverable: **-**

Report type: **Scientific Report**

Issue date: **18/06/2021**

Project partner: **Milieu**

Version: **1.0**



DOCUMENT SUMMARY	
Project Information	
Project Title:	Soil Care for profitable and sustainable crop production in Europe
Project Acronym:	SoilCare
Call Identifier:	H2020-SFS-2015-2b
Grant agreement no.:	677407
Starting Date:	01.03.2016
End Date:	31.08.2021
Project duration	66 months
Web-Site address:	www.soilcare-project.eu
Project coordinator:	Wageningen Environmental Research (WEnR)
EU project representative & coordinator of the project:	Dr. Rudi Hessel - (rudi.hessel@wur.nl) +31 317 486 530
Project manager(s):	Erik van den Elsen (erik.vandenelsen@wur.nl), Simone Verzandvoort (simone.verzandvoort@wur.nl), Falentijn Assinck (falentijn.assinck@wur.nl)
Report Information	
Report Title:	Policy analysis: Promoting SICS adoption in Almeria, Spain
Principle Author(s):	Alicia McNeill, Melanie Muro, Tugce Tugran, Zuzana Lukacova, Milieu and Emilio Galdeano-Gómez, José A. Aznar-Sánchez, University of Almeria
Principle Author e-mail:	melanie.muro@milieu.be
Deliverable Number:	-
Work Package:	WP7
WP Leader:	Milieu
Nature:	PU
Dissemination:	Document
Editor (s):	-
E-Mail(s):	-
Telephone Number(s):	-
Report Due Date	-
Report publish date:	18-06-2021
Copyright	©2020 the SoilCare project and Partners Copyright notice and disclaimer: http://tinyurl.com/soilcare-disclaimer

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
10	Milieu LTD	MLTD	Belgium
11	Norwegian Institute of Bioeconomy Research	NIBIO	Norway
12	Bodemkundige Dienst van België	BDB	Belgium
13	Aarhus University	AU	Denmark
14	Game & Wildlife Conservation Trust	GWCT	United Kingdom
15	Teagasc	TEAGASC	Ireland
16	Soil Cares Research	SCR	Netherlands
17	Instituto Politecnico De Coimbra	IPC/ESAC	Spain
18	National Research and Development Institute for Soil Science, Agrochemistry and Environmental Protection	ICPA	Romania
19	University of Padova	UNIPD	Italy
20	Institute of Agrophysics of the Polish Academy of	IAPAN	Poland
21	Wageningen University	WU	Netherlands
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

Contents

Executive Summary	2
1 Introduction.....	6
2 Analysis of policy shortcomings and opportunities in Almeria, Spain	12
2.1 Which existing policies and policy instruments shape agricultural practices in Almeria?....	13
2.2 To what extent do existing policies facilitate adoption of soil-improving practices in Almeria?	17
2.3 Which factors shape success or failure of policy instruments in Almeria?.....	21
3 Recommendations for actions to promote the uptake of SICS.....	24
Annex: Overview of key policies in Almeria, Spain	26

List of tables

Table 1: Coverage of SICS in current regional policies, instruments and measures in Almeria (ES).....	2
Table 2: Adoption barriers, enablers, and actions to increase uptake of the SICS tested at study site identified by stakeholders. Due to time limitations, some of the workshops only addressed a subset of SICS tested in the respective study site. Participants were asked to identify actions for the most important factors affecting SICS adoption; therefore, not all adoption factors were discussed in detail. To assess the effectiveness and feasibility of an action, a scale from 1 (not at all effective/feasible) to 4 (highly effective/feasible) was used.	4
Table 3: List of promising general SICS.....	6
Table 4: Summary of policy approaches	7
Table 5: Organisations represented by interview partners	10
Table 6: Description of the study site.....	12
Table 7 Overview of experiments carried out in the Spanish study site, and the SICS category and cluster under which they are grouped	13
Table 8 Coverage of SICS in current regional policies, instruments and measures in Almeria (ES).....	19
Table 9: SICS being tested, adoption factors (enablers or barriers) and actions to overcome the barriers	23

List of figures

Figure 1: Research strategy	9
Figure 2: Types of stakeholders participating in the Almeira (ES) adoption workshop	11

Executive Summary

The soil-improving cropping systems (SICS) tested at the SoilCare study site in Almeria, Spain, include cover crops, reduced tillage, and efficient irrigation management. In addition, there are several long-term experiments testing various tillage methods (conventional, reduced and no tillage), fertiliser applications, crop rotation systems (including legumes and other soil improving crops), as well as residue management methods (post-harvest residues left on the fields for nutrients and organic matter recovery). Both the SICS trialled at the site within the context of SoilCare as well as the long-term experiments are aimed to address the main soil threats of soil compaction, water scarcity, high salt content, and excessive nutrient input. They therefore represent important practices that might benefit soil health in the region if widely taken up.

Policy shortcomings and opportunities

The table below provides an overview of policies promoting the full range of SICS covered by the SoilCare project (shaded in light green). The analysis shows that several policies regulate and incentivise the use of cover crops, reduced tillage, and integrated nutrient management, the SICS tested at the study site (shaded in dark green): direct payments, greening measures, and rural development plans under the CAP all provide financial rewards to farmers adopting reduced or no-tillage practices and cover crops (in the form of nitrogen-fixing crops) but only on certain types of land. Integrated nutrient management practices are regulated mostly through water protection legislation. In addition, policies implementing the EU Organic Regulation formulate mandatory requirements for fertiliser use and tillage practices. Most of the policies identified as relevant do not regulate or incentivise efficient irrigation practices with the exception of the National Action Programme to Combat Desertification, which, however, mainly focuses on promoting good soil management practices through information sharing and demonstration projects.

Table 1: Coverage of SICS in current regional policies, instruments and measures in Almeria (ES)

Policy	Crop rotation	Green manures, cover crops, catch crops	Integrated nutrient management	Enhanced efficiency irrigation	Controlled drainage	Reduced tillage	Integrated pest management	Smart weed control	Smart residue management	Controlled traffic management	Integrated landscape management
CAP GAEC cross-compliance standards and greening payments ¹											

¹ 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 pagos al desarrollo rural

Policy	Crop rotation	Green manures, cover crops, catch crops	Integrated nutrient management	Enhanced efficiency Irrigation	Controlled drainage	Reduced tillage	Integrated pest management	Smart weed control	Smart residue management	Controlled traffic management	Integrated landscape management
CAP Greening requirements ¹⁹											
CAP Rural Development Program of Andalucía 2014-2020											
Royal Decree on agro-ecological production and its indication in agricultural products and foodstuffs											
Decree on organic agro-food production in Andalusia											
III Andalusian Plan of Ecological Production Horizon 2020	X	X	X			X	X			X	X
Law on fiscal, administrative and social measures											
Law on Waters for Andalusia.											
Royal Decree amending Annex II of Royal Decree 1514/2009 of 2 October, which regulates the protection of groundwater											
Royal Decree protecting waters from the pollution by nitrates derived of agricultural sources											
Order approving the action program applicable in areas vulnerable to nitrate pollution from designated agricultural sources in Andalusia											
Decree on the Use of Sewage Sludge in the Agricultural Sector											
Decree approving the Waste Regulations of Andalusia											
Royal Decree establishing the framework of action to achieve a sustainable use of phytosanitary products											
Decree on 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 application of phytosanitary products											
Royal Decree modifying the Royal Decree 506/2013, of June 28, on fertilizer products											
National Action Programme to Combat Desertification											

Recommendations for actions to promote the uptake of SICS

Research indicates that there are several factors that shape the success or failure of policy instruments in Almeria, and the uptake of SICS tested in the study site region in general. These factors include:

- Applying for payments is too bureaucratic
- Lack of enforcement
- Trust in long-established practices
- Costs of transitioning to new practices

- Environmental conditions

The table below provides an overview of barriers and enablers for the SICS tested at the study site and which were identified by stakeholders during the adoption workshop.

Table 2: Adoption barriers, enablers, and actions to increase uptake of the SICS tested at study site identified by stakeholders. Due to time limitations, some of the workshops only addressed a subset of SICS tested in the respective study site. Participants were asked to identify actions for the most important factors affecting SICS adoption; therefore, not all adoption factors were discussed in detail. To assess the effectiveness and feasibility of an action, a scale from 1 (not at all effective/feasible) to 4 (highly effective/feasible) was used.

Cover crops and enhanced efficiency irrigation: Controlled deficit irrigation and mulch cover with pruning remains and vegetable coverings sown	
Adoption factors (+ or -)	Actions
Maladapted policy setup (-)	More focus on subsidising sustainable agricultural management
Farmers' resistance for new practices (-)	Dissemination of successful experience from fellow farmers
Lack of awareness and information (-)	Awareness and information campaigns, training of farmers
Lack of access to technology and machinery (-)	Financial support through grants or subsidies
Lack of enforcement and monitoring (-)	Effective control of current regulations regarding bad practices (burning of stubble, illegal wells, pollution by nitrates)
Water scarcity (-)	<i>None identified</i>
Operational costs (-)	Subsidies to alleviate costs associated with seed
Size of exploitation (-)	<i>None identified</i>
Cover crops and enhanced efficiency irrigation: Controlled deficit irrigation and vegetative cover of adventitious herbs/plant cover planted	
Adoption factors (+ or -)	Actions
High provision of inputs (+)	<i>None identified</i>
Dissemination of efficiency potential as wind erosion control (+)	Dissemination of successful experience from fellow farmers
Access to technology / machinery (+)	Financial support through grants or subsidies
Lack of enforcement and monitoring (-)	Effective control of current regulations regarding bad practices (burning of stubble, illegal wells, pollution by nitrates)
Farmers' resistance to new practices (-)	Dissemination of successful experience from fellow farmers
Plant cover selection (-)	<i>None identified</i>
Lack of training for farmers (-)	Awareness and information campaigns, training of farmers

Recommendations for actions to promote the uptake of SICS

Based on this analysis, and feedback collected from stakeholder, the following recommendations were formulated:

- **Establish mechanisms for effective knowledge dissemination and exchange between farmers:** Some of the practices benefitting soil will require farmers to learn about these techniques, their application to different conditions as well as their benefits in order to change their misconceptions about these methods. To this end, research findings should be made accessible and widely disseminated and educational activities should be encouraged. Knowledge should be disseminated via multiple channels, through the provision of guidance document but also farms visits and demonstration days. Since farmers tend to place a lot of trust in their peers, establishing a network of model farms, for example under the umbrella of the National Action Programme to Combat Desertification, demonstrating how to use and adapt different SICS in the

region would effectively support farmers in learning and sharing experiences about these practices.

- **Subsidise transition to practices benefitting soil health:** The uptake of certain SICS, such as cover cropping, enhanced efficiency irrigation and reduced tillage, might require upfront investments, such as the purchasing of additional seeds and new machinery. Grants should be made available to farmers buying new equipment to implement these practices or groups of farmers intending to set up a 'machinery exchange'. Such an exchange could also be set up and managed by the regional/local farm advisory services or municipalities.
- **Strengthen policy enforcement:** While it was found that there are a number of policies already in place that – directly and indirectly - regulate and incentivise different SICS, stakeholders report that outcomes on soil health are limited due to weak enforcement mechanisms. It is clear mechanisms for checking compliance with existing regulations need to be strengthened and expanded.
- **Make incentives more effective by simplifying application process:** Evidence suggest that economic incentives might not be a key driver for SICS adoption with the current system perceived to be overly bureaucratic by farmers. With the post-2020 CAP, new funding rules funding rules will be introduced. The Good Agricultural Environmental Conditions (GAECs) now offer a greater chance for soil protection. New conditions with the potential to improve soil health have been added, e.g., the new GAEC 7 requires "No bare soil in most sensitive period(s)" (European Commission, 2018b). Cover crops will be an important strategy for meeting this requirement. The payment agencies should seek to simplify procedures for farmers applying for CAP payments in order not to deter farmers from adopting SICS.

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 is an essential ecosystem 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. However, these are often not adopted to their full potential and in some cases are eventually abandoned, and the question remains as to why support and adoption of these practices by European farmers is still considerably weak.²

Research aim and questions

The work presented here was carried out as part of the EU-funded SoilCare project³. The overall aim of SoilCare is to identify, evaluate and promote promising soil-improving cropping systems (SICS). SoilCare defines SICS as cropping systems that improve soil quality (and hence its functions), and that have positive impacts on the profitability and sustainability of agriculture. Cropping systems refer to crop type, crop rotation, and associated agronomic management techniques (see Table 3).

Table 3: List of promising general SICS⁴

Component	Expected impact
Crop rotation	Improves crop productivity, soil biodiversity and system sustainability; decreases need for pesticides and risk of erosion
Green manures, cover crops, catch crops	Improves Soil Organic Matter (SOM) content, soil structure, soil biodiversity, nutrient use efficiency; decreases nutrient leaching, run-off, erosion
Integrated nutrient management	Improves crop productivity, soil nutrient status and resource use efficiency;
Enhanced efficiency irrigation	Improves crop productivity and resource use efficiency; minimizes risks of salinization and desertification
Controlled drainage	Improves crop productivity and resource use efficiency; minimizes the risk of waterlogging
Reduced tillage	Reduces energy cost and may enhance SOM content and soil structure; may increase the need for herbicides/ pesticides

² E.g., Lahmar, R. 2010. Adoption of conservation agriculture in Europe: Lessons of the KASSA project. *Land Use Policy* 27(1): 4-10

³ SoilCare: Soilcare for profitable and sustainable crop production in Europe, <https://www.soilcare-project.eu/>

⁴ 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>

Component	Expected impact
Integrated pest management	Improves crop productivity and resource use efficiency; minimizes the loss of biodiversity.
Smart weed control	Improves crop productivity and resource use efficiency; may decrease the need for herbicides
Smart residue management	Reduces evaporation and soil temperature; may increase/decrease the success of germination
Controlled traffic management	Reduces energy cost and the risk of soil compaction
Integrated landscape management	Improves biodiversity and cropping systems sustainability

The main aim of the work presented here was to formulate policy alternatives⁵ and actions at EU and study site level to facilitate the adoption of soil-improving cropping systems. 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.

A starting point for any policy analysis is to recognise the success and failures of different types of policy – whether they are regulatory instruments, economic instruments, voluntary instruments, or educational/information instruments. There is plenty of academic research available on the efficiency and effectiveness of these instruments in general, and it is beyond the scope of this Country Report to assess them in detail. However, it is important to recognise the limitations of each, as many of the success and failures of national soil policy may be attributed to the fundamental successes and failures of the types of policy. Table 2 below provides a summary of the different types of policies.

Table 4: Summary of policy approaches

Policy approach	Premise	Positive attributes	Negative attributes
Regulatory instruments	Force farmers to adopt SICS	<ul style="list-style-type: none"> Levels the playing field between competitors, as everyone must play by the same rules Fairly consistent (often long-term) 	<ul style="list-style-type: none"> Inflexible regardless of individual situations May be costly to implement Monitoring and enforcement can be costly Discourages innovation
Economic instruments	Incentivise farmers to adopt SICS	<ul style="list-style-type: none"> Encourages innovative methods Can offset cost of implementation 	<ul style="list-style-type: none"> Can be subject to fluctuations as the market fluctuates

⁵ Policy, loosely defined, is “officially accepted set of rules or ideas about what should be done” or “a system of courses of action with a common long-term objective (or objectives) formulated by governmental entities or its representatives” (see <http://learnersdictionary.com/definition/policy> and <https://www.thefreedictionary.com/policy>). Policy alternative refers to a set of different types of policy options including economic instruments, regulatory instruments, planning instruments and information/knowledge instruments.

Policy approach	Premise	Positive attributes	Negative attributes
	using subsidies and taxes etc.	and/or discourage adverse behaviour <ul style="list-style-type: none"> Allows a certain amount of flexibility 	<ul style="list-style-type: none"> High likelihood of setting subsidies/taxes at incorrect rate (which leads to inefficiencies) Can be subject to game-playing behaviour
Voluntary instruments	Encourage farmers to adopt SICS	<ul style="list-style-type: none"> Sense of “ownership” as the decision was taken freely High degree of flexibility 	<ul style="list-style-type: none"> Does not guarantee implementation
Educational/information instruments	Educate farmers so they understand the importance of SICS	<ul style="list-style-type: none"> Implementation as a result of truly understanding the impacts of the actions High degree of flexibility 	<ul style="list-style-type: none"> Does not guarantee implementation Relies on interest of affected parties Often takes more time to become effective

Against this background, the following research objectives were formulated at the outset of the work:

- A. To identify existing policies and policy instruments at EU-level as well as national and (sub)regional level in the 16 SoilCare countries promoting soil quality, and particularly the adoption of soil-improving cropping systems.
- B. To describe the intended mechanisms and impacts of existing policies, instruments, and practices.
- C. To assess the extent to which existing policies, policy instruments and practices promote the adoption of soil-improving cropping systems.
- D. To identify contextual factors, particularly institutional settings, influencing policy impact on farmer adoption.
- E. To identify existing policies, policy alternatives and complementary actions that could promote the uptake of SICS.
- F. To assess the performance of good policy alternatives, their advantages, and disadvantages.

This report presents an inventory and analysis of bottlenecks and opportunities in sectoral and environmental policies to facilitate the adoption of SICS in Spain and fits into a larger research initiative involving 16 European countries in total.⁶ Based on this analysis, it presents policy alternatives and actions for the national and/or (sub)regional level with the potential of

⁶ The 16 countries include 13 EU Member States, i.e., Belgium, Germany, France, Czech, Poland, Hungary, Romania, Denmark, Sweden, Greece, Spain, Italy, and Portugal and three non-EU countries, i.e., UK, Switzerland, and Norway.

promoting the uptake of SICS.

Methods

The research and preparation of this report were undertaken by two groups of researchers – the core team of the task, who were responsible for the preparation and research for EU-level policy and all 16 study sites, working in close coordination with researchers with specific knowledge about the study site – the study site researchers. This approach ensured that there was both consistency between the 16 country reports, of which this Spanish report is but one, but local knowledge and documents and information in local languages were also well utilised.

Figure 1 illustrates the overall study design and methods, which were applied to answer specific research questions. Whilst each data collection activity focused on a sub-set of the research questions, they are closely related, and the information gathered through the mix of methods applied were used to feed into different research questions.

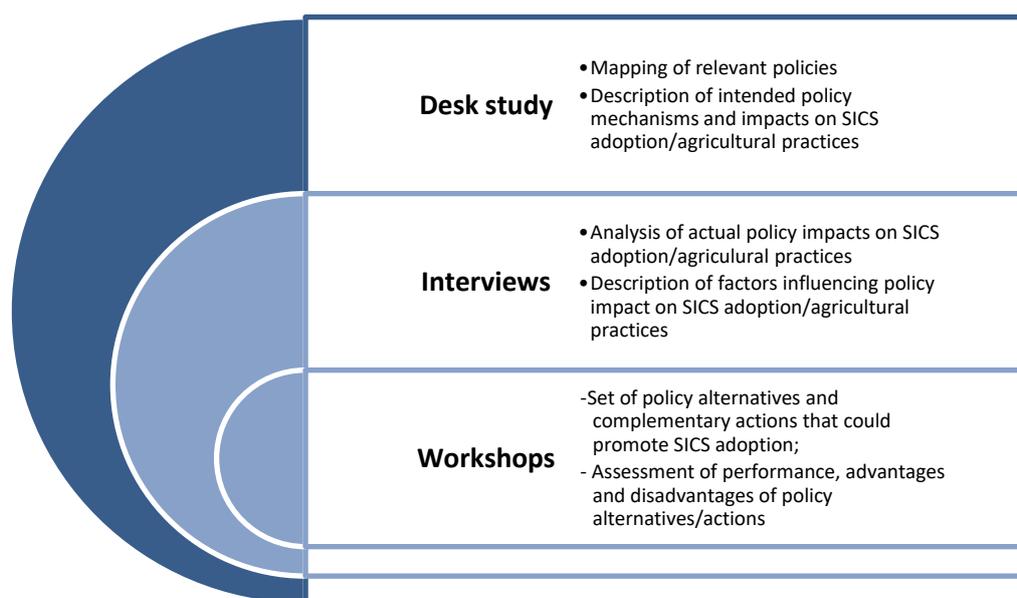


Figure 1: Research strategy

Data collection and analysis involved the following three activities:

- 1) A desk-study of policy documents (in the broadest sense) and relevant literature:** policies potentially impacting the adoption of SICS in the study sites were identified. The aim of this step was to provide a broad overview of soil-related national and regional⁷ policies from which the most relevant policies could be selected for in-depth

⁷ The term "region" refers in this context to the sub-national level, particularly the area of the country where the respective study site is located.

analysis. A draft inventory was compiled, including those national, regional, and sub-regional policies that were linked to a set of pre-selected EU policies (primarily concerning environmental and agricultural topics); however, in the case of regional and sub-regional policies, these were limited to those directly relevant to the study site (i.e. not all regions and sub-regions were included). For each policy, the following information was recorded: date of adoption, governance scale, type of instrument, link to cropping system (components) etc.⁸ Based on the screening done in the first step, the national and regional policies deemed most relevant for the study site were subject to a more in-depth analysis. This was done through desk research carried out by the study site researchers.

- 2) Interviews with selected national and regional policymakers and stakeholders:** based on this analysis, Study Site Researchers then conducted interviews with policymakers and stakeholders using a semi-structured interview guide. In Spain, two interviews were carried out (see Table 5).

Table 5: Organisations represented by interview partners

Organisation	Stakeholder category
Jefe del Servicio de Promoción Rural, Consejería de Agricultura, Pesca y Desarrollo Rural (Delegación Territorial)	Regional/local government
Jefe de Servicio de Agricultura, Ganadería, Industrias y Calidad, Consejería de Agricultura, Pesca y Desarrollo Rural (Delegación Territorial)	Regional/local government

- 3) An adoption workshop with national and regional policymakers and stakeholders:** To develop and assess policy alternatives, the Study Site Research Teams organised a stakeholder workshop in each site, following a common guidance document which detailed the structure and methods for the event. Study site teams mostly invited those stakeholders they were already working with, either within the context of SoilCare or as part of their regular engagement activities. The Spanish workshop brought together 14 stakeholders, including farmers, policymakers, advisory services and scientists (see Figure 2).

⁸ The policy inventory is available at: <https://www.soilcare-project.eu/outputs>

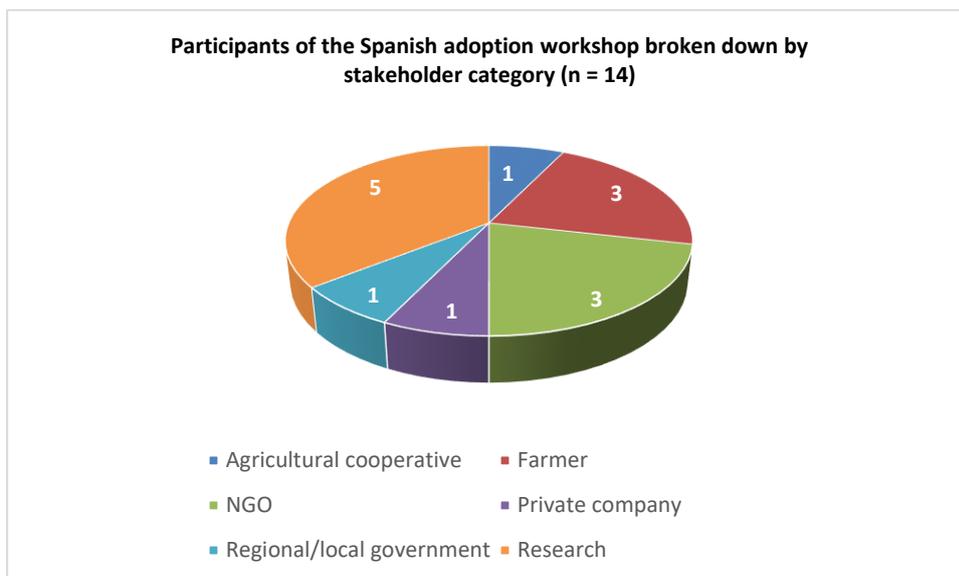


Figure 2: Types of stakeholders participating in the Almeira (ES) adoption workshop

Report outline and where to find supplementary information

Section 2 of this report presents an analysis of policy instruments relevant for shaping agricultural practices in Almeria where the Spanish study site is located.⁹ It examines how existing instruments may impact on the adoption of SICS and explores the factors which enable or hamper uptake of these practices.

Section 3, on the basis of the previous section, formulates actions which could promote a shift in agricultural practices in the study site region and facilitate a wider adoption of SICS.

A detailed analysis of all relevant EU-level policies as well as national, regional and sub-regional policies in the countries covered by this research is reported in *D7.1 Inventory of opportunities and bottlenecks in policy to facilitate the adoption of soil-improving techniques* for, available at: <https://www.soilcare-project.eu/outputs/deliverables>.

A synthesis of findings and recommendations from the EU-level and cross-country analysis can be found in *D7.2 Report on the selection of good policy alternatives at EU and study site level*, available at: <https://www.soilcare-project.eu/outputs/deliverables>.

Individual country policy inventories can be downloaded from: <https://www.soilcare-project.eu/outputs>

⁹ See D7.1 at <https://www.soilcare-project.eu/outputs>

2 Analysis of policy shortcomings and opportunities in Almeria, Spain

This section provides a review and analysis of national instruments relevant for shaping agricultural practices in the region of Almeria where the study site is located. Policies investigated include both policies implementing EU instruments as well as those initiated by the national Spanish authorities. The information is drawn from the policy inventories compiled by the Study Site Researchers as well as interviews conducted with key stakeholders.

The case study site is briefly described in the table below.

Table 6: Description of the study site

Site Name	Almeria, Spain (Sorbas-Tabernas Basin and Cabo de Gata Natural Park)
Climate	Sorbas-Tabernas: semiarid thermo-Mediterranean, average annual rainfall of 235 mm. Cabo de Gata: semiarid warm Mediterranean, average annual rainfall is approximately 220 mm, with prolonged summer droughts.
Temperatures	Sorbas-Tabernas: average annual temperature of 17.8° C. Cabo de Gata: average annual temperature between 18-19° C. with sporadic isolated frosts.
Soil type	Leptosol or Regosol (World Reference Base), also Cambisols for olive cultivation. Soils are loamy to sandy loam, with basic pH, low organic matter and nutrients content and shallow depth. In some places, calcareous Fluvisols are found in the "Ramblas" around the study zone.
Main soil threats	Sorbas-Tabernas: high salt content, sensitivity to pests and diseases and crop costs. Cabo de Gata: scarce water resources, soil and airborne fungi, high soil compaction
Current practices	Non-tillage and weed control with herbicides or reduced tillage is applied in most modern olive and stone fruit orchards, drip irrigation, use of conventional fertiliser, conventional use of pesticides. Some conventional and organic oil orchards in Sorbas Tabernas, use of herbicide and reduce tillage in Cabo de Gata.

The experiments carried out in the study site are described below. Each field trial provides evidence on the costs and benefits.

Table 7 Overview of experiments carried out in the Spanish study site, and the SICS category and cluster under which they are grouped

General treatment category	SICS cluster ¹⁰	Experiments
Cover crops, reduced tillage, enhanced efficiency irrigation	Soil cultivation/Soil improving crops	1. Regulated vs constant deficit irrigation and minimum tillage in olive orchards
		2. Regulated vs constant deficit irrigation and minimum tillage plus pruning residues added in olive orchards
		3. Regulated vs constant deficit irrigation and minimum tillage plus temporal cover crops (natural weeds and sowed) in olive orchards
		4. Regulated vs standard irrigation and non-tillage (herbicide weed control) in peach orchards
		5. Regulated vs standard irrigation and non-tillage plus pruning residues added and temporal natural vegetation in peach orchards
		6. Regulated vs standard irrigation and non-tillage plus pruning residues and temporal cover crops sowed in peach orchards

2.1 Which existing policies and policy instruments shape agricultural practices in Almeria?

This section provides a review and analysis of national and regional instruments relevant for shaping agricultural practices in the region where the study site is located. Policies investigated include both policies implementing EU instruments as well as those initiated by Spain and the region of Almeria, where the study site is located¹¹: The overview provides a description of those policies identified as most important for soil-improving practices and does not intend to provide an exhaustive overview of the policy landscape governing agricultural methods. The information is drawn from the policy inventories compiled by the Study Site Researchers as well as interviews conducted with key stakeholders.

Agricultural policies

The different funding instruments established under the EU **Common Agricultural Policy (CAP)** greatly influence farming practices in the region. Direct payments are tied to farmers meeting the **Good Agricultural and Environmental Conditions (GAEC)** as well as the greening requirements set out by the policy.

The following GAEC standards are relevant for soil protection in Spain:

- GAEC 4 prohibits non-irrigated arable land on which winter crops are grown to be ploughed before the 1st of September. In addition, green cover of at least one metre

¹⁰ SICS are grouped into four clusters: (1) Soil-improving crops, (2) Fertilisation/amendments, (3) Soil cultivation, and (4) Alleviation of compaction.

¹¹ See the Annex for a more detailed overview of the policies described in this section.

wide is 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.

Greening requirements were first introduced in 2015 and apply to direct payments under Pillar 1 of the CAP. Cover cropping is one of the options farmers may implement for Ecological Focus Areas (EFAs). Farmers with over 15 ha of arable land have had to devote 5% of their farmed area to EFAs to qualify for full direct subsidy payments. However, the list of EFA options which Spanish farmers can choose exclude cover crops, providing only the following choices: fallow land, agroforestry, afforested areas, and nitrogen-fixing crops.

In addition to these conditional payments, the **Rural Development Programme (RDP) for Andalusia 2014-2020**¹² provides funding for contractual, voluntary commitments by farmers to implement certain sustainable agricultural practices. The RDP outlines Andalusia's priorities for allocating the € 2.4 billion of public money (€ 1.9 billion from the EU budget and € 523 million of national co-funding) available over the seven-year funding period. Andalusia's RDP will fund actions under all six Rural Development priorities – with a particular emphasis on "Promoting the competitiveness of the agricultural and agro-industry sector" and "Restoring, preserving and enhancing ecosystems related to agriculture and forestry." For Focus Area (FA) 4C Soil erosion and management, the RDP establishes the target of "17.09% of agricultural land under contracts". Measures implemented through these contracts should improve biodiversity, water management or soil management and prevent soil erosion. Most funds under this priority will be used for area-based payments to farmers for using environment/climate friendly management practices, including organic farming, as well as support for environment/climate-friendly forest investments. 15% of the agricultural land will be under contract for biodiversity, 16% for water management and 17% for soil management. Moreover, 23% of the forest area will be under risk prevention actions. For FA 5C Carbon conservation and sequestration, measures concentrate on forest areas with the aim of 1.34% of forest land under investment to improve resilience and environmental value of forest ecosystems, mainly with a view to preventing and reducing forest fires.¹³

The **Royal Decree on agricultural production and its indication in agricultural products and foodstuffs** implements the EU Organic Regulation at the national level. On the regional scale, the **Decree on organic agro-food production in Andalusia** establishes standards organic agro-food production in Andalusia, defining requirements for such practices as crop rotation, use of chemical inputs, and tillage.

¹² Formally adopted by the European Commission on 10 August 2015, last amended on 21 August 2020

¹³ European Commission. 2020. Factsheet on 2014-2020 Rural Development Programme for the Region of Andalusia. https://ec.europa.eu/info/sites/info/files/food-farming-fisheries/key_policies/documents/rdp-factsheet-spain-andalucia_en.pdf

The third Andalusian Plan of Ecological Production Horizon 2020 aims to consolidate the growth of organic production in Andalusia, to improve the competitiveness of farms and industries and promote the consumption of organic food at home, as well as the presence of companies in international markets. Out of a total budget of 300 million euros¹⁴, more than 7,400 beneficiaries have already received financial assistance of more than 31.5 million euros. Measures include multi-year plans through which farmers and ranchers commit to organic production¹⁵.

Water policies

The **Law on fiscal, administrative, and social measures** amended the Water Act, essentially transposing the Water Framework Directive into Spanish Law.¹⁶ At Regional level, several Water Laws were subsequently changed, including the Law on Waters of Andalusia. With the main pressures on water quality from agriculture being diffuse pollution from nutrients and chemicals, and abstractions in surface water and groundwater, measures established by the River Basin Management Plans place certain requirements on nutrient, pest, and irrigation management practices. Whilst these measures primarily aim to maintain and improve water quality, they can reasonably expect to benefit soil health by reducing soil pollution, salinisation, acidification, and erosion.

The Groundwater Directive, a daughter Directive of the WFD, is transposed nationally through the Royal Decree on the protection of groundwater from pollution and deterioration, and regionally law on Waters for Andalusia (see above). It addresses nutrient management and pest management and thus has some importance for farmers as it restricts the use of pesticides and fertilizers in certain situations.

Regional legislation transposing the Groundwater Directive is the Law 9/2010 of July 30 on. This law established principles and environmental objectives, focusing on establishing policies which do not treat water as an exclusive economic resource. Such policies should also have positive environmental benefits.

The **Royal Decree protecting waters from the pollution by nitrates derived of agricultural sources** implements the Nitrates Directive and establishes actions, and minimum requirements for the activities to be implemented by the Autonomous Communities (CC.AA.). The CC.AA. are responsible for defining (voluntary) good practice codes for all farmers, and programmes of measures for Nitrate Vulnerable Zones that include the good practice measures as well as a series of further (mandatory) measures. The CC.AA. can also go beyond these minimum requirements. However, this is not the case for the Autonomous Community of Andalusia. In relation to soil protection, measures related to nitrate regulations in Spain may contribute to

¹⁴ https://www.areflh.org/images/stories/nouveaux_doc_depuis_juin_2016/livre-blanc/Ricardo-Andalousie.pdf

¹⁵ <http://biocordoba.org/en/news/biocordoba-will-turn-the-city-into-a-benchmark-for-organic-production/>

¹⁶ A number of minor regulations closed transposition gaps and enabled the planning process in the first cycle, see SWD(2015) 56 final. Report on the implementation of the Water Framework Directive River Basin Management Plans Member State: SPAIN. https://ec.europa.eu/environment/water/water-framework/pdf/4th_report/MS%20annex%20-%20Spain.pdf

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). On the regional level, the **Order approving the action program applicable in areas vulnerable to nitrate pollution from designated agricultural sources in Andalusia** approves the Action Programme in areas vulnerable to contamination by nitrates from agricultural and livestock sources in Andalusia, which are detailed in Annexes I and II of this Order.

Waste and chemicals policies

The **Decree regulating the use of sewage sludge in the agricultural sector** transposes the EU Sewage Sludge Directive which regulates the application of sewage sludge on agricultural soil with the aim of preventing soil and water contamination with heavy metals. The Decree establishes restrictions on the on the volume of sludge and areas where it can be applied to land, its uses, composition, type of treatment in sewage treatment plants, and areas where sludge will be used. It also establishes a national sludge registry. In addition, the Decree establishes reporting requirements for the buying and selling of sewage sludge. A regional Decree implements the national requirements in Andalusia.

The Sustainable Use of Pesticides Directive (SUPD) is transposed into Spanish law through the **Royal Decree establishing the framework of action to achieve a sustainable use of phytosanitary products**. The Decree describes the National Action Plan for sustainable use of plant protection products, setting out a range of activities, including the promoted of integrated pest management approaches with an emphasis on the use of non-chemical plant protection products. In addition, training and educational requirements for users applying plant protection products are to be increased, again with a focus on promoting the use of fewer toxic products, and application restrictions (for example, establishing buffer strips where no pesticides should be applied). The overall aim of the Decree is to reduce impacts on human health and the environment with Chapter VII explicitly addressing water protection; there are, however, no specific provisions addressing soil. In Andalusia, the **Decree establishing the regulatory framework for the Autonomous Community of Andalusia concerning the application of phytosanitary products** implements the national requirements at the regional level.

Cross-cutting policies

Spain is party to the United Nation Convention to Combat Desertification (UNCCD). The aim of the UNCCD is to prevent or reverse issues of drought, soil productivity and living conditions in the world's drylands. The convention is the only legally binding international agreement focusing on sustainable soil and land management. Parties to the Convention can declare themselves 'affected' countries, which then requires them to implement national, regional, and

sub-regional action programmes to reverse land degradation.¹⁷ Spain is one of thirteen EU Member States which declared itself an 'affected country' status and subsequently prepared a **National Action Programme to Combat Desertification** (NAP) in 2008. The NAP details country-specific objectives and measures to be taken to combat desertification. It is a cross-cutting instrument which evaluates the impact of different sectors (agriculture, forestry, water resources management) on land degradation processes. The overarching objective of the Spanish NAP is to contribute to the achievement of the sustainable development of the affected areas within the national territory and, in particular the prevention of land degradation and the recovery of desertified lands. Actions are mainly restricted to information and demonstration projects promoting sustainable land management and restoration practices in areas affected by desertification.

2.2 To what extent do existing policies facilitate adoption of soil-improving practices in Almeria?

The soil-improving cropping systems (SICS) tested at the SoilCare study site in Almeria, Spain, include cover crops, reduced tillage, and efficient irrigation management. In addition, there are several long-term experiments testing various tillage methods (conventional, reduced and no tillage), fertiliser applications, crop rotation systems (including legumes and other soil improving crops), as well as residue management methods (post-harvest residues left on the fields for nutrients and organic matter recovery). Both the SICS trialled at the site within the context of SoilCare as well as the long-term experiments are aimed to address the main soil threats of soil compaction, water scarcity, high salt content, and excessive nutrient input. They therefore represent important practices that might benefit soil health in the region if widely taken up.

This section takes the policies identified in the previous section and evaluates how they can mitigate the soil threats in Spain¹⁸.

Cover crops

Cover crops are incentivised through GAEC 4 of the CAPs cross-compliance standards, although only on slopes, which farmers must meet in order to receive direct payments under Pillar I of the CAP. Cover cropping is not included in the list of EFA options available to Spanish farmers, but nitrogen-fixing crops are, which could function as cover crops. In addition, the Third Andalusian Plan of Ecological Production promotes the use for cover crops in organic production but, as a strategic planning document, only acts as a benchmark for good practices rather than prescribe specific methods. Similarly, the National Action Programme to Combat Desertification which establishes a network of demonstration and information projects on

¹⁷ https://www.unccd.int/sites/default/files/relevant-links/2017-01/UNCCD_Convention_ENG_0.pdf

¹⁸ It should be noted that because no interview transcripts were provided, no evidence of the actual implementation of these policies was available.

sustainable land management which might include cover cropping (as well as the soil-improving practices below), may educate farmers about this practice but does not establish management requirements or incentivises specific techniques.

Reduced/no tillage

Reduced tillage incentivised the CAPs cross-compliance standards: GAEC 4 prohibits ploughing in certain areas before 1 September, and GAEC 5 bans ploughing on certain slopes. Area-based payments under the RDP 2014-2020 (FA 4C Soil erosion and management) incentivises soil management practices preventing soil erosion, including reduced tillage methods. Legislation implementing the organic regulation at national and regional level establishes the production requirements which need to be met by farmers in order to label and market their products as "organic". These requirements include several SICS, inter alia reduced tillage.

Improved efficiency irrigation

In an area prone to droughts, irrigation management is important, especially given that excessive water in the region has occasionally been linked to damages caused by soil fungus. Despite this, most of the policies identified as relevant do not regulate irrigation or incentivise efficient irrigation practices. Legislation implementing the WFD in Spain and Andalusia focus on water quality rather than quantity and only include some aspects concerning irrigation, such as Article 111 of the Law on fiscal, administrative, and social measures which requires the "Declaration of general interest of certain works of hydraulic infrastructures for irrigation and other infrastructures". One notable exception is the National Action Programme to Combat Desertification, which, however, mainly focuses on promoting good soil management practices through information sharing and demonstration projects. In addition,

Integrated nutrient management

Well-managed nutrient input is essential to address and prevent the loss of soil organic matter and to avoid excessive nitrogen fertilisation, which is an issue in the region of Andalusia. Nutrient input in agriculture is regulated through several pieces of legislation, mostly with a view to protecting water quality rather than soil. It is covered by all the relevant policies discussed in section 3.1, such as the organic production legislation, water protection legislation including legislation on fertiliser and sewage sludge use. In addition, the National Action Plan on Desertification includes actions established by the National Irrigation Plan (in development) in the form of guidelines that request the incorporation of environmental criteria in the management of lands and waters to prevent their degradation, the recovery of aquifers and the reduction of desertification processes.

Within this context, interviewees noted that thanks to the use of organic farming methods, the fertility of the soils has increased, and their content in residues from herbicides has decreased.

The table below provides an overview of policies promoting the full range of SICS covered by the SoilCare project (shaded in light green). The analysis shows that several policies regulate and incentivise the use of cover crops, reduced tillage, and integrated nutrient management, the SICS tested at the study site (shaded in dark green): direct payments, greening measures, and rural development plans under the CAP all provide financial rewards to farmers adopting reduced or no-tillage practices and cover crops (in the form of nitrogen-fixing crops) but only on certain types of land. Integrated nutrient management practices are regulated mostly through water protection legislation. In addition, policies implementing the EU Organic Regulation formulate mandatory requirements for fertiliser use and tillage practices. Most of the policies identified as relevant do not regulate or incentivise efficient irrigation practices with the exception of the National Action Programme to Combat Desertification, which, however, mainly focuses on promoting good soil management practices through information sharing and demonstration projects.

Table 8 Coverage of SICS in current regional policies, instruments and measures in Almeria (ES)

Policy	Crop rotation	Green manures, cover crops, catch crops	Integrated nutrient management	Enhanced efficiency Irrigation	Controlled drainage	Reduced tillage	Integrated pest management	Smart weed control	Smart residue management	Controlled traffic management	Integrated landscape management
CAP GAEC cross-compliance standards and greening payments ¹⁹											
CAP Greening requirements ¹⁹											
CAP Rural Development Program of Andalucía 2014-2020 <i>Programa de Desarrollo Rural de Andalucía 2014-2020</i>											
Royal Decree on agro-ecological production and its indication in agricultural products and foodstuffs <i>Real Decreto sobre producción agrícola ecológica y su indicación en los productos agrarios y alimenticios</i>											
Decree on organic agro-food production in Andalusia <i>Decreto sobre la producción agroalimentaria ecológica en Andalucía.</i>											
III Andalusian Plan of Ecological Production Horizon 2020 <i>III Plan Andaluz de la Producción Ecológica Horizonte 2020</i>	X	X	X			X	X			X	X
Law on fiscal, administrative and social measures <i>Ley de medidas fiscales, administrativas y del orden social</i>											
Law on Waters for Andalusia. <i>Ley de Aguas para Andalucía</i>											

¹⁹ 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 pagos al desarrollo rural

2.3 Which factors shape success or failure of policy instruments in Almeria?

Research indicates that there are several factors that shape the success or failure of policy instruments in Almeria, and the uptake of SICS tested in the study site region in general. These factors include:

- Applying for payments is too bureaucratic
- Lack of enforcement
- Trust in long-established practices
- Costs of transitioning to new practices
- Environmental conditions

Applying for payments is too bureaucratic

Interviewees highlighted that the current institutional configuration means that applying for compensation payments is too bureaucratic which dissuades farmers from accessing funds. At the same time, the Order of 12 March 2015 concerns the rules of the Autonomous Community of Andalusia 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 programme to be included in the single application. No information was available regarding to whether this Order makes the application process easier to navigate for farmers, nor whether something similar could be applied to those funds falling outside the scope of this Order.

Lack of enforcement

The stakeholders consulted noted that the methods of monitoring and certifying organic agricultural production should be more comprehensive. It is highlighted that authorities are not carrying out enough inspections, not just to verify compliance with organic production standards, but also with other environmental and agricultural policies. This might suggest that enforcement of the existing policies could be improved, which might lead to a greater adoption of SICS. Farmers are unlikely to invest the time and money needed to adopt SICS if there is little reward, nor if the certification system concerning organic production is not strict enough. Farmers would be unwilling to make the effort if another farmer can gain organic certification through a loophole or ambiguous requirements, or if another farmer is relaxing their practices knowing they are unlikely to be caught out due to infrequent inspections.

Trust in long-established practices

Farmer knowledge and perceptions of certain practices limit the uptake of certain practices, such as keeping the soil bare, burning of stubble and pruning, although the latter is prohibited by law (see the box below). Farmers are reluctant to adopt practices if these do not correspond to their experiences and beliefs.

Costs of transitioning to new practices

Stakeholders identified the costs of purchasing additional seeds to plant cover crops (on top of the main crop) as well as lack of access to machinery and new technology as financial factors impeding the wider uptake of cover cropping and efficient irrigation techniques.

Environmental conditions

Water availability is one of the limiting factors for agricultural production in the study area. Lack of water is especially important with use of vegetable cover since the latter can come into competition with the crops in case there is water scarcity. As such, the success of certain SICS depends on water availability and rain patterns. Environmental conditions can also motivate positive change as the uptake of organic farming in certain areas of Almeria demonstrates. In the area, there are two types of organic agriculture: (1) intensive high-performance horticulture and (2) organic agriculture in marginal areas of low productivity in rural areas. In the latter case, organic agriculture has been adopted as a measure to revitalise economically deprived areas. These farms are characterised by low soil quality, high terrain slope, scarce water availability which all limit productivity.

The box and table below provide a summary of the stakeholder recommendations for actions to promote SICS adoption in the site.

Box 1: Stakeholder recommendations for actions to promote the uptake of promising SICS in the Almeira region, Spain

Summary of stakeholder recommendations for actions to promote SICS adoption

Stakeholders identified farmer perceptions and knowledge as well as limited water availability as the main factors hampering uptake of controlled deficit irrigation and cover crops. It was noted that the traditional belief was that the surface of the crop must remain bare, and that the benefits of the SICS trialled was poorly understood by farmers in the region. Dissemination of successful experiences with applying enhanced efficiency irrigation and different cover crops/plant residues was thus proposed as an action to remove this barrier, along with training on how to use these methods and payments rewarding sustainable practices.

Stakeholders also noted that some of varieties used cover crops can pose a risk of increasing pests for the crop, explain farmer reluctance to using them. Workshop participants also highlighted the role compliance checks may play in facilitating the adoption of sustainable soil management practices. The current system of controls of compliance with regulations on water quality, nitrate pollution, and waste management was assessed as ineffective by stakeholders and viewed as leading to bad practices, such as burning of stubble, the drilling of illegal wells, and high levels of nitrate pollution.

Finally, the costs for seeds as well as access to machinery and new technology were cited as financial factors impeding the wider uptake of cover cropping and efficient irrigation techniques. Stakeholders concluded that

grants or subsidies would be effective measures to support farmers in transitioning to these practices.

Table 9: SICS being tested, adoption factors (enablers or barriers) and actions to overcome the barriers²⁰

Cover crops and enhanced efficiency irrigation: Controlled deficit irrigation and mulch cover with pruning remains and vegetable coverings sown	
Adoption factors (+ or -)	Actions
Maladapted policy setup (-)	More focus on subsidising sustainable agricultural management
Farmers' resistance for new practices (-)	Dissemination of successful experience from fellow farmers
Lack of awareness and information (-)	Awareness and information campaigns, training of farmers
Lack of access to technology and machinery (-)	Financial support through grants or subsidies
Lack of enforcement and monitoring (-)	Effective control of current regulations regarding bad practices (burning of stubble, illegal wells, pollution by nitrates)
Water scarcity (-)	<i>None identified</i>
Operational costs (-)	Subsidies to alleviate costs associated with seed
Size of exploitation (-)	<i>None identified</i>
Cover crops and enhanced efficiency irrigation: Controlled deficit irrigation and vegetative cover of adventitious herbs/plant cover planted	
Adoption factors (+ or -)	Actions
High provision of inputs (+)	<i>None identified</i>
Dissemination of efficiency potential as wind erosion control (+)	Dissemination of successful experience from fellow farmers
Access to technology / machinery (+)	Financial support through grants or subsidies
Lack of enforcement and monitoring (-)	Effective control of current regulations regarding bad practices (burning of stubble, illegal wells, pollution by nitrates)
Farmers' resistance to new practices (-)	Dissemination of successful experience from fellow farmers
Plant cover selection (-)	<i>None identified</i>
Lack of training for farmers (-)	Awareness and information campaigns, training of farmers

²⁰Due to time limitations, some of the workshops only addressed a subset of SICS tested in the respective study site. Participants were asked to identify actions for the most important factors affecting SICS adoption; therefore, not all adoption factors were discussed in detail. To assess the effectiveness and feasibility of an action, a scale from 1 (not at all effective/feasible) to 4 (highly effective/feasible) was used but not consistently applied in all stakeholder workshops.

3 Recommendations for actions to promote the uptake of SICS

SICS that are being tested at the study site (cover crops, tillage, and irrigation management) aim to address the main soil threats of soil compaction, water scarcity, and excessive nutrient input.

This report presented an inventory and analysis of bottlenecks and opportunities in sectoral and environmental policies to facilitate the adoption of Soil-Improving Cropping Systems in the region of Almeria in Spain. Based on this analysis, and feedback collected from stakeholder, it presented actions for the national and/or (sub)regional level with the potential of promoting the uptake of SICS.

Drawing on these insights, the following general recommendations can be made:

- **Establish mechanisms for effective knowledge dissemination and exchange between farmers:** Some of the practices benefitting soil will require farmers to learn about these techniques, their application to different conditions as well as their benefits in order to change their misconceptions about these methods. To this end, research findings should be made accessible and widely disseminated and educational activities should be encouraged. Knowledge should be disseminated via multiple channels, through the provision of guidance document but also farms visits and demonstration days. Since farmers tend to place a lot of trust in their peers, establishing a network of model farms, for example under the umbrella of the National Action Programme to Combat Desertification, demonstrating how to use and adapt different SICS in the region would effectively support farmers in learning and sharing experiences about these practices.
- **Subsidise transition to practices benefitting soil health:** The uptake of certain SICS, such as cover cropping, enhanced efficiency irrigation and reduced tillage, might require upfront investments, such as the purchasing of additional seeds and new machinery. Grants should be made available to farmers buying new equipment to implement these practices or groups of farmers intending to set up a 'machinery exchange'. Such an exchange could also be set up and managed by the regional/local farm advisory services or municipalities.
- **Strengthen policy enforcement:** While it was found that there are a number of policies already in place that – directly and indirectly - regulate and incentivise different SICS, stakeholders report that outcomes on soil health are limited due to weak enforcement mechanisms. It is clear mechanisms for checking compliance with existing regulations need to be strengthened and expanded.
- **Make incentives more effective by simplifying application process:** Evidence suggest that economic incentives might not be a key driver for SICS adoption with the current system perceived to be overly bureaucratic by farmers. With the post-2020 CAP, new funding rules funding rules will be introduced. The Good Agricultural Environmental Conditions (GAECs) now offer a greater chance for soil protection. New

conditions with the potential to improve soil health have been added, e.g., the new GAEC 7 requires “No bare soil in most sensitive period(s)” (European Commission, 2018b). Cover crops will be an important strategy for meeting this requirement. The payment agencies should seek to simplify procedures for farmers applying for CAP payments in order not to deter farmers from adopting SICS.

Annex: Overview of key policies in Almeria, Spain

Policy name	English translation	Scale	EU or MS level	SICS addressed	Description of policy
Real Decreto 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 pagos al desarrollo rural.	CAP GAEC Cross-compliance Standards	National	EU - CAP	Green manures, cover crops, catch crops, reduced tillage, integrated 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 GAEC standards relevant for soil protection in Spain are. 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 - CAP	Crop rotation Green manures, cover crops, catch crops	Greening requirements apply to direct payments under Pillar 1 of the CAP, although it is mainly arable farmers who the rules apply to. The list of EFA elements which Spanish farmers can choose from includes three of the seven elements that can protect soils and soil carbon: land lying fallow, agroforestry, afforested areas, and nitrogen fixing crops.
Programa de Desarrollo Rural de Andalucía 1	CAP Rural Development Programme of Andalucía	National	EU - CAP	Crop rotation, reduced tillage	Within the National Rural development programme of Spain, soil is not the primary focus and priority 5E Carbon conservation / sequestration was not included in the programme. However, FA 4C Soil erosion and management is applied to 1 000 hectares benefiting from forest fire restoration actions.
Real Decreto sobre producción agrícola ecológica y su indicación en los productos agrarios y alimenticios.	Royal Decree on agro-ecological production and its indication in agricultural products and foodstuffs	National	EU - Organic Regulation	Crop rotation, integrated nutrient management, reduced tillage, integrated pest management	This Decree regulates the requirements assigned to organic products, creates a national-level advisory body, the "Organic Agriculture Regulatory Commission", and establishes the mechanisms for the application of certain aspects of Regulation (EEC) 2092/91.
Decreto sobre la producción agroalimentaria ecológica en Andalucía.	Decree on organic agro-food production in Andalusia.	Regional	EU - Organic Regulation	Crop rotation, integrated nutrient management, reduced tillage, integrated pest management	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 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 authorisation regime of private control agencies.

Policy name	English translation	Scale	EU or MS level	SICS addressed	Description of policy
III Plan Andaluz de la Producción Ecológica Horizonte 2020	Third Andalusian Plan of Ecological Production Horizon 2020	Regional	MS-level	Crop rotation, green manures, cover crops, catch crops, integrated nutrient management, reduced tillage, integrated pest management, controlled traffic management, integrated landscape 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.
Ley de medidas fiscales, administrativas y del orden social.	Law on fiscal, administrative and social measures	National	EU - Water Framework Directive	Integrated nutrient management, enhanced efficiency irrigation, controlled drainage, integrated pest management, integrated landscape management	This law amends the Water Act (Royal Legislative Decree 1/2001), essentially transposing the Water Framework Directive into Spanish Law. At Regional level, several Water Laws were subsequently changed, including the Law on Waters of Andalusia (Law 9/2010). A number of other regulations closed transposition gaps, including: Decree 14/2005 of January 18th on the transfer of means and services by the Spanish National Government to the Andalusian Regional Government regarding Hydraulic resource management; Decree 357/2009 of October 20th, which determines the Territorial limits of the intercommunity river basins in Andalusia; Decree 14/2012 of January 31st, establishing the Committee of Competent Authorities of river basin districts of the intracomunity basins in Andalusia detailing its organization, functions and powers; Decree 52/2012 of February 29th, regulating the Andalusian Water Observatory.
Ley de Aguas para Andalucía.	Law on Waters for Andalusia.	Regional	EU - Water Framework Directive	Integrated nutrient management, enhanced efficiency irrigation, controlled drainage, integrated pest management, integrated landscape 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 por el que se modifica el anexo II del Real Decreto 1514/2009, de 2 de octubre, por el que se	Royal Decree 1075/2015 of 27 November, amending Annex II of Royal Decree	National	EU - Groundwater Directive	Integrated nutrient management, integrated 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.

Policy name	English translation	Scale	EU or MS level	SICS addressed	Description of policy
regula la protección de las aguas subterráneas contra la contaminación y el deterioro.	1514/2009 of 2 October, which regulates the protection of groundwater against pollution and deterioration.				
Real Decreto sobre protección de las aguas contra la contaminación producida por los nitratos procedentes de fuentes agrarias	Royal Decree protecting waters from the pollution by nitrates derived of agricultural sources	National	EU- Nitrates Directive	Crop rotation, integrated nutrient management	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 por la que se aprueba el programa de actuación aplicable en las zonas vulnerables a la contaminación por nitratos procedentes de fuentes agrarias designadas en Andalucía.	Order approving the action program applicable in areas vulnerable to nitrate pollution from designated agricultural sources in Andalusia.	Regional	EU- Nitrates Directive	Crop rotation, integrated nutrient management	The purpose of this Order is the approval of the Action Program in areas vulnerable to contamination by nitrates from agricultural and livestock sources designated in Andalusia, which is contained in Annexes I and II of this Order.
Real Decreto por el que se regula la utilización de los lodos de depuración en el sector agrario	Decree on the Use of Sewage Sludge in the Agricultural Sector	National	EU – Sewage Sludge Directive	Integrated 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.

Policy name	English translation	Scale	EU or MS level	SICS addressed	Description of policy
Decreto por el que se aprueba el Reglamento de Residuos de Andalucía.	Decree approving the Waste Regulations of Andalusia	Regional	EU – Sewage Sludge Directive	Integrated 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, 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 por el que se establece el marco de actuación para conseguir un uso sostenible de los productos fitosanitarios	Royal Decree establishing the framework of action to achieve a sustainable use of phytosanitary products	National	EU – Sustainable Use of Pesticides Directive	Integrated pest management	The Royal Decree 1311/2012 establishing the framework of action to achieve a sustainable use of phytosanitary products. It outlines the National Action Plan for the sustainable use of plant protection products, using 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 fewer toxic products are used, restrictions of application (buffer strips where no pesticides should be applied), etc. 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 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 on 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 application of phytosanitary products.	Regional	EU – Sustainable Use of Pesticides Directive	Integrated pest management	This Decree establishes, for the Autonomous Community of Andalusia, the regulatory framework for the application concerning phytosanitary products.
Real Decreto 535/2017, de 26 de mayo, por el que se modifica el Real	Royal Decree 535/2017, of May 26, by which	National	EU- Fertiliser Regulation	Integrated nutrient management	This Royal Decree modifies Royal Decree 506/2013, of June 28, on fertiliser products, which deals with the use of waste in the manufacture of fertilizer products and

Policy name	English translation	Scale	EU or MS level	SICS addressed	Description of policy
Decreto 506/2013, de 28 de junio, sobre productos fertilizantes.	modifies the Royal Decree 506/2013, of June 28, on fertilizer products.				establishes the need to have the "corresponding authorization from the environmental authority" .
Programa de Acción Nacional contra la Desertificación	National Action Programme to Combat Desertification, August 2008	National	MS-level	Crop rotation, green manures, cover crops, catch crops, integrated nutrient management, reduced tillage, integrated pest management, controlled traffic management integrated landscape management	The NAP details country-specific objectives and measures to be taken to combat desertification. It is a cross-cutting instrument which evaluates the impact of different sectors (agriculture, forestry, water resources management) on land degradation processes. The overarching objective of the Spanish NAP is to contribute to the achievement of the sustainable development of the affected areas within the national territory and, in particular, the prevention of land degradation and the recovery of desertified lands. It creates an integrated system of evaluation and monitoring of desertification in Spain and promotes a network of demonstration projects for restoration and sustainable management of areas affected by desertification. Actions are mainly restricted to information and demonstration projects promoting sustainable land management practices.