

## **Policy analysis:**

# **Promoting SICS adoption in Low Mondego Valley, Portugal**

Authors: Alicia McNeill, Melanie Muro, Tugce Tugran, Zuzana Lukacova, Milieu

Contributors : António Ferreira, Anne-Karine Boulet, Escola Superior Agrária de Coimbra

Report number: **25**

Deliverable: -

Report type: **Scientific Report**

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

Project partner: **Milieu**

Version: **1.0**





DOCUMENT SUMMARY	
<b>Project Information</b>	
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:	<a href="http://www.soilcare-project.eu">www.soilcare-project.eu</a>
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> )
<b>Report Information</b>	
Report Title:	Policy analysis: Promoting SICS adoption in Low Mondego Valley, Portugal
Principle Author(s):	Alicia McNeill, Melanie Muro, Tugce Tugran, Zuzana Lukacova, Milieu Contributors : António Ferreira, Anne-Karine Boulet, Escola Superior Agrária de Coimbra
Principle Author e-mail:	<a href="mailto:melanie.muro@milieu.be">melanie.muro@milieu.be</a>
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: <a href="http://tinyurl.com/soilcare-disclaimer">http://tinyurl.com/soilcare-disclaimer</a>

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.....	8
2 Analysis of policy shortcomings and opportunities in Low Mondego Valley, Portugal .....	14
2.1 Which existing policies and policy instruments shape agricultural practices in Low Mondego Valley, Portugal?.....	15
2.2 To what extent do existing policies facilitate adoption of soil-improving practices in Low Mondego Valley?.....	18
2.3 Which factors shape success or failure of policy instruments in Low Mondego Valley?.....	21
3 Recommendations for actions to promote the uptake of SICS.....	27
Annex: Overview of key policies in Low Mondego Valley Portugal .....	30

## Tables

Table 1: Coverage of SICS in current national and regional policies, instruments, and measures in Low Mondego Valley (PT) .....	2
Table 2: SICS being tested, adoption factors (enablers or barriers) and actions to overcome the barriers .....	4
Table 3: List of promising general SICS.....	8
Table 4: Summary of policy approaches .....	9
Table 5: Organisations represented by interview partners .....	12
Table 6: Description of the study site.....	14
Table 7: Overview of experiments carried out in the German study site, and the SICS category and cluster under which they are grouped .....	14
Table 8: Coverage of SICS in current national and regional policies, instruments, and measures in Low Mondego Valley (PT) .....	20
Table 9: Table 9: SICS being tested, adoption factors (enablers or barriers) and actions to overcome the barriers .....	26

## Figures

Figure 1: Research strategy .....	11
Figure 2: Types of stakeholders participating in the Portuguese adoption workshop .....	13

## Executive summary

The main soil threats in Low Mondego Valley study site include:

- Low soil organic matter content (estimated to be below 2%)
- soil compaction – caused harrowing, traditional tillage, and compaction caused by livestock (due to very soaked ground in winter)
- Erosion – primarily resulting from intense rain in winter
- Pollution/contamination of soil/water – caused by residues from wastewater treatment plants (sludge), plant protection products, and nitrates
- Acidification and low soil microbial diversity

SICS that are being tested at the study site are thought to address these soil threats and include soil improving crops (Organic rice in rotation with perennial lucerne and Conventional grain corn in succession with legume winter cover crops used as green manure) and integrated nutrient methods (Conventional grain corn fertilised by urban sludge). 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 regulation, incentivising, and promoting the full range of SICS covered by the SoilCare project (shaded in light green). The analysis shows that several policies regulate and incentives the use of cover crops, crop rotations 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 crop rotation and cover crops. Nutrient input in agriculture is regulated through several pieces of legislation, mostly with a view to protecting water quality rather than soil, such as the national Water Law, regulations dealing with the sustainable use of pesticides, sewage sludge, and nitrates on agricultural land

Table 1: Coverage of SICS in current national and regional policies, instruments, and measures in Low Mondego Valley (PT)

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 - Complementary National Direct Payments Requirement (Greening included)											

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
Cross compliance - Statutory Management Requirements (SMR) and standards of good agricultural and environmental condition (GAEC).											
CAP - Rural Development Programme 2014 - 2020											
National Water Law											
National Nitrates Directive - Law on the Protection of Water from Pollution Caused by the Use of Nitrates in Agriculture											
National Groundwater Law											
National legal framework for agricultural use of sewage sludge											
National sustainable Use of Pesticides Law											
National Action Program to Combat Desertification (PANCD)											

Evidence gathered through interviews, desk research and a stakeholder workshop shows that different contextual factors contribute to and undermine the uptake of SICS in general, and of the practices tested in the study site in particular. Some of the findings suggest that the uptake of SICSs is improving. On the other hand, barriers to the uptake of these practices remain.

The key factors shaping the success of policy instruments include:

- Funding priorities
- Costs of adopting SICS
- Economic incentives mostly reward existing practices
- Lack of knowledge and technical support
- Policy instruments not flexible enough to take into account regional/structural differences
- Bureaucratic permitting procedures for sewage sludge application
- Unwillingness to give up traditional practices
- Limited influence of producer organisations
- Lack of monitoring and enforcement

– Market demands/pressures

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

<b>Soil improving crops: Legume winter cover crops used as green manure</b>			
<b>Adoption factors (+ or -)</b>	<b>Actions</b>	<b>Effectiveness</b>	<b>Feasibility</b>
Lack of subsidies (-)	<i>None identified</i>		
Mild climate (+/-)	<i>None identified</i>		
Cost and access to seeds (-)	Develop national seed multiplication programs,	3	3
Lack of farmer interest and supportive networks (-)	Create a network of national trials that allows adapting the technique to each region, according to the characteristics of each area.		
Lack of training in green fertilisation (-)	Implement/ finance projects to compile existing information, implement/maintain demonstration areas; dissemination at fairs, workshops for the public, farmers, technicians, as well as promote in schools (textbooks, field trips).	4	2
Green manure technique lost (-)	Implement/ finance projects to compile existing information, create a network of national trials to adapt technique to regional conditions	4	3
Difficult to access relevant information / specific documents for the Baixo Mondego region (-)	<i>None identified</i>		
No political incentives to adopt the green manure technique (-)	Create operational groups (politicians, technicians, and farmers), to (i) envisage the technique at a more global level, with the orientation of the country's policies, changing the course to current practices; (ii) invest in increasing soil fertility and the quality of the environment, in general; and (iii) stop unconditionally financing less favorable techniques , priority should be given to conservation farming techniques that are also able to be a source of food production that is both profitable and sustainable	3	3
<b>Soil improving crops: Organic rice in rotation with Lucerne</b>			
<b>Adoption factors (+ or -)</b>	<b>Actions</b>	<b>Effectiveness</b>	<b>Feasibility</b>
Cost for organic certification in small areas, organic fertilisation and labour (-)	Review certification costs for small areas. Land reparcelling is the only way to solve many problems arising from the mini-fundio but it is a political measure	4	1
High cost of installing lucerne (-)	<i>None identified</i>		
Subsidies in place for rice cultivation (+)	<i>None identified</i>		
Economic value underestimated (-)	Communicate the quality of products to justify higher prices (together with cooperatives or producer associations)	4	2
Favourable climate and soil conditions (+)	<i>None identified</i>		
Weed management (more pests attacking organic rice) (-)	New techniques explored, e.g., planting rice instead of sowing it	2	2
New generation of farmers open and interested to try this technique (+)	<i>None identified</i>		
Technical support from cooperatives, open days (+)	Need for more specific training organisation for technicians and farmers	4	3



Policy support for organic rice cultivation (+)	Strengthen incentives with the new CAP at national or regional level with specific funds	4	1
<b>Fertilisation/amendments: Organic amendment with sludge</b>			
<b>Adoption factors (+ or -)</b>	<b>Actions</b>	<b>Effectiveness</b>	<b>Feasibility</b>
Low cost for farmer (+)	Agricultural valorisation is a good solution for WWTPs and advantageous for the farmer who keeps organic matter at almost zero cost.	4	4
Lack of knowledge about the sludge application and need for a specific machinery (-)	It is necessary to make farmers aware of the environmental risks of poor application of sludge (eg inadequate quantities, under inappropriate climatic conditions) and to hold them accountable for application practices. Mandatory training for those who have an approved sludge management plan	4	3
Bad smell of sludge	Improve the stabilisation of organic matter, through digestion, dehydration, and / or by composting	3	2
High bureaucracy (administrative permits for the sludge application) (-)	Simplification of the management plan approval process is necessary.	3	2
Specific rules for sludge application (crop type, soil type, quantities, application dates, waiting times before sowing) (-)	<i>None identified</i>		
Lack of knowledge about the environmental benefits (-)	Dissemination of the results of studies on the impact of sludge on soils in seminars or dissemination to the general public, in order to demystify the use of sludge. Explain that risks are controlled through the sludge management plan.	3	2
Easy access to information (+)	<i>None identified</i>		
Bad reputation of sludge application amongst the public and farmers (-)	<i>None identified</i>		
Strict and complicated legislation (-)	<i>None identified</i>		

### **Recommendations for actions to promote the uptake of SICS**

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

- **Design targeted incentives that reward uptake of appropriate practices:** As mentioned above, subsidies and other economic incentives play a large role in Portuguese agriculture, however, evidence suggests that financial measures might finance practices already in place or which are not appropriate in specific locations. At the same time, regional and local policies must be flexible enough to allow for regional differences. A financial measure on cover crops may well be appropriate in the south of the country, but less appropriate in the north. Financial incentives need to be more targeted, both tied to specific actions and region (or environmental/geographic conditions) to result in the desired change. Priority should be given to conservation farming techniques that are also able to be a source of food production that is both profitable and sustainable.
- **Strengthen policy enforcement:** While it was found that there are several 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

implementation and enforcement mechanisms. It is clear mechanisms for checking compliance with existing regulations need to be strengthened and expanded. 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)”. Cover crops will be an important strategy for meeting this requirement. The payment agencies should seek to ensure that these conditions are complied with and verified through, e.g., more frequent inspections and farmer reporting (including for example images of the implemented practices).

- **Subsidise transition to practices benefitting soil health:** The uptake of certain SICS might require upfront investments, such as the purchasing of seeds or new machinery. Grants should be made available to farmers buying new equipment to implement these practices or groups of farmers. A revision of certification costs might encourage a move to organic production, such as organic rice cultivation tested at the study site. Land reparcelling and the establishment of a national seed multiplication program were identified as actions which could facilitate a transition and reduce costs in the long run.
- **Simplification of permitting procedures for sewage sludge application:** a simplification of permitting and management plan approval process is necessary, as currently, many farmers prefer to avoid bureaucratic complications related to the use of sludge, even if it is free.
- **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 (and risks) to change their misconceptions about these methods. To this end, research findings should be systematically compiled, 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, demonstration days, and social media. Since farmers tend to place a lot of trust in their peers, establishing a network of model farms demonstrating how to use and adapt different SICS in the region would effectively support farmers in learning and sharing experiences about these practices.
- **Invest in and build capacity of Farm Advisory Services:** like framers, farm advisors also need to learn about new practices, their practical application, costs, and benefits to support farmers they assist. Strengthening the technical skills of farm advisory services and setting up mechanisms for continuous learning are therefore crucial.
- **Communicate environmental benefits generated by SICS:** high-quality products need to be sold at fair process which compensate farmers for the benefits they generate for the environment and society as a whole. The prospect of a fair price for a product stemming from sustainable practices will make their uptake more appealing to farmers.

It will be equally important to continue to educate consumers about the advantages and disadvantages of conventional farming practices vs. sustainable practices to ensure increased demand for sustainably produced products and encourage the retail sector to make these more widely available to all sections of society. To this end, cooperatives or producer associations play a major role in marketing these products, explaining production methods – especially important for practices such as sewage sludge application which might be perceived as a high-risk technique – and negotiating prices with retailers.

## 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 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.<sup>1</sup>

### Research aim and questions

The work presented here was carried out as part of the EU-funded SoilCare project.<sup>2</sup> 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 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 Soil Organic Matter (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

<sup>1</sup> Lahmar, R. 2010. Adoption of conservation agriculture in Europe: Lessons of the KASSA project. Land Use Policy 27(1): 4-10.

<sup>2</sup> SoilCare: Soilcare for profitable and sustainable crop production in Europe, <https://www.soilcare-project.eu/>

<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>

Component	Expected impact
<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 traffic management</b>	Reduces energy cost and the risk of soil compaction
<b>Integrated landscape management</b>	Improves biodiversity and cropping systems sustainability

The main aim of the work presented here was to formulate policy alternatives<sup>4</sup> 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
<b>Regulatory instruments</b>	Force farmers to adopt SICS	<ul style="list-style-type: none"> <li>Levels the playing field between competitors, as everyone must play by the same rules</li> <li>Fairly consistent (often long-term)</li> </ul>	<ul style="list-style-type: none"> <li>Inflexible regardless of individual situations</li> <li>May be costly to implement</li> <li>Monitoring and enforcement can be costly</li> <li>Discourages innovation</li> </ul>
<b>Economic instruments</b>	Incentivise farmers to adopt SICS	<ul style="list-style-type: none"> <li>Encourages innovative methods</li> </ul>	<ul style="list-style-type: none"> <li>Can be subject to fluctuations as the market fluctuates</li> </ul>

<sup>4</sup> 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.	<ul style="list-style-type: none"> <li>• Can offset cost of implementation and/or discourage adverse behaviour</li> <li>• Allows a certain amount of flexibility</li> </ul>	<ul style="list-style-type: none"> <li>• High likelihood of setting subsidies/taxes at incorrect rate (which leads to inefficiencies)</li> <li>• Can be subject to game-playing behaviour</li> </ul>
<b>Voluntary instruments</b>	Encourage farmers to adopt SICS	<ul style="list-style-type: none"> <li>• Sense of “ownership” as the decision was taken freely</li> <li>• High degree of flexibility</li> </ul>	<ul style="list-style-type: none"> <li>• Does not guarantee implementation</li> </ul>
<b>Educational/information instruments</b>	Educate farmers so they understand the importance of SICS	<ul style="list-style-type: none"> <li>• Implementation as a result of truly understanding the impacts of the actions</li> <li>• High degree of flexibility</li> </ul>	<ul style="list-style-type: none"> <li>• Does not guarantee implementation</li> <li>• Relies on interest of affected parties</li> <li>• Often takes more time to become effective</li> </ul>

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 Switzerland and fits into a larger research initiative involving 16 European countries in total.<sup>5</sup> Based on this analysis, it presents policy alternatives and actions for the national and/or (sub)regional level with the potential of promoting the uptake of SICS.

<sup>5</sup> 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.

## 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 Swiss 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.

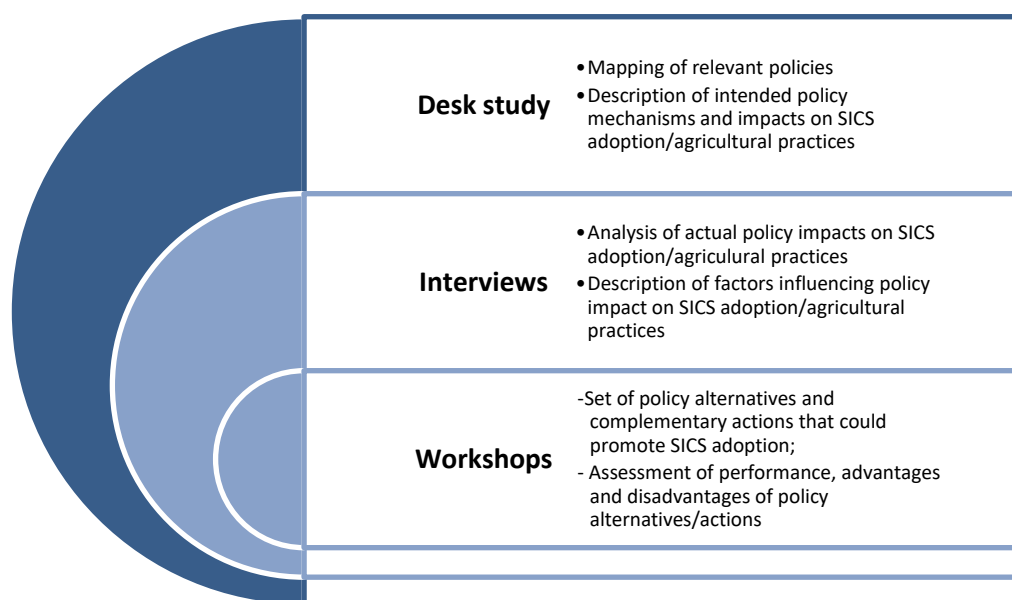


Figure 1: Research strategy

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 regional<sup>6</sup> policies from which the most relevant policies could be selected for in-depth 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

<sup>6</sup> 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.

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.<sup>7</sup> 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 Portugal, four interviews were carried out (see Table 5).

Table 5: Organisations represented by interview partners

Organisation	Stakeholder category
CCDRC - Comissão de Coordenação e Desenvolvimento Regional do Centro –(Regional Coordination and Development Commission of the Center)	Regional/local government
CAMV - Cooperativa Agrícola do Concelho de Montemor-o-Velho (Agricultural Cooperative of the Municipality of Montemor-o-Velho)	Agricultural cooperative
DRAPC - Direção Regional de Agricultura e Pescas do Centro (Regional Directorate for Agriculture and Fisheries)	Regional/local government
Évora University	Research

- 3) An adaption 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 Portuguese workshop brought together 25 stakeholders, including farmers, researchers, local/regional government, and private companies (see Figure 2).

<sup>7</sup> The policy inventory is available at: <https://www.soilcare-project.eu/outputs>



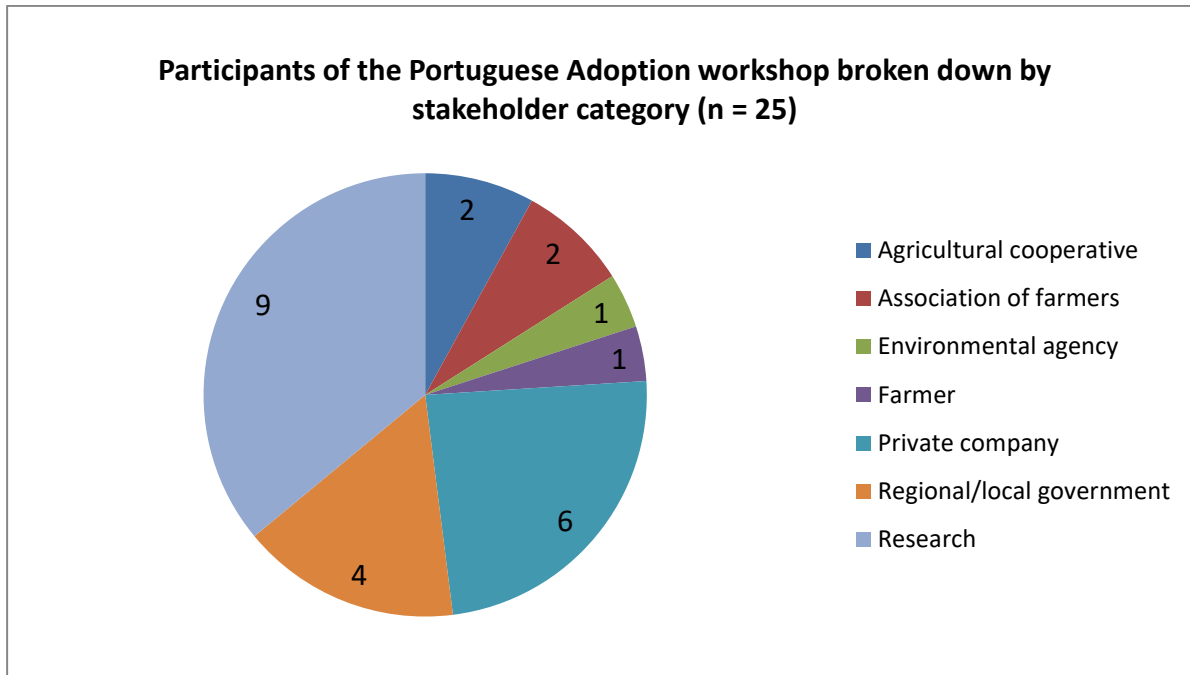


Figure 2: Types of stakeholders participating in the Portuguese adoption workshop

### 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 Low Mondego Valley, Portugal, where the study site is located.<sup>8</sup> 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/resources/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/resources/deliverables>.

<sup>8</sup> See D7.1 at <https://www.soilcare-project.eu/resources>

## 2 Analysis of policy shortcomings and opportunities in Low Mondego Valley, Portugal

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

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

Table 6: Description of the study site

Site Name	Low Mondego Valley
Climate	Mediterranean, characterized by rainy winters and dry summers, a Csa climate under the Köppen climate classification: "Hot-summer Mediterranean climate "
Temperatures	Annual average temperature of 16.1°C, with smooth variations. The annual average precipitation is 922 mm, essentially concentrated between October and March.
Soil type	Soils are modern alluvial soils, with a texture from silt-loam to sandy-clay-loam
Main soil threats	Compaction, loss of SOM, erosion, loss of microbial activity and acidity
Current practices	The Baixo Mondego valley is mainly dedicated to monoculture of irrigated corn grain and flooding rice. The eastern part is mainly used for corn, while the western area, closer to the river mouth, is used mainly for rice. Conventional tillage is practiced with various passes of heavy machinery. Disc harrow passes for straw stubble incorporation, furrow plough passes for soil inversion, chisel and rotary tiller passes to prepare seedbed. Production is based on expensive production factors: mineral fertilisers to compensate for the important soil nutrient exportation after harvesting, pesticides for pest control problems driven by intensive monoculture.

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 German study site, and the SICS category and cluster under which they are grouped

General treatment category	SICS cluster <sup>9</sup>	Experiments
Crop rotations, cover crops, fertilisation	Soil improving crops	1. Bico da Barca - Organic rice in rotation with perennial lucerne
	Soil improving crops	2. Loreto – Conventional grain corn in succession with legume winter cover crops used as green manure
	Fertilisation/Amendments	3. São Silvestre - Conventional grain corn fertilised by urban sludge

<sup>9</sup> SICS are grouped into four clusters: (1) Soil-improving crops, (2) Fertilisation/amendments, (3) Soil cultivation, and (4) Alleviation of compaction.

## 2.1 Which existing policies and policy instruments shape agricultural practices in Low Mondego Valley, Portugal?

A policy analysis at the national level suggests that the adoption of the Soil-Improving Cropping Systems (SICS) may be directly and indirectly shaped by the following policies<sup>10</sup>: The overview below 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 in the region.

### *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 **Statutory Management Requirements (SMR)** and **Good Agricultural and Environmental Conditions (GAEC)** as well as the greening requirements set out by the policy.

The most relevant in Portugal are:

- SMR 1 1 - protection of waters against pollution caused by nitrates from agricultural sources;
- SMR 2 and SMR 3 - conservation of natural habitats and wild flora and fauna;
- GAEC 1/2/3 - Water protection;
- GAEC 4 - Minimum soil cover;
- GAEC 5 - Minimum land management, reflecting site-specific conditions to limit erosion;
- GAEC 6 - Maintenance of soil organic matter;
- GAEC 7 - Maintenance of landscape characteristics.

Greening requirements were first introduced in 2015 and apply to direct payments under Pillar 1 of the CAP. Practices eligible for greening payments are : diversification of crops, maintenance of permanent grasslands, and establishment of Ecological Focus Areas (EFA). With regards to crop diversification, many farmers choose to plant a fall winter crop so they do not have to diversify summer crops on the farm. Areas designed as environmentally sensitive permanent grassland cannot be converted to other uses and cannot be ploughed. So far, Portugal has only designated less than 1% (1,727 ha) of the total permanent grassland area situated in Natura 2000 area (284,050 ha) as sensitive grassland area. Areas outside Natura 2000 sites were all designated as sensitive permanent grassland.

---

<sup>10</sup> See the Annex for a more detailed overview of the policies described in this section.

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. The list of EFA elements which Portuguese farmers can choose from includes four of the seven options provided at EU level: fallow land, nitrogen fixing crops (pea, fava, lupine, clover, chickpea, beans, lucerne and peanut), agroforestry, and afforested areas.

In addition to these conditional payments, the **Rural Development Programme (RDP) for Portugal 2014-2020** provides funding for contractual, voluntary commitments by farmers to implement certain sustainable agricultural practices. The actions and measures focus on the following four areas of intervention: Innovation and knowledge, Competitiveness and organisation of production, Environment resource efficiency and climate, and Local development. Overall, 26,2% of the RDP budget is dedicated to Focus Area 4: Restoring, preserving and enhancing ecosystems related to agriculture and forestry. 11.44% of the budget allocated to FA 4 is used to finance Measure M10 - AEC (Agri-Environment Climate) Payments are used to support commitments by farmers to better soil management for example by direct seeding, sowing along contours and incorporating straw or other matter.

Further to M10, the Measure M7 - Agriculture and Natural Resources and the following sub-measures, incentivise sustainable agricultural practices:

- 7.1 Organic Agriculture; 7.2 Integrated Production
- 7.3 Payments Natura Network
- 7.4. Soil Conservation: Direct seeding or mobilisation in the line or interline seeding for permanent crops
- 7.5. Efficient Water Use. Dealing with soil erosion was identified as a need,

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.

In addition, Portugal spends over 10% of its RDP budget on focus area 5E- Fostering carbon conservation and sequestration in agriculture and forestry.

### *Water policies*

The **National Water Law**: transposes the EU Water Framework Directive into Portuguese law. It establishes the institutional framework and planning instruments for the sustainable management of water with the aim of protecting surface and groundwater quality. 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 EU Nitrates Directive is implemented at national level through the **Law on the Protection of Water from Pollution Caused by the Use of Nitrates in Agriculture**. It aims to promote more rational and sustainable fertilisation practices, requiring the establishment of a Code of Good Agricultural Practice to be implemented by farmers on a voluntary basis. Furthermore, Nitrate Vulnerable Zones need to be identified and action programmes set up for these zones. The measures to be included in these programmes must include periods when the land application of certain types of fertilisers is prohibited. Limitations on the application of fertilisers must be consistent with good agricultural practice taking into account soil conditions, soil type, slope and land use and agricultural practices, including crop rotation systems.

The **Groundwater Directive**, a daughter Directive of the WFD, is transposed nationally through National Groundwater Law: against Pollution and Deterioration. The Law 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 and pesticides.

#### *Waste and chemicals policies*

The **National Legal Framework for Agricultural Use of Sewage Sludge** transposes the Sewage Sludge Directive and lays down the rules for the application of sewage sludge on agricultural soil with the aim of avoiding harmful effects on people, water, soil, vegetation and animals. It establishes standards for analysis of sludge, of soil, dates and applicable quantities and pollution thresholds. The use of sludge in agriculture requires a license and is subject to a Sludge Management Plan (PGL). The PGL needs to be prepared by an accredited technician.

**The National Sustainable Use of Pesticides Law** transposes the EU Sustainable Use of Pesticides Directive (SUPD). It 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 plant protection products. Its aim is to avoid the use of non-approved pesticides. It establishes basic principles for Integrated Pest Management and promotes the use of non-toxic alternatives to the use of plant protection products. The Law mandates the development of an Action Plan for the Sustainable Use of Plant Protection Products (NAP). The Portuguese NAP sets targets, measures and timetables to reduce the risk and effects of the use of pesticides on human health and promotes integrated production and organic farming.

#### *Cross-cutting policies*

Portugal 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.<sup>11</sup> Portugal is one of thirteen EU Member States which declared itself an 'affected country' status and subsequently prepared a National Action Programme to Combat Desertification (PANCD) in 2014. The NAP details country-specific objectives and measures to be taken to combat desertification. It is a cross-cutting instrument which aims to

- Protect and conserve soil;
- Promote the use and sustainable management of water;
- Maintain and promote the biodiversity of dry and dry sub-humid areas;
- Promote mitigation and adaptation to climate change.

Actions are mainly restricted to monitoring awareness-raising and research activities.

## **2.2 To what extent do existing policies facilitate adoption of soil-improving practices in Low Mondego Valley?**

The main soil threats in Low Mondego Valley study site include:

- soil compaction – caused harrowing, traditional tillage, and compaction caused by livestock (due to very soaked ground in winter)
- Erosion – primarily resulting from intense rain in winter
- Pollution/contamination of soil/water – caused by residues from wastewater treatment plants (sludge), plant protection products, and nitrates
- Low soil organic matter content (estimated to be below 2%)
- Acidification and low soil microbial diversity

SICS that are being tested at the study site are thought to address these soil threats and include soil improving crops (Organic rice in rotation with perennial lucerne and Conventional grain corn in succession with legume winter cover crops) and integrated nutrient methods (Conventional grain corn fertilised by urban sludge). 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 the extent to which they regulate, incentivise and promote the adoption of these practices in the study site region.

### *Crop rotation and cover crops*

Crop rotation and cover crops are incentivised through the CAP direct payments, specifically GAEC and greening requirements. However, according to the same interviewee, there are

---

<sup>11</sup> [https://www.unccd.int/sites/default/files/relevant-links/2017-01/UNCCD\\_Convention\\_ENG\\_0.pdf](https://www.unccd.int/sites/default/files/relevant-links/2017-01/UNCCD_Convention_ENG_0.pdf)

problems with the implementation. For example, there are farmers who plant only maize, and have difficulties in implementing the crop rotation plan, which requires three crops. Such a policy forces them to plant crops that are often not very profitable – for example sunflower, which sometimes does not produce a high yield. The Ministry of Agriculture currently allows the rotation of the crops to be replaced by a coating during the winter, which means only one crop is planted (not three) and the farmer is committed to a winter cover crop, for example oats. This means the farmer invests effort in one crop, without having to invest in more. As pointed out by the interviewee, the market for such crops must also be considered – if there is no market demand, then there is no point in growing it just to achieve three different crops.

In addition, another interviewee noted that CAP payments can lead to monocultures. As pointed out by the interviewee, the diversity of soil microbiology is closely associated with plant diversity – in cases with a monoculture or little crop rotation, soil microbes conducive to the single crop will dominate and soil biodiversity will decrease. According to the interviewee, this lack of microbe biodiversity remains a problem throughout Portugal.

### *Integrated nutrient management*

Nutrient input in agriculture is regulated through several pieces of legislation, mostly with a view to protecting water quality rather than soil, such as the national Water Law, regulations dealing with the sustainable use of pesticides, and sewage sludge. Interviewees noted that there have been improvements, especially through the implementation of the Nitrates Directive. In this case, the interviewee noted that there has been a lot of work on the part of farmers, and already a large share of farmers adhered to the measure of integrated production where there is a tight control of the fertilisers, including nitrates. This also means that already regular analysis is carried out on nitrogen, phosphorus, potassium, and organic matter, and farmers are very aware of the nutrient requirements of their crops. They are already beginning to use controlled-release nitrates so that nitrogen is more retained, and that plants use nitrates more effectively. Additionally, farmers are also increasingly controlling irrigation, which is an extremely important factor in the management of nitrogen. With excessive irrigation there is water loss at the end of the furrows, and lead to the entrainment of fertilisers.

At the same time, another interviewee noted that where farmers have access to manure, that manure is returned to the soil, however, in the region, there are few stabling cattle, and therefore not a lot of available manure. In such cases, the interviewee noted that the focus should be on the use of crop residue instead.

Another interviewee pointed out that farmers growing rice have an additional incentive to manage their nutrient application effectively, as excess nitrogen will cause luxury consumption and therefore a decrease in production. This is another reason farmers are likely to use less rather than more fertiliser. On the other hand, the interviewee noted that for some years now, although farmers no longer use nitric nitrogen in rice, they use ammoniacal and amidic nitrates, which are less leached into the water. However, sometimes illogical measures are applied as pointed out by one of the interviewed stakeholders. For example, the obligation for winter





## 2.3 Which factors shape success or failure of policy instruments in Low Mondego Valley?

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

### *Funding priorities*

Stakeholders highlighted that financing for regional development was focused toward financing small and large industrial projects, rather than financing agricultural and forest entrepreneurship.

### *Costs of adopting SICS*

The costs for mitigating the threat of soil compaction were also identified as hampering the uptake of SICS, particularly reduced tillage practices. Undertaking spring decompaction for maize and rice can amount to 250 to 300 euros per hectare. However, as one interviewee explained, the compacted soils make a change to a reduced tillage system difficult, as this then makes early irrigation difficult and extremely costly, and there is an added risk that seeds will not germinate simultaneously, which leads to production losses, and thus more costs. These problems, therefore, push many farmers to continue with conventional tillage. Another example cited by stakeholders participating in the adoption workshop was the costs of seeds. Seeds are often quite expensive because they are imported, and there is a lack of appropriate subsidy scheme and no policy incentives in place. Especially the use of cover crops would drive up costs since additional seeds would need to be purchased on top of the main crop. Similarly, organic rice cultivation, which was tested at the site, would require organic certification, involving yet more costs which seem disproportionate, especially if the rice is only cultivated on a small area of land. Land reparceling was identified as the way to address this challenge. Finally, economic factors were also identified as an enabler, as organic rice has economic benefits as there is a market for high quality and differentiated produces, and there is a favourable subsidy scheme in place.

### *Economic incentives mostly reward existing practices*

One interviewee noted that agriculture in Portugal was highly driven by subsidies (especially the CAP), which may not necessarily translate into the adoption of SICS as was noted by several stakeholders. One interviewee explained that agricultural policy supported farmers' incomes for implementing practices they already used and had always done so. Because of this, funding received from direct payments, or other agri-environmental measures were nothing more than

“hidden aid” supplementing the farmer’s income, without aiming to improve the environmental performance of agriculture. The interviewee pointed out that the most popular agri-environmental measure was integrated production, but, in Portugal, the requirements did not mandate the farmer to do anything in particular, merely purchase certified seed or only using pesticides that were homologated, neither of which mitigate any soil threats.

Another example provided was funding available for irrigation. Irrigation can either be used in autumn/winter to supplement the rain that falls during the season, or in summer to produce summer/spring crops. If it is used in winter, the productivity of the crop is about five times higher than that of summer crops, and because it is supplementing the climate conditions, it uses far less water than summer/spring irrigation. However, under agro-environmental financing measures, farmers receive the same amount of funding regardless of when they use irrigation.

The interviewee was, however, able to give an example of an AEC measure supporting direct seeding (under the RDP) having a positive impact on soil. This measure represents only 5% of the total amount of money received, which makes it far less attractive to farmers, in terms of financial incentives. Instead, the interviewee claims that farmers are adopting this measure, and other soil improving measures which require a large technical change, with good results, because they have good technical support. In the interviewees view, the only way to promote the adoption of SICS is to ensure good technical support accompanies the financial incentives.

#### *Lack of knowledge and technical support*

A lack of knowledge was identified by interviewees as one of the main reasons SICS were not adopted. One interviewee spoke with first-hand experience – in their work with agricultural entrepreneurs and farmers, the dissemination of knowledge that accompanies the technical support they provided was key to changing attitudes. Similarly, another interviewee spoke of a project concerning land reparation, which, once farmers had seen to be successful in one valley, were more willing to adopt in their own valley. This same interviewee also mentioned a project in the region that focused on lessons learnt – many of those that were trained in this experimental unit of the Regional Directorate have gone on to successfully implement better practices.

At the same time, interviewees noted that a lack of knowledge and training remained a problem. One interviewee pointed out when there is a major change to the production system leading to significant technological changes, the farmer is unable to implement them as he has no knowledge to do so. Additionally, one interviewee noted that research mainly focused on producing scientific articles rather than finding practical solutions to the problem. Furthermore, a lot of the research that was carried out was not disseminated widely beyond the area in which it was produced. At the same time, it was highlighted that there was work to be done to ensure the research was more regionalised. The interviewee pointed out that the Ministry of

Agriculture has only one agronomic station, whereas environmental conditions and especially production systems vary greatly throughout the country. While information was gathered on a more regional basis, it was mostly done by higher education institutions (although this is not always the case), that focus not on informing farmers, but on scientific articles. Information was thus not reaching the farmers nor policy makers. This last point, according to the interviewee, was crucial as policy makers were not interested in what was already known about good practices when they design policy measures, they need to know about new solutions, and how they could be implemented.

Lack of knowledge and dissemination were also raised as a key barrier to the adoption of SICS tested at the site, the use of organic amendments with sludge. Stakeholders stated that there was little knowledge about sludge application methods amongst farmers and its environmental benefits. Farmers knew that the application of sludge allowed an increase in productivity at almost zero cost, but in general they were not very aware of the benefits to the soil, and often had misconceptions about environmental risks. Similarly, stakeholders noted that farmers were lacking knowledge about the use of legumes green manure, the second practice trialed at the site, and highlighted that information currently available on the topic was dispersed and not readily available.

Several interviewees highlighted that there were already various good examples of projects and initiatives that promote SICS adoption, and these needed to be shared with others more effectively. For example, the Regional Directorate for Agriculture and Fisheries for central Portugal has carried out experimentation activities in partnership with agricultural organisations, companies, agricultural producers, universities, and polytechnic institutes for many years in order to transfer knowledge produced by science to the productive sector.

#### *Policy instruments not flexible enough to take into account regional/structural differences*

All interviewees on the diversity of Portugal's geographic conditions and farming operations, implying that research, and especially policy need to be adapted to the region in question, otherwise it acts as a barrier to the adoption of SICS. Another interviewee pointed out that this also concerned farm size, which varied throughout the country and tremendously impacted on the agricultural systems practiced.

One interviewee gave an example of policy encouraging the use of cover crops in winter. They noted that in some cases, this measure worked well, for example in Ribatejo or Alentejo, as the main crop (corn) could be collected earlier in the season, and the land was sloping so it drained well, making ryegrass or oats an ideal crop. However, in a valley such as where the study site is located, the ground is usually soaked in winter, making the measure less productive. Similarly, nutrient management can vary significantly throughout the country, in the north far less is used, as in the south the temperatures are warmer, and plants produce more, and thus require more nutrients. Another example was given regarding manure. In

Portugal, manure is to be buried, especially in nitrate protection zone. However, there is no scientific basis for this requirement, and it is merely a copy of what is done by a specific country in Northern Europe. In Northern Europe, the focus is on the emission of nitrates into the atmosphere as greenhouse gases, but although burying manure reduces losses by volatilization, mineralisation increases, which increases the risk of nitrate washing losses, which may be a risk to water. By implementing this measure, farmers are increasing both erosion and mineralisation, rather than mitigating any soil threats. To make matters worse, this practice directly contradicts another measure encouraging direct seeding and the return of organic residues to the soil. A farmer may be compliant with the measure on direct seeding, but if he wants to use manure, legislation requires him to mobilise the soil, making it not possible to do both.

Other interviewees also noted that EU policy did not always reflect the agricultural reality of each Member State. Another point was made that EU legislation was steered by the bigger, more influential Member States such as Germany and France, which was, according to stakeholder opinion, why there was less focus on soil at EU level as these countries had more water quality rather than soil problems, and that this was reflected in the number of water protection policies already in place.

#### *Bureaucratic permitting procedures for sewage sludge application*

Applications for permits to apply sludge on agricultural land are judged to be bureaucratic, lengthy, and requiring the approval of several entities which discourages many farmers to seek a license. In addition, farmers perceive the legislation to be extremely strict and complicated.

#### *Unwillingness to give up traditional practices*

Several comments made by interviewees suggested that there was a reluctance of farmers to adopt new practices the replace traditional practices. These traditional practices may not necessarily be detrimental to SICS, as traditional practices do allow for geographic differences. One interviewee mentioned furrows used for irrigation, which can be considered the most economical irrigation system worldwide. As the interviewee pointed out, sometimes doing the opposite of nature costs money, and will not always bring return. However, one interviewee pointed out that under a traditional system, farmers do not want to know what the soil is, as all they need to do is follow the "recipe", as has always been done. This means that the ability to interpret the ecosystem is not needed, even if the practices are threatening the soil. With conservation agriculture, argued the interviewee, the farmer is much more aware of the natural factors necessary for soil health such as soil biodiversity, soil structure, roots of plans being used to improve drainage etc. This way of thinking is much more likely to adopt an appropriate SICS, although it requires the farmer to think and come up with a more complex diagnosis, which requires specialised technical knowledge.

### *Limited influence of producer organisations*

One interviewee mentioned the role of producer organisations, which in Portugal are insufficient in number and size. According to the interviewee, it was essential that organisations could grow and become more professional to meet the difficulties of some sectors of agriculture and some territories. Strong organisations were more likely to attract support to their organisations and ranks, with a direct impact on territorial cohesion and the development of agriculture. This would promote better agricultural practices.

### *Lack of monitoring and enforcement*

Another issue with the adoption of SICS became clear during the interviews: weak monitoring enforcement. For a measure to be effective, it must be implemented, and there must be some way to enforce it – a farmer who has a tight bottom line is unable to compete with a neighbor who does not adopt SICS and can therefore accept a lower cost for his products. In Portugal, although policy evaluation is carried out by the Office of Planning, Policy, and General Administration (GPP), and each Community Support Framework is subject to an evaluation, according to the interviewees, the issue of non-compliance goes beyond farmers merely accepting money for practices they have always done. One interviewee went so far as to say that close to 90% of organic farmers carry out illegal or extensive livestock production, meaning they are not legitimately organic farmers. The interviewee pointed out that they were taking advantage of the measure in order to monetise a system that was not profitable beforehand. Similarly, the interviewee claimed that there were those that simply did not comply with the regulations, for example using pesticides, knowing that there was a lack of control and even if the measure seemed strict, there was no surveillance capacity.

### *Market demands/pressures*

Another interviewee noted that a key to non-compliance was the market. If there was a market for crops that benefit soil quality, farmers were more likely to see the benefit of growing them. According to the interviewee, non-compliance implies difficulty in market penetration. This issue ties in closely to the problems discussed with economic measures, as such economic measures should be able to mitigate such a market failure.

The table below provides a summary of the stakeholder recommendations for actions to promote SICS adoption in the study site region.

Table 9: Table 9: SICS being tested, adoption factors (enablers or barriers) and actions to overcome the barriers<sup>12</sup>

<b>Soil improving crops: Legumes green manure</b>			
<b>Adoption factors (+ or -)</b>	<b>Actions</b>	<b>Effectiveness</b>	<b>Feasibility</b>
Lack of subsidies (-)	<i>None identified</i>		
Mild climate (+/-)	<i>None identified</i>		
Cost and access to seeds (-)	Develop national seed multiplication programs,	3	3
Lack of farmer interest and supportive networks (-)	Create a network of national trials that allows adapting the technique to each region, according to the characteristics of each area.		
Lack of training in green fertilisation (-)	Implement/ finance projects to compile existing information, implement/maintain demonstration areas; dissemination at fairs, workshops for the public, farmers, technicians, as well as promote in schools (textbooks, field trips).	4	2
Green manure technique lost (-)	Implement/ finance projects to compile existing information, create a network of national trials to adapt technique to regional conditions	4	3
Difficult to access relevant information / specific documents for the Baixo Mondego region (-)	<i>None identified</i>		
No political incentives to adopt the green manure technique (-)	Create operational groups (politicians, technicians, and farmers), to (i) envisage the technique at a more global level, with the orientation of the country's policies, changing the course to current practices; (ii) invest in increasing soil fertility and the quality of the environment, in general; and (iii) stop unconditionally financing less favorable techniques , priority should be given to conservation farming techniques that are also able to be a source of food production that is both profitable and sustainable.	3	3
<b>Soil improving crops: Organic rice in rotation with Lucerne</b>			
<b>Adoption factors (+ or -)</b>	<b>Actions</b>	<b>Effectiveness</b>	<b>Feasibility</b>
Cost for organic certification in small areas, organic fertilisation and labour (-)	Review certification costs for small areas. Land reparcelling is the only way to solve many problems arising from the mini-fundio but it is a political measure	4	1
High cost of installing lucerne (-)	<i>None identified</i>		
Subsidies in place for rice cultivation (+)	<i>None identified</i>		
Economic value underestimated (-)	Communicate the quality of products to increase prices to a level where they reflect added effort. Market niches have to be organised together with cooperatives or producer associations	4	2
Favourable climate and soil conditions (+)	<i>None identified</i>		
Weed management (more pests attacking organic rice) (-)	New techniques explored, e.g. planting rice instead of sowing it	2	2
New generation of farmers open and interested to try this technique (+)	<i>None identified</i>		
Technical support from cooperatives, open days (+)	Need for more specific training organisation for technicians and farmers	4	3
Policy support for organic rice cultivation (+)	Strengthen incentives with the new CAP at national or regional level with specific funds.	4	1

<sup>12</sup> 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.

Fertilisation/amendments: Organic amendment with sludge			
Adoption factors (+ or -)	Actions	Effectiveness	Feasibility
Low cost for farmer (+)	Agricultural valorisation is a good solution for WWTPs and advantageous for the farmer who keeps organic matter at almost zero cost.	4	4
Lack of knowledge about the sludge application and need for a specific machinery (-)	It is necessary to make farmers aware of the environmental risks of poor application of sludge (eg inadequate quantities, under inappropriate climatic conditions) and to hold them accountable for application practices. Mandatory training for those who have an approved sludge management plan	4	3
Bad smell of sludge	Improve the stabilisation of organic matter, through digestion, dehydration, and / or by composting	3	2
High bureaucracy (administrative permits for the sludge application) (-)	Simplification of the management plan approval process is necessary.	3	2
Specific rules for sludge application (crop type, soil type, quantities, application dates, waiting times before sowing) (-)	<i>None identified</i>		
Lack of knowledge about the environmental benefits (-)	Dissemination of the results of studies on the impact of sludge on soils in seminars or dissemination to the general public, in order to demystify the use of sludge. Explain that risks are controlled through the sludge management plan.	3	2
Easy access to information (+)	<i>None identified</i>		
Bad reputation of sludge application amongst the public and farmers (-)	<i>None identified</i>		
Strict and complicated legislation (-)	<i>None identified</i>		

### 3 Recommendations for actions to promote the uptake of SICS

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 (SICS) at the EU-level as well as the region of Low Mondego Valley in Portugal. SICS that are being tested at the study site, crop rotations, cover crops, and integrated nutrient management, are thought to be suitable to address the main soil threats of soil erosion, soil compaction, low soil organic matter and microbial diversity.

The analysis shows that the existing policy framework promotes all these relevant SICS to some extent but also identifies some barriers to achieving higher adoption rates. Both existing policy and economic measures, the frameworks are well established, although there does seem to be room for improvement in the dissemination of knowledge and good practices. However, both the policy framework and economic measures are currently ineffective, due to a failure to acknowledge different needs and geographic conditions of farmers. This means the existing frameworks are not coherent with each other, including between different governance levels, but also that many of the measures do not make sense to the individual farmer, who is being told to both mobilise the soil and simultaneously keep it undisturbed, or to plant winter crops in a water-logged valley knowing they will not survive. At the same time, subsidies are being received for practices which are either not ambitious enough or are designed to benefit problems in other parts of the country.

Based on the evidence set out in this report, the following recommendations can be made:

- **Design targeted incentives that reward uptake of appropriate practices:** As mentioned above, subsidies and other economic incentives play a large role in Portuguese agriculture, however, evidence suggests that financial measures might finance practices already in place or which are not appropriate in specific locations. At the same time, regional and local policies must be flexible enough to allow for regional differences. A financial measure on cover crops may well be appropriate in the south of the country, but less appropriate in the north. Financial incentives need to be more targeted, both tied to specific actions and region (or environmental/geographic conditions) to result in the desired change. Priority should be given to conservation farming techniques that are also able to be a source of food production that is both profitable and sustainable.
- **Strengthen policy enforcement:** While it was found that there are several 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 implementation and enforcement mechanisms. It is clear mechanisms for checking compliance with existing regulations need to be strengthened and expanded. 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)”. Cover crops will be an important strategy for meeting this requirement. The payment agencies should seek to ensure that these conditions are complied with and verified through, e.g., more frequent inspections and farmer reporting (including for example images of the implemented practices).
- **Subsidise transition to practices benefitting soil health:** The uptake of certain SICS might require upfront investments, such as the purchasing of seeds or new machinery. Grants should be made available to farmers buying new equipment to implement these practices or groups of farmers. A revision of certification costs might encourage a move to organic production, such as organic rice cultivation tested at the study site. Land reparcelling and the establishment of a national seed multiplication program were identified as actions which could facilitate a transition and reduce costs in the long run.
- **Simplification of permitting procedures for sewage sludge application:** a simplification of permitting and management plan approval process is necessary, as currently, many farmers prefer to avoid bureaucratic complications related to the use of sludge, even if it is free.
- **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 (and risks) to change their misconceptions about these methods. To this end, research



findings should be systematically compiled, 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, demonstration days, and social media. Since farmers tend to place a lot of trust in their peers, establishing a network of model farms demonstrating how to use and adapt different SICS in the region would effectively support farmers in learning and sharing experiences about these practices.

- **Invest in and build capacity of Farm Advisory Services:** like framers, farm advisors also need to learn about new practices, their practical application, costs, and benefits to support farmers they assist. Strengthening the technical skills of farm advisory services and setting up mechanisms for continuous learning are therefore crucial.
- **Communicate environmental benefits generated by SICS:** high-quality products need to be sold at fair process which compensate farmers for the benefits they generate for the environment and society as a whole. The prospect of a fair price for a product stemming from sustainable practices will make their uptake more appealing to farmers. It will be equally important to continue to educate consumers about the advantages and disadvantages of conventional farming practices vs. sustainable practices to ensure increased demand for sustainably produced products and encourage the retail sector to make these more widely available to all sections of society. To this end, cooperatives or producer associations play a major role in marketing these products, explaining production methods – especially important for practices such as sewage sludge application which might perceived as a high-risk technique – and negotiating prices with retailers.

## Annex: Overview of key policies in Low Mondego Valley Portugal

Policy name	English translation	Scale	EU or MS-based policy	SICS covered	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 (CAP Greening)	Crop rotation, green manure , catch/cover crops, reduced tillage, integrated landscape management	Regulation establishes supplementary national rules for direct payment schemes provided by the Regulation (EU) No 1307/2013 of 17 December, concerning the implementation of national decisions concerning basic payment, payment for agricultural practices beneficial to the climate and the environment (greening), payment for young farmers, crop-specific payment for cotton, voluntary simplified scheme for small farmer, voluntary coupled support scheme Greening represents 30% of the budget in Portugal and practices are : Diversification of crops; Permanent grassland maintenance; Ecological focus areas; National Certification Regime for maize and tomato, with the requirement of soil cover during fall-winter period with the installation of a sown crop, were established as coupled practices. At the level of crop diversification, many farmers choose to make a fall winter crop, so they do not have to diversify summer crops on the farm. At the level of permanent grasslands, the area designed as environmentally sensitive permanent grassland cannot convert to other uses and cannot be ploughed. But Portugal only designates as sensitive grassland area less than 1% (1,727 ha) of the total permanent grassland area situated in Natura 2000 area (284,050 ha). Any area outside the Natura 2000 area was designated as sensitive permanent grassland. At the level of areas of ecological focus areas, in 2015 they are counted as SIE: fallow; Nitrogen fixing crops (pea, fava, lupine, clover, chickpea, beans, lucerne and peanut), Agroforestry, Forestry of agricultural land, Landscaping elements under cross-compliance: riparian galleries in Natura network; linear elements of rice cultivation. The list of EFA elements which Portuguese farmers can choose from includes four of the seven elements that can protect soils and soil carbon: fallow, agroforestry, afforested areas and areas with nitrogen-fixing crops. 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.
Despacho normativo n.º 6/2015, de 20 de fevereiro,	CAPA - Cross compliance -	National	EU (CAP Cross-Compliance)	Crop rotation, green manure , catch/cover	Establishes the Statutory Management Requirements (SMR) and standards of good agricultural and environmental condition (GAEC)

Policy name	English translation	Scale	EU or MS-based policy	SICS covered	Description of policy
<i>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</i>	Statutory Management Requirements (SMR) and standards of good agricultural and environmental condition (GAEC).			crops, reduced tillage, controlled traffic management, integrated landscape management	(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; 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.
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 Programme for Continente 2020	National	EU (CAP RDP)	All SICS	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; 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 e.g., by direct seeding, sowing along contours and incorporating straw or other matter. Adoption of Organic Agriculture; Integrated Production; Soil Conservation techniques: Direct

Policy name	English translation	Scale	EU or MS-based policy	SICS covered	Description of policy
					seeding or mobilization in the line or interline seeding for permanent crops; better Efficient Water Use
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 (CAP RDP)	Crop rotation, green manures, cover crops, catch crops, integrated nutrient management, enhanced efficiency irrigation, reduced tillage, integrated pest management, controlled traffic management, integrated 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 'of measure No 7' Agriculture and natural resources' of the Mainland Rural Development Program Adoption of Soil conservation techniques, most Efficient use of water, Traditional permanent crops Extensive grazing, Mosaic agro-forestry
Lei n.º 58/2005, de 29 de dezembro - Lei da Água	National Water Law	National	EU (WFD)	Integrated nutrient management, integrated pest management	It transposes into national law the Water Framework Directive 2000/60 / EC of the European Parliament and of the Council of 23 October, approving the Water Law and laying the foundations and institutional framework for sustainable management of water. Its purpose is to protect the surface water bodies inland, coastal and transitional, and groundwater and improve their ecological and chemical status. It lays down that Member States shall protect, improve and recover all bodies of surface water with the environmental objective of achieving Good Surface Waters by 2015. Some of its objectives are relevant for soil protection, namely the reduction of pollution from surface runoff and in groundwater, the protection of water-related ecosystems such as wetlands and the retention of flood water. Adoption of more rational fertilization and treatment practices
Decreto -Lei n.º 235/97, de 3 de setembro, <i>alterado pelo Decreto -Lei n.º 68/99, de 11 de março</i> - Proteção da água contra a poluição causada por nitratos de origem agrícola	National Nitrates Directive - Law on the Protection of Water from Pollution Caused by the Use of Nitrates in Agriculture	National	EU (Nitrates Directive)	Integrated nutrient management	Adoption of more rational and sustainable fertilisation practices
Decreto-Lei n.º 208/2008 de 28 de outubro	National Groundwater Law	National	EU (Groundwater Directive)	Integrated nutrient management, integrated pest management	This directive transposes the Directive 2006/118 / EC of the European Parliament and of the Council of 12 December on the protection of groundwater against pollution and deterioration into national law. It establishes the regime of protection of groundwater against pollution and deterioration: qualities standards (nitrates and pesticides), indicators

Policy name	English translation	Scale	EU or MS-based policy	SICS covered	Description of policy
					and thresholds of pollutants (metals ...) Adoption of more rational and sustainable fertilization and treatment practices
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 (Sewage Sludge Directive)	Integrated nutrient management	It lays down the use of sewage sludge in agricultural soils, in order to avoid harmful effects on man, 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. The use of sludge in agriculture is compulsory licensing, the use of sludge in agricultural land is subject to a Sludge Management Plan (PGL), prepared by an accredited technician and responsible for certain perimeter (s) of intervention and approved by the territorially competent entity (DRAP). Terra Fertile is responsible for the implementation these plans 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 (SUPD)	Integrated pest 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. The law includes minimum standards for the facilities of the companies that carry out these activities and sets the basic principles for Integrated Pest Management which should promote the use of alternatives to the use of plant protection products. avoid the use of non-approved pesticides and provide a sustainable use of pesticides.
Resolução do Conselho de Ministros n.º 78/2014 - Diário da República n.º 248, Série I, de 24-12-2014 - Programa de Ação Nacional de Combate à Desertificação	National Action Program to Combat Desertification (PANCD)	National	UN	Crop rotation, integrated nutrient management, enhanced efficiency irrigation, reduced tillage, integrated pest management, smart residue management	First revision and update of the National Action Program to Combat Desertification (PANCD). The national plan promotes good practices, monitoring, awareness raising, and research. It has as specific objectives: <ul style="list-style-type: none"> <li>- Protect and conserve the soil;</li> <li>- Promote the use and sustainable management of water;</li> <li>- Maintain and promote the biodiversity of dry and dry sub-humid areas;</li> <li>- Promote mitigation and adaptation to climate change.</li> </ul>