SoilCare
SOILCARE FOR PROFITABLE AND SUSTAINABLE CROP PRODUCTION IN EUROPE

Policy analysis:

Promoting SICS adoption in Akershus, Eastern Norway

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Executive summary

The soil-improving cropping systems (SICS) tested at "Akershus" in Eastern Norway include measures for compaction alleviation (cover crops, including biological compaction release), soil-improving crops (cover crops and catch crops), and precision agriculture and are thought to address the main soil threats at the site, compaction, erosion, and nutrient loss. They therefore represent important practices that might benefit soil health in the region if widely taken up. The main aim of the work presented here was to formulate policy alternatives and actions at to facilitate the adoption of soil-improving cropping systems.

Policy shortcomings and opportunities

The existing policy framework in Eastern Norway already promotes the SICS covered by the SoilCare project through a range of existing regulatory, economic, and voluntary policy instruments and measures (shaded in light green). The analysis[1] shows that economic instruments promote the use of cover crops, the SICS tested at the study site (shaded in dark green), a practice which is relevant to alleviating compaction, halting erosion, and generally improving soil health. The same instruments incentivse reduced tillage practices which also reduce compaction and erosion while smart residue and controlled traffic management, which could address the same soil threats, are not incentivised, or regulated by existing policies.

Table 1: Coverage of SICS in current regional policies, instruments, and measures in Eastern Norway

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
Regulations on subsidies for regional environmental measures in agriculture *(FOR-2016-04-06-392 Forskrift om tilskudd til regionale miljøtiltak i landbruket, (forskrift om RMP-tilskudd), Oslo og Akershus)*											
Regulation on water management framework *(FOR-2006-12-15-1446 Forskrift om rammer for vannforvaltningen)*											
Regulation on organic fertilisers *(FOR-2003-07-04-*											

[1] See the Annex for a more detailed overview of the policies described in this section.

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
951 Forskrift om gjødselvarer mv. av organisk opphav)											
Regulation on plant protection products (FOR-2015-05-06-455 Forskrift om plantevernmidler)											

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:

- Weak financial incentives
- Lack of explicit soil objectives in existing legislation/soil-specific legislation
- Low coherence between policies
- Land tenure
- Lack of knowledge sharing/dissemination
- Climate change impacts

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: Participants were asked to identify actions for the most important factors affecting SICS adoption; therefore, not all adoption factors were discussed in detail. The effectiveness and feasibility of an action was not assessed.

Compaction alleviation and soil-improving crops (*SICS category: Cover crops*)	
Adoption barriers (-) and enablers (+)	**Actions**
Changing climate – longer growth season (+)	*None identified*
Experiences with compaction damage (+)	More research and awareness (preventive, repairing)
Positive experiences with advisory services and farm visits (+)	More use of farm walks and dissemination of results/reports

Compaction alleviation and soil-improving crops (*SICS category: Cover crops*)	
Access to right information (+)	Wider dissemination of existing knowledge, sharing practices, study visits, increase knowledge about the positive effects of cover crops
Subsidies (+)	Increase the subsidies for cover crops in the Regional Environmental Programme
Costs associated with seeds and financial risks (-)	Increase subsidy rates
Lack of information (-)	Wider dissemination of existing knowledge, sharing practices, study visits, increase knowledge about the positive effects of cover crops
Climate limitations (-)	*None identified*
Design of subsidy schemes limiting use of certain types seeds, methods and dates for sowing due to policy design (-)	Adapt legislation to support practices that are beneficial in the long-term
Lack of experience under Norwegian conditions (-)	Large scale trials with farmers, more research, and long-term experiments Make research results accessible Provide funds to develop a cover crop guideline

Recommendations for actions to promote the uptake of SICS

Based on the analysis of bottlenecks and opportunities in national policy to facilitate the adoption of Soil-Improving Cropping Systems in the Akershus, Eastern Norway, the following recommendations were formulated:

- **Design a more flexible system of economic incentives:** Voluntary financial incentives are the main driver for the adoption of agricultural practices beneficial to soil in Eastern Norway. There is a need to consider the different conditions in which farmers operate (such as differences in tenure) to ensure funding is accessible without creating additional administrative burden. Furthermore, incentives must be adapted to changing conditions such as inflation, so they do not lose their attractiveness over time.
- **Revise the existing policy framework to include ambitious, long-term targets**: Certain policies, most notably economic policy instruments are successful in encouraging farmers to adopt SICS. To expand these positive outcomes, policies may be adapted to accommodate a wider range of farm types and to include more ambitious targets. In addition, experience shows that changes to the policy framework and subsidy schemes, such as the Regional Environmental Programme, could act as a barrier to implementation. Providing sustained funding and legislative security will be crucial in motivating farmers to adapt their practices.
- **Mainstreaming of soil objectives and good soil management practices in existing legislation:** Many benefits to soil health are achieved through other sectoral or environmental policies. While this is not considered a barrier to SICS adoption, there is

a risk that key soil threats are not addressed if they do not fall under legislation for other sectors.

- **Establish mechanisms for effective knowledge dissemination and exchange:** There is anecdotal evidence that awareness raising, exchange of practices, guidance from farm advisory services will have an influence in changing farmers' practices by increasing their awareness about the potential benefits of SICS. 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.

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 project.3 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[4]

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

[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
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
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 alternatives[5] 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	• Levels the playing field between competitors, as everyone must play by the same rules	• Inflexible regardless of individual situations • May be costly to implement

[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
		• Fairly consistent (often long-term)	• Monitoring and enforcement can be costly • Discourages innovation
Economic instruments	Incentivise farmers to adopt SICS using payments and taxes etc.	• Encourages innovative methods • Can offset cost of implementation and/or discourage adverse behaviour • Allows a certain amount of flexibility	• Can be subject to fluctuations as the market fluctuates • 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	• Sense of "ownership" as the decision was taken freely • High degree of flexibility	• Does not guarantee implementation
Educational/information instruments	Educate farmers so they understand the importance of SICS	• Implementation as a result of truly understanding the impacts of the actions • High degree of flexibility	• 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 Norway 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 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 Norwegian 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.

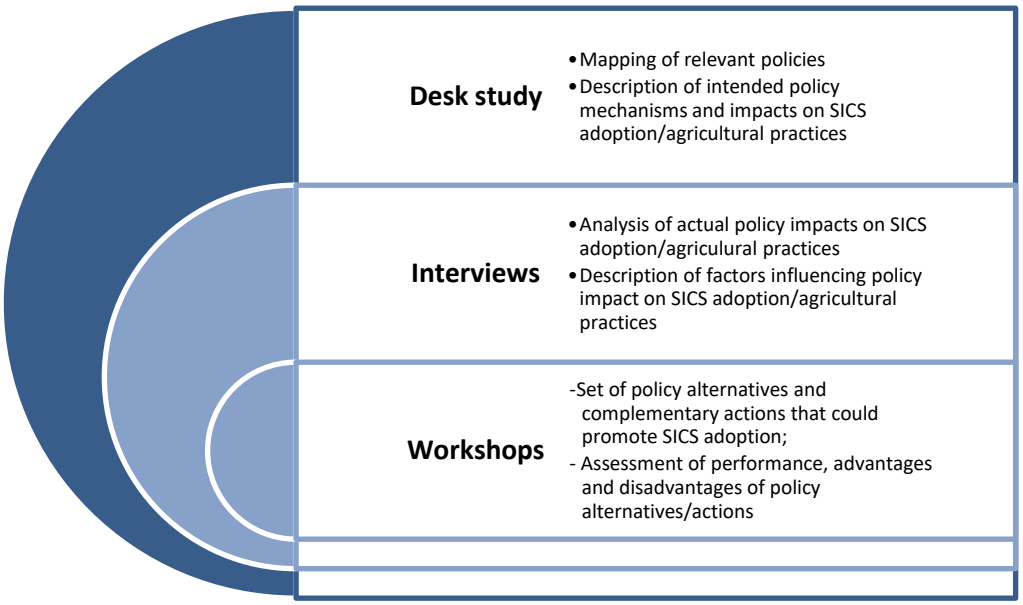

Figure 1: Research strategy

[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.

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[7] 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 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 policy-makers and stakeholders using a semi-structured interview guide. In Norway, four interviews were carried out (see Table 5).

Table 5: Organisations represented by interview partners

Organisation	Stakeholder category
Norwegian Agricultural Agency (2 interviews)	Agricultural agency
Norwegian Agricultural Extension service	Farm Advisory Service
County Governor in Oslo and Akershus	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 Norwegian workshop brought together 12 stakeholders, including farmers, policymakers, advisory services and scientists (see Figure 2).

[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.

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

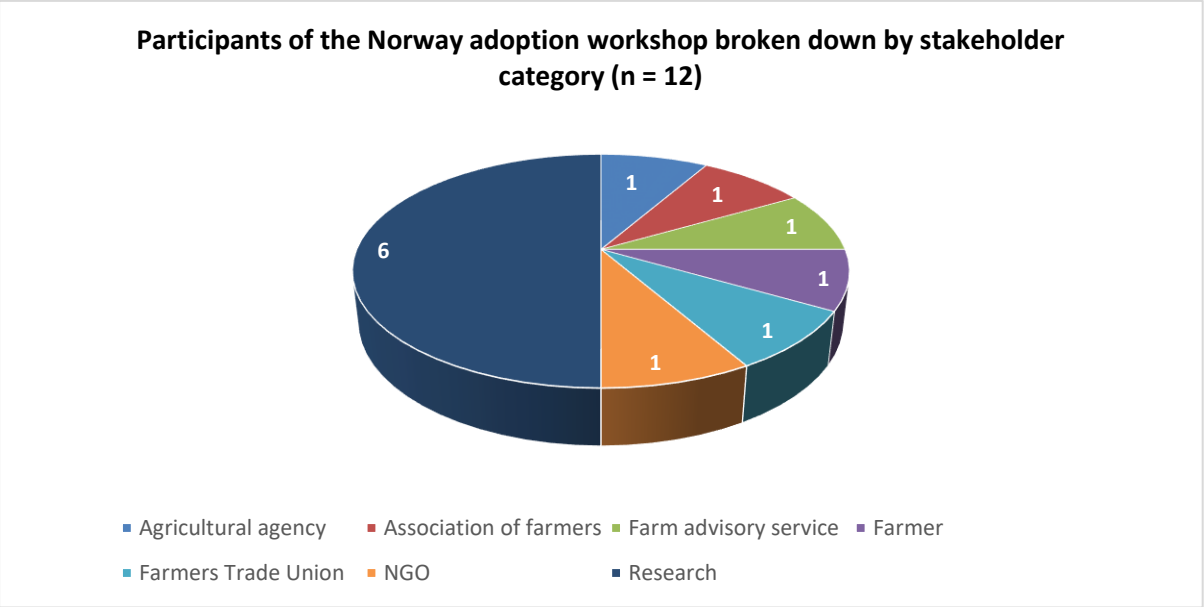

Figure 2: Types of stakeholders participating in the Norwegian adoption workshop

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 Eastern Norway where the Norwegian 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 D*7.1 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 Eastern Norway

This section provides a review and analysis of national and regional instruments relevant for shaping agricultural practices in Eastern Norway where the study site, Akershus, is located. The area is one of the main areas for cereal cropping systems. 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	Akershus, Eastern Norway
Climate	Humid continental climate with warm summers and cold winters; precipitation range between 665-785 mm annually and winter period with frozen soils and snowmelt has a major influence and soil processes (infiltration, erosion).
Soil type	Marine sediments with clay and silt
Main soil threats	Erosion, soil compaction, lack of good drainage, lack of crop rotation, plant diseases, nutrient loss (leaching)
Current practices	Mostly conventional practices, some conservation practices like reduced tillage, leaving area in stubble until spring, light autumn harrowing (leaving minimum 30 % straw on soil surface), direct drilling, use of catch crops.

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

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

General treatment category	SICS cluster[10]	Experiments
Cover crops	Compaction	**1. Biological compaction release (4 levels of compaction)** Cover crop with deep root crops (3 types of crops), no cover crops
	Soil improving crops	**2. Cover crop- Catch crop (CC)** Undersown of - Mix 1: Chicory, perennial ryegrass and alfalfa; Undersown of - Mix 2: White clover, "Birdsfoot trefoil" and crimson clover; Sown after harvest - Mix 3: Forage radish and Ryegrass; Sown after harvest - Mix 4: vetch, hairy vetch and pisum; No cover crop (Barley)
		3. Precision agriculture

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

The analysis identified several agricultural, water and chemicals policies influencing agricultural

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

practices in the region of Norway where the study site is located[11]:

Agricultural policies

At regional level, **Regulations on subsidies for regional environmental measures in agriculture (or Regional Environmental Programme, RMP)** covering both Oslo and Akershus have a high potential to impact farmers' behaviour in terms of their selection of SICS and related funding.

The purpose of this regulation is to ensure that the farms in Oslo and Akershus operate environmentally responsible through payments supporting practices that benefit the environment or reduce environmental impacts stemming from agriculture. Subsidies are available for (list not exhaustive):

- no or postponed tillage (maintaining cover in fields),
- directly sown grains (i.e., no tillage seeding systems),
- use of catch crops (proving there is no application of pesticides and fertilisers and no tillage until the following spring),
- creation of buffer zones along waterways and fields (but must meet criteria defined by the regulation in relation to the area, application of fertilisers etc.),
- establishing perennial grasses on areas exposed to erosion or at risk of flooding,
- reducing the use of chemicals through e.g., mechanical weeding, and burning,
- protecting biodiversity by maintaining or establishing landscape elements/features such as trees and hedgerows and habitats where birds breed).

Also of note is the **National Soil Protection Strategy**, which aims to ensure that by 2020 the annual reassignment of fertile soil does not exceed 4000 ha.

Water policies

The **Regulation on water management framework** aims to ensure the most comprehensive protection and sustainable use of water resources. Comparable to the EU Water Framework Directive (WFD), the Regulation requires the preparation of regional management plans and associated action programs with a view to meeting environmental quality objectives. The regulation does not prescribe or limit the use of certain agricultural practices but, by focusing on water quality, measures indirectly set requirements for nutrient and pest management.

Waste/chemicals policies

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

Another piece of legislation directly impacting on nutrient management is the **Regulation on organic fertilisers** which is modelled on the EU Sewage Sludge Directive. The objective of this regulation is to ensure a satisfactory quality of fertilisers products, prevent pollution, ensure health and hygiene standards, and to encourage the use of fertilisers of organic origin. Organic fertilisers regulated include livestock manure, silage paste, sewage sludge, water sludge, compost products and other organic fertilisers, organic-mineral fertilisers, organic and inorganic cultivation media, soil improvers, soil removers, anaerobically reacted biomass, combustion products, composting preparations, and microorganisms. The regulation sets limits for the content of heavy metals, the timing where application is allowed, and quantities in relation to total nitrogen (17 kilo/hectare).

Finally, the **Regulation on plant protection products** applies to the approval, sale, and use of pesticides, active substances including microorganisms, and other pesticide ingredients. Pesticide authorisation certificates are required for purchase and use of professional products and to provide professional guidance on chemical crop protection. The Regulation limits the types of applications especially relating to aerial applications. It lays down rules for application of pesticides in relation to dwellings, summer homes and waterways. Integrated Pest Management is also covered by the Regulation, requiring users of professional products to integrate and apply the general principles of integrated plant protection. The Regulation is modelled on the to the EU Sustainable Use of Pesticides Directive.

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

The study site region of Eastern Norway is characterised by poor soil management, with a lack of good drainage and crop rotation as well as a dominance of monocultures. Main soil threats include

- erosion (e.g., due to poor maintenance on hydro technical installations, monocropping of cereals, autumn ploughing),
- soil compaction,
- nutrient loss (leaching), and
- climate change impacts

Various agricultural methods have been tested in Eastern Norway since the 1980s, including practices such as reduced tillage, the establishment of vegetation zones and grass covered waterways, use of catch crops and nutrient management. The SICS tested in this project include measures for compaction alleviation (cover crops, including biological compaction release), soil-improving crops (cover crops and catch crops), and precision agriculture and are thought to address these soil threats. This section assesses how the policy instruments identified above already promote the agricultural practices tested in the study site.

In cereal production areas, implementing permanent grass cover is supported through the Regional Environmental Programme (RMP). In one of the experiments in the site, cover crops were sown together with the main crops, a practice which is also eligible for funding under the RMP grant scheme[12]. However, subsidy rates for cover crops have declined in recent years, and it is uncertain whether these incentives will be sufficient to motivate farmers to use cover crops in the future as payments may not fully cover the implementation or conversion costs.

Research shows that the total effect of all the agricultural measures financed through the RMP increased or was maintained in all counties from 2006 to 2010. Erosion by water was reduced by 10 percent on average, and the RMP is considered to have helped obtaining this result[13]. The RMP aims to make sure that local conditions are considered, so that the implemented measure is as effective as possible. However, as the instruments within the RMP often only apply to single measures, there is a risk that benefits from one measure may be offset by other negative impacts of practices because of the lack of a comprehensive management plan.

It is worth noting that although the RMP does not focus much on cover crops, it does incentivise other soil-improving systems. Reduced tillage and the establishment of vegetation zones are also promoted through the RMP and implemented by many farmers. For example, poor water quality has led to the introduction of requirements for vegetation zones which are supported by payments in Eastern Norway and Østfold. However, it must be noted that whilst these measures prevent soil and nutrient losses from agricultural fields, these effects are a byproduct of activities aiming to improve water quality, and not soil quality per se.

From the 1990s onward, farmers increasingly adopted no and reduced tillage practices, a trend, which started declining again a few years ago. Interviewees identified stagnating subsidy rates as one of the reasons for this trend reversal. At the same time, according to an interviewee, in areas with cereal production in the Eastern Norway County, on average of 50% of production areas is autumn ploughed, thus the RMP has increased the uptake of reduced tillage to decrease erosion and nutrient losses.

Nutrient management is also addressed through the subsidies in the RMP, but it is mainly regulated by the Regulation on water management framework, Regulation on plant protection products and Regulation on organic fertilisers, all of which impose bans and restrictions on nutrient management practices. Overall, these policies have increased the awareness of water and soil protection issues and triggered more widespread use of SICS, such as reduced tillage.

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[14] shows that several economic policies promote the use of cover crops, the SICS tested at the study site (shaded in dark green), a practice which is relevant to alleviating compaction, halting erosion, and generally improving soil health The same instruments incentivse reduced tillage practices which also reduce

[12]RMP grant scheme 2016-2017

[13]http://www.bioforsk.no/ikbViewer/Content/100816/RMP_evaluering%20BioforskRapport7%20(21)%20(2011)27jan.pdf

[14] See the Annex for a more detailed overview of the policies described in this section.

compaction and erosion while smart residue and controlled traffic management, which could address the same soil threats, are not incentivised, or regulated by existing policies.

Table 8: Coverage of SICS in current regional policies, instruments, and measures in Eastern Norway

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
Regulations on subsidies for regional environmental measures in agriculture *(FOR-2016-04-06-392 Forskrift om tilskudd til regionale miljøtiltak i landbruket, (forskrift om RMP-tilskudd), Oslo og Akershus)*											
Regulation on water management framework *(FOR-2006-12-15-1446 Forskrift om rammer for vannforvaltningen)*											
Regulation on organic fertilisers *(FOR-2003-07-04-951 Forskrift om gjødselvarer mv. av organisk opphav)*											
Regulation on plant protection products (FOR-2015-05-06-455 Forskrift om plantevernmidler)											

2.3 Which factors shape success or failure of policy instruments?

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.

Findings can be summarised around the following main points:

The key factors shaping the success of policy instruments include:

- Weak financial incentives
- Lack of explicit soil objectives in existing legislation/soil-specific legislation
- Low coherence between policies

- Land tenure
- Lack of knowledge sharing/dissemination
- Climate change impacts

Weak financial incentives

Economic instruments play the most important role in the adoption of SICS in Eastern Norway. There have been examples of where the instruments have had a direct impact on farmers' practices, and interviewees and the identified policies have all stressed this importance. The subsidies system appears to be comprehensive – to apply for subsidies through the RMP, the farmer must be eligible for production subsidies under the Regulation on production subsidies (which in itself requires vegetation zones along open waters with no tillage). In addition, agricultural fields are divided into four different erosion risk classes, with those at lowest erosion risk not eligible for any subsidies. Having such a comprehensive system might discourage game-playing behaviour, as gaining a subsidy would not be a simple procedure. This does run the risk of excluding farmers who cannot comply with the requirements (either in terms of administrative or practical burdens), however, the interviewees did not mention this as an issue.

At the same time, there appear to be several inefficiencies with the economic instruments used, especially in cases where subsidies are not updated to account for inflation and increased challenges and as a result, farmers are not incentivized to adopt the SICS. This would suggest that if economic instruments are to remain the key driver behind SICS adoption, care needs to be taken to ensure they are revised and updated regularly. For instance, it was noted by one interviewee that the number of farmers postponing ploughing until spring is decreasing, especially compared to previous years, due to both climate change and stagnating subsidy rates.

Lack of explicit soil objectives in existing legislation/soil-specific legislation

There is currently no soil-specific, binding, regulation concerning soil directly. Interviewees highlighted that the existing regulatory framework places strong emphasis on water management and achieving adequate water quality, and less so on soil management. While this in itself is not considered a barrier to SICS adoption, there is a risk that key soil threats are not addressed if they do not fall under legislation for other sectors – one interviewee went so far as to suggest soil-specific legislation following the lines of the WFD. However, interviewees did acknowledge that the implementation of the water framework regulation increased awareness and affected the level of tillage employed.

Low coherence between policy measures

Several interviewees identified instances where SICS adoption is non-coherent with other policy instruments, for example the national agricultural policy. This is because SICS can

decrease the overall production quantity, which would be in conflict with such policies that promote an increase in production – an example was given of the food production strategy (although it was noted that this particular document is a strategy and not statutory). In addition, it was noted that the revision of the RMP has been delayed twice, which could act as a barrier to implementation – farmers would rather wait for the revision before undertaking any changes to their soil management, for fear that the revision will impact them positively (e.g. they could receive more money under a new scheme) or negatively (e.g. they may be punished under a new scheme for a practice only just implemented). If the revision continues to be delayed, this will only encourage inaction for an indeterminate amount of time.

Land tenure

Interviewees explained that many farmers in Eastern Norway lease their land, which can affect long-term decisions taken by these farmers. According to one interviewee, 40-50% of land is leased, although they did not see this as being negative. On the other hand, another interviewee noted that allocations for drainage are primarily utilised by farmers who own their land – 80% of allocations go to those that own their own land.

Lack of knowledge sharing/dissemination

Stakeholders identified the need for knowledge sharing and more effective dissemination of research as key to promoting the uptake of cover crops in Eastern Norway. It was concluded that farmers had only limited understanding of the benefits and practical implementation of cover crops. At the same time, stakeholders highlighted that many farmers had practical, first-hand experiences with compaction damage which might motivate them to engage in education and training opportunities. In addition, advisory services were generally valued in the region, putting them in a prime position to deliver the needed information to the farmers.

Climate change impacts

Climate change impacts are expected to drive future implementation of SICS, and agricultural practices in general. According to the interviewees, research is needed to understand the future impacts of climate and disseminate this information to policy makers and politicians. At the same time, this can contribute to the current development of more efficient and modern agriculture. One interviewee spoke optimistically of new technology (drones and robots) which can help mitigate climate change challenges, which will in turn secure food production.

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

Box 1 Stakeholder recommendations for actions to promote the uptake of promising SICS in Eastern Norway

Summary of stakeholder recommendations for actions to promote SICS adoption

In the Norwegian study site, located in the East of the country, different cover crop experiments were carried out to test the extent to which they could alleviate compaction and improve soil health.

The most important enablers identified were subsidies for cover crops which need to be increased in the Regional Environmental Programme (legislation). It was highlighted that policy makers should develop legislations based on long-term thinking, considering that changes in soil quality only happen over long periods of time. Lastly, the sharing of research outputs and of experiences between farmers - through e.g. the farm visits by the agricultural advisory services and the dissemination of site visit reports - was highlighted as an important adoption factor. Finally, it was concluded that soil quality should be added to the curriculum in agricultural educations to ensure that that future farmers have the knowledge needed to safeguard soil quality when operating the farmland.

The most important barriers for the adoption of cover corps as a SICS were identified as lack of experience with applying these practices under Norwegian conditions and the need to develop guidance for farmers. Overall, it was emphasised that there was a general lack of attention towards the protection of soil quality in Norway with the public and political focus being on land take (loss of agricultural land to urbanisation).

Participants were asked to identify actions for the most important factors affecting the adoption of cover crops; 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 suggested but not applied during the meeting due to time constraints.

Table 9: Adoption barriers, enablers, and actions to increase uptake of cover crops in Eastern Norway identified by stakeholders

Compaction alleviation and soil-improving crops (*SICS category: Cover crops*)	
Adoption barriers (-) and enablers (+)	**Actions**
Changing climate – longer growth season (+)	*None identified*
Experiences with compaction damage (+)	More research and awareness (preventive, repairing)
Positive experiences with advisory services and farm visits (+)	More use of farm walks and dissemination of results/reports
Access to right information (+)	Wider dissemination of existing knowledge, sharing practices, study visits, increase knowledge about the positive effects of cover crops
Subsidies (+)	Increase the subsidies for cover crops in the Regional Environmental Programme
Costs associated with seeds and financial risks (-)	Increase subsidy rates
Lack of information (-)	Wider dissemination of existing knowledge, sharing practices, study visits, increase knowledge about the positive effects of cover crops
Climate limitations (-)	*None identified*
Design of subsidy schemes limiting use of certain types seeds, methods and dates for sowing due to policy design (-)	Adapt legislation to support practices that are beneficial in the long-term
Lack of experience under Norwegian conditions (-)	Large scale trials with farmers, more research, and long-term experiments Make research results accessible Provide funds to develop a cover crop guideline

3 Conclusions and recommendations

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 at the Eastern Norway study site in Norway.

The analysis shows that the existing policy framework promotes the practices trialled at the study site, measures for compaction alleviation (cover crops, including biological compaction release), and soil-improving crops (cover crops and catch crops). Economic instruments play a strong role in SICS implementation, however, there is evidence that there are potential inefficiencies, so care should be taken to ensure that the amount of funds available correspond to the trade-off of adopting SICS. The legal context could be improved to promote SICS implementation, for example by focusing more specifically on soil or brining national policy in line with soil protection efforts, however, further work could be done to develop the voluntary instruments, as well as the knowledge and education instruments. This would mean that the adoption of SICS is not solely reliant on economic measures, and ensure farmers adopt SICS for the right reasons.

In the light of these findings, the following recommendations can be made. Whilst the actions outlined here specifically aim to promote the uptake of the cover cropping practices tested at the study site, they are likely to encourage the adoption of soil-improving cropping systems in general.

- **Design a more flexible system of economic incentives:** Voluntary financial incentives are the main driver for the adoption of agricultural practices beneficial to soil in Eastern Norway. There is a need to consider the different conditions in which farmers operate (such as differences in tenure) to ensure funding is accessible without creating additional administrative burden. Furthermore, incentives must be adapted to changing conditions such as inflation, so they do not lose their attractiveness over time.
- **Revise the existing policy framework to include ambitious, long-term targets**: Certain policies, most notably economic policy instruments are successful in encouraging farmers to adopt SICS. To expand these positive outcomes, policies may be adapted to accommodate a wider range of farm types and to include more ambitious targets. In addition, experience shows that changes to the policy framework and subsidy schemes, such as the Regional Environmental Programme, could act as a barrier to implementation. Providing sustained funding and legislative security will be crucial in motivating farmers to adapt their practices.
- **Mainstreaming of soil objectives and good soil management practices in existing legislation:** Many benefits to soil health are achieved through other sectoral or environmental policies. While this is not considered a barrier to SICS adoption, there is a risk that key soil threats are not addressed if they do not fall under legislation for other sectors.
- **Establish mechanisms for effective knowledge dissemination and exchange:** There is anecdotal evidence that awareness raising, exchange of practices, guidance from

farm advisory services will have an influence in changing farmers' practices by increasing their awareness about the potential benefits of SICS. 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.

Annex: Overview of key policies in Eastern Norway – Norway

Policy name	English translation	Scale	Impact on SICS	Description of policy
FOR-2016-04-06-392 Forskrift om tilskudd til regionale miljøtiltak i landbruket, (forskrift om RMP-tilskudd), Oslo og Akershus	Regulations on subsidies for regional environmental measures in agriculture (regulation on RMP subsidies), Oslo and Akershus	Regional	Integrated nutrient management, integrated landscape management, crop rotation, cover crops, reduced tillage	The purpose of this regulation is to ensure that the farms in Oslo and Akershus are environmentally responsible and safeguard the cultural landscape. The regulation establishes rules for subsidies to improve the environment or reduce environmental impact of agriculture. A number of specific measures that are soil/cropping system related are eligible for subsides such as no or postponed tillage (maintaining cover in fields) and direct sown grains i.e. no tillage seeding systems. Catch crops are also eligible for subsidies proving there is no application of pesticides and fertilisers and no tillage until following spring. Buffer zones along waterways and fields are eligible for subsidies, but must meet a number of criteria defined by the regulation in relation to the area, application of fertilisers etc. Specific subsidies are available for establishing perennial grasses erosion exposed areas or areas at risk of flooding. Chapter 3 deals with subsidies targeting reducing use of chemical such as mechanical weeding and burning. Chapter 5 deals with subsidies specifically targeting measures to protect biodiversity, such as natural landscapes i.e. trees and hedgerows and habitats where birds breed.
FOR-2003-07-04-951 Forskrift om gjødselvarer mv. av organisk opphav	Regulation on organic fertilisers	National	Integrated nutrient management	The objective of this regulation is to ensure satisfactory quality of products covered by the regulations, to prevent pollution, health and hygiene disadvantages in the manufacture, storage and use of fertilisers of organic origin and facilitate the use of these products as a resource. The regulation will also contribute to environmentally sound management of the soil and to take into account the importance of biodiversity. The regulation includes organic fertiliser products, including livestock manure, silage paste, sewage sludge, water sludge, compost products and other organic fertilisers, organic-mineral fertilisers, organic and inorganic cultivation media, soil improvers, soil removers, anaerobically reacted biomass, combustion products, composting preparations and microorganisms. The regulation sets limits for content of heavy metals (Pb, Cd, Hg, Ni, Zn, Cu and Cr). The regulation also sets the timing where application is allowed and quantities in relation to total nitrogen (17 kilo/hectare). Note - This regulation refers to the Sewage Sludge Directive.

Policy name	English translation	Scale	Impact on SICS	Description of policy
FOR-2015-05-06-455 Forskrift om plantevernmidler	Regulation on plant protection products	National	Integrated pest management	The regulation applies to the approval, sale and use of pesticides, active substances including microorganisms and other pesticide ingredients. Pesticide authorisation certificates are required for purchase and use of professional products and to provide professional guidance on chemical crop protection. The regulation limits the types of applications especially relating to aerial applications. The regulation lays down rules for application of pesticides in relation to dwellings, summer homes and waterways. Integrated Pest Management is also covered by the regulation, so that users of professional products should integrate and apply the general principles of integrated plant protection as set out in Appendix 2. Note – it is modelled according to SUD
FOR-2006-12-15-1446 Forskrift om rammer for vannforvaltningen	Regulation on water management framework	National	Integrated nutrient management, integrated pest management	The purpose of this regulation is to provide a framework for setting environmental targets that will ensure the most comprehensive protection and sustainable use of water resources. The regulation will ensure that regional management plans and associated action programs are prepared and approved with a view to meeting the environmental objectives and ensure that the necessary knowledge base is obtained for this work. Note – the regulation is based on the WFD.