



BEATLES: Co-creating Behavioural Change Towards Climate-Smart Food Systems

D2.5 Field experiments v2

PROJECT ACRONYM: BEATLES

PROGRAMME: HORIZON Europe

Grant Agreement: No 101060645

TYPE OF ACTION: HORIZON Research & Innovation Actions

START DATE: 1 July 2022

DURATION: 48 months



Funded by
the European Union

Document Information

Issued by:	University of Copenhagen (UCPH)
Issue date:	30/06/2025
Due date:	30/06/2025
Work package leader:	University of Copenhagen
Start date:	Month 24
Dissemination level:	Public

Document History

Version	Date	Modifications made by
draft	17/06/2025	UCPH
Version 1	30/06/2025	UCPH

Authors

First Name	Last Name	Beneficiary
Kassa	Tarekegn Erekaló	UCPH
Sigrid	Denver	UCPH
Søren Marcus	Pedersen	UCPH
Tove	Christensen	UCPH

In case you want any additional information, or you want to consult with the authors of this document, please send your inquiries to: tove@ifro.ku.dk

Contributors

A warm thank you to the UCs (Naturland (Germany), INTIA (Spain), AFL (Lithuania), DELPHY (the Netherlands) and FBCD (Denmark) for their tireless efforts to make the experiment and the questionnaires relevant for the local farmers. And, not least, for being invaluable in the data collection process. Also highly appreciated, the sparring from the AUA team (Greece), SEI (Sweden) and other BEATLES partners.

Quality Reviewers

First Name	Last Name	Beneficiary
Gohar	Isakhanyan	WUR
Marilena	Gemtou	AUA

Disclaimer

Funded by the European Union under GA no. 101060645. Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or REA. Neither the European Union nor the granting authority can be held responsible for them.

© **BEATLES Consortium, 2022**

Reproduction is authorised provided the source is acknowledged.

Executive Summary

There are several barriers for adoption of climate smart agricultural practices or technologies (hereafter referred to as CSA). In the present field experiment, we focus on barriers for non-adopters related to the lack of CSA-specific information. The objectives of this farmer field experiment (FIELD1) are to investigate the effect of information-based interventions in terms of CSA-specific information (factsheets) on two main outcome variables: farmers' awareness and adoption of specific CSAs.

A two-step pre-post experimental design has been used to test the effect of information-based interventions on awareness and adoption behaviour for CSAs. The two-step experimental approach implies that the experiment, includes testing the effect of the specific intervention on the outcome variables immediately after the intervention (step 1) as well as a testing potential longer-term effects of the intervention after around seven months (step 2). Using a pre-post-test experimental approach implies that the outcome variables are elicited before and after the intervention – thereby, the farmers function as their own control.

Data are collected in five countries across Europe using short online surveys. Around ten farmers from specific agricultural case sectors in each country are recruited: apple growers in Spain, potato and onion growers in the Netherlands, wheat farmers in Lithuania, organic dairy farmers in Germany and pig farmers in Denmark. For each case sector, each farmer is presented with information about one out of two CSAs that are chosen based on their relevance for the use case.

This report is deliverable D2.5. It shall be seen as an extension of the previous deliverable D2.2 from July 2024. Note that while D2.2 reported a status for the ongoing FIELD1 experiment in July 2024 then D2.5 reports the finalized FIELD1 experiment.

More specifically, the previous deliverable D2.2 (July 2024) reported the set-up and status of FIELD1. Deliverable D2.2 focused on describing objectives, hypotheses, design and methodology. These parts are copied in deliverable D2.5 with minor adjustments. In addition, deliverable D2.5 also includes reporting of data collection for the first round of data collection in July – September 2024 (step 1) and the second round of data collection in February – May 2025 (step 2) as well as results, analyses and conclusions. Altogether, 48 farmers participated in both rounds of data collection in FIELD1.

In short, two out of three of the participants stated to know something or a lot about [a specific CSA] before the intervention. The intervention (a factsheet with information about [a specific CSA]) did not have statistically significant effect on either awareness, willingness to adopt or interest in learning. The questionnaire might still have had an effect though because seven months after the first questionnaire, 1/3 of the participants stated that it increased their motivation to learn more about CSA.

Our results indicate that only a few farmers had actually adopted [a specific CSA] during the 7 months time span but almost half of the sample had taken the first steps to adopt. Thereby, including adoption planning of initial steps towards adoption were a valuable contribution and is a result worth pursuing. These results indicate that decisions take time and that information regarding whether farmers have been taking the first steps is important to elicit in order to guide farmers in their decision process.

All conclusions are of course given with reservations to conclude too strongly considering a relatively small group of respondents where altogether 48 farmers from five countries participated in both rounds of questionnaires. Future follow-up studies with more participants would enable us to conclude in more details.

Table of Contents

EXECUTIVE SUMMARY	2
LIST OF FIGURES	5
LIST OF TABLES	6
LIST OF TERMS AND DEFINITIONS	7
1. INTRODUCTION.....	8
1.1 BACKGROUND.....	8
1.2 THIS STUDY.....	10
2. METHODOLOGY	11
2.1. OVERVIEW.....	11
2.2. TARGET FARMERS	12
2.3. EXPERIMENTAL DESIGN.....	13
2.4. CHOICE OF CSA.....	15
2.5. DATA COLLECTION METHOD	16
3. DATA ANALYSIS (RESULTS AND DISCUSSION)	18
3.2 ATTITUDINAL RESULTS (AWARENESS)	20
3.3 BEHAVIOURAL RESULTS (ADOPTION)	23
3.3 ATTITUDINAL RESULTS (LEARNING)	26
4. BARRIERS AND DRIVERS OF CSA ADOPTION	27
5. CONCLUSIONS.....	30
6. REFERENCES	33
APPENDIX	35
APPENDIX 1: QUESTIONNAIRE 1.....	35
APPENDIX 2: QUESTIONNAIRE 2	39
APPENDIX 3: CSA DESCRIPTIONS.....	46
1) LT SOLAR ENERGY (172 WORDS)	46
2) LT VARIABLE RATE FERTILIZATION (175 WORDS).....	46
3) ES ORGANIC APPLES (171 WORDS)	47
4) ES SOLAR ENERGY (175 WORDS).....	47
5) NL PRECISION IRRIGATION (180 WORDS)	48
6) NL SOLAR ENERGY (180 WORDS)	48
7) D INCREASED LONGEVITY (175 WORDS).....	49
8) D REDUCTION OF CONCENTRATE BY INCREASE QUALITY OF FORAGE FEED (179 WORDS).....	49
9) DK ACIDIFICATION OF MANURE IN THE BARN (180 WORDS)	50
10) DK FAVA BEANS AS FEED PROTEIN (179 WORDS)	50
APPENDIX 4: PARTICIPANTS' PERCEPTIONS ABOUT [A SPECIFIC CSA]	51

List of Figures

<i>Figure 1: Overview of the pre-post-test design of farmer field experiment targeted non-adopters</i>	12
<i>Figure 2: Distribution of participants' self-reported knowledge about CSA (N=48 merged sample)</i>	21
<i>Figure 3: Participants' main barriers for CSA adoption from five countries (N=63)</i>	28
<i>Figure 4: Participants' main motivators for adopting [a specific CSA] from five countries (N=63)</i>	29

List of Tables

Table 1: Overview of questions used to represent outcome variables.....	13
Table 2: Overview of the two CSAs investigated for each UC.....	15
Table 3: Overview over distribution of CSA factsheets and targeted number of participants in step 1 and step 2.....	17
Table 4: Number of participants in step 1.....	18
Table 5: Number of participants in step 2.....	19
Table 6: Farm Size Distribution (% of sample).....	19
Table 7: Gender of Participants (% of sample).....	19
Table 8: Farming Experience	19
Table 9: Country-wise distribution of participants' knowledge about CSA, step 1.....	20
Table 10: Knowledge About CSA by Country (%), step 2.....	20
Table 11: Paired t-Test results on CSA knowledge (Before vs. After)	20
Table 12: Distribution of participants' immediate reaction to the information sheet, step 1	22
Table 13: Distribution of participants' reaction to the information 7 months later, step 2.....	22
Table 14: Country-wise distribution of participants' reaction to the information 7 months later, step 2 (only positive reactions shown).....	22
Table 15: Country-wise distribution of participants' adoption intention pre-intervention, step 1.....	23
Table 16: Country-wise distribution of participants' adoption intention, step 2.....	23
Table 17: Test of difference between adoption intention in step 1 (pre-intervention) and step 2.....	23
Table 18: Country-wise distribution of participants' adoption planning and actual adoption, step 2.....	24
Table 19: Country-wise distribution of participants' reaction to the statement that [a specific CSA] is not at all economically or practically possible, step 1.....	24
Table 20: Country-wise distribution of participants' reaction to the statement that [a specific CSA] is not at all economically or practically possible, step 2.....	25
Table 21: Country-wise distribution of participants' social interaction between step 1 and step 2.....	25
Table 22: Country-wise distribution of participants' search for information about CSA between step 1 and step 2.....	26
Table 23: Country-wise distribution of participants' motivation to learn more about CSA, step 1.....	26
Table 24: Country-wise distribution of participants' motivation reduce climate impact, step 1.....	27
Table 25: Country-wise distribution of barriers for adopting [a specific CSA], step 2.....	28
Table 26: Country-wise distribution of motivators for adopting [a specific CSA], step 2.....	29

List of Terms and Definitions

Abbreviation	Definition
CSA	Climate smart Agriculture
UC	Use cases
DK	Denmark
LT	Lithuania
DE	Germany
NL	Netherlands
ES	Spain

Table 0: Terms and Definitions

1. Introduction

1.1 Background

The BEATLES project aspires to change the way agri-food systems currently operate and accelerate the systemic transition to climate smart agriculture and smart farming technologies. There are several barriers for adoption of CSA practices or technologies. A recent systematic review of decision-making factors affecting farmers' adoption of CSAs found that farm and farmers perception of CSA were important but also food system structure and interactions with other stakeholders in the chain affect adoption (Gemtou et al. 2024). Their findings indicate that access to information that is timely, reliable and unbiased is important for upscaling the use of CSAs. Also, in relation to this study, is their findings, that sharing of information through social networks could increase farmers' adoption of CSAs. Similar insights were found in Pedersen et al. (2024) who investigated how stakeholders in different parts of the food supply chains saw the challenges and opportunities for increasing uptake of CSAs among farmers. They found that financial incentives for farmers, technological support, and value-chain development were seen by the other stakeholders as important drivers for increasing farmers' adoption of CSAs. Also, access to relevant and credible information among farmers was mentioned by stakeholders as important for increasing uptake of CSAs which is in line with Long et al. (2016). A number of stakeholders mentioned the importance of the social norm for increasing uptake of CSAs both in terms of descriptive social norm (do what the majority does) and the injunctive norm (do what is expected by others) which is in line with the work by Le Coent et al. (2021) in the context of payments for environmental services.

Farmers' intention to adopt and continue using CSAs is found to depend on their experience with its use, as adopters and non-adopters have varying levels of knowledge and awareness about CSAs (Kernecker et al., 2020). In particular, adopters of CSAs possess hands-on experiences and expectations from their previous experiences, which could guide their future plans to implement other CSAs or skip using the CSA. While non-adopters might have general information about one or more CSAs they do not have direct experience with the benefits of adopting CSAs, which can impact their future adoption plans. Previous studies (Chowdhury et al., 2015; Chuang et al., 2020) have also shown that inadequate information, missing knowledge, a lack of awareness, and a perceived lack of practical value may contribute to the non- or low adoption rate of CSAs, suggesting the need for targeted interventions to facilitate adoption. Information provision to increase knowledge and awareness is therefore the focus of the experimental intervention in this study.

Information can be provided in many ways ranging from making information freely available on the internet to targeted practical and specific information

provided by an advisor combined with practical training. For example, in a survey among US farmers regarding cover crops, Myers & Wilson (2023) found that non-adopter training and information provision through local workshops, field demonstrations, and one-on-one requested technical assistance increased the farmers' understanding of how CSAs could benefit their farming operations. However, there is clearly a trade-off between the costs for the information provider and the cost for the information receiver. For example, it is relatively cheap to provide information about CSAs freely on the internet, but it requires a great deal of resources from the farmers to collect and digest the information.

Furthermore, different farmers might need different types of information in order to consider changing behaviour such as adopting CSAs. While some need scientific 'proof' that implementing a CSA has an effect on the environment others might look for evidence that the investment in a new CSA pays off in monetary terms (at least after a period of time) while a third group might be more interested in how it can fit into the daily practices and routines. Also, some farmers want to be first movers while others want to be sure about the effect and satisfaction from other farmers before they want to invest in new technology or change practices. So, even when having decided to investigate how adoption of a CSA can be supported using an information-based intervention, there are many ways of doing that.

In the present field experiment (called FIELD1), we use online surveys to test an intervention in terms of a factsheet with information about a specific CSA. More specifically, the factsheets offer hands-on information that is hypothesized to increase awareness and adoption of the CSA. The information provided was based on the hypothesis that facts about the CSA concerning the potential for reduced climate impact, economic consequences and the social norm regarding the number of farmers already using it (together with the CSAs distinct impacts on other environmental issues, resource use, animal welfare or farmer / worker welfare) will have an impact on awareness and adoption.

Another important factor - related to understanding the effect of information provision on behavioural changes towards higher adoption of CSAs - is the time span. Most studies on information provision test the effect after a short time – maybe in the same questionnaire – either by comparing pre-post intervention outcomes or by testing differences in outcome variables between control groups and intervention groups. However, doing consumer experiments, Polman & Maglio (2023) found that the longer-term effects are smaller than the immediate effects and asked for further studies on this topic. Regarding hypothesizing what effect a longer time span will have on the effect of the intervention, it is equally easy to image the following three scenarios: One scenario where we expect increased effect due to networking and discussing the provided information with others thereby getting more familiar with the topic. Another scenario is where the provided information is fading away and where the daily work takes all attention whereby the intervention is simply forgotten. A third scenario is where farmers are

networking and discussing the provided CSA information and find the information non-useful and dismiss the idea of adoption based on (expected) negative experiences.

As the differences between short- and long-term effects of CSA information have not been investigated to the knowledge of the authors and only few studies were found in other areas, there was little inspiration as to when to expect a long-term effect of an intervention to differ from the immediate effect.

To investigate the long-term effects, we measure change in awareness, learning and adoption at two different points in time. Introducing a time lag between the intervention and the second measurement of behavioural change opened up for two tests. First, the long-term effect of an intervention on awareness, learning and adoption intention could be tested. Furthermore, the time-lag also made it possible to test not only the effect of the intervention on adoption intention but also elicit whether the participants had actually adopted the CSA in question or at least started the adoption process. Second, the time-lag allowed the participants to return to their normal life and thereby choosing or not choosing to discuss the intervention with others. Thereby, introducing a time lag enabled the experiment to monitor interacting with other people such as family members, neighbours, fellow farmers, and farm advisors (social networking).

The specific CSAs that were of interest for this study were decided in coordination between the researchers (authors) together with the use case leaders for the five countries. More specifically, the CSAs to be presented for current non-adopters included solar panels, precision irrigation or fertilization, shifting towards animal feed with lower climate impact, improved manure handling, and increased life span for dairy cows (longevity).

1.2 This study

The behavioural experiment documented in this report is regarded as a field experiment as it involves analysing the change in real adoption behaviour. When recruiting farmers for the first questionnaire, they are informed that a second survey will be send out, but they are not informed about that it is a follow-up study. Thereby, we expect farmers to behave as if the experiment had ended after the first questionnaire. Due to this time lag between the two steps in the experiment, it is possible to use stated self-reported behaviour regarding social networking as control variable to test the potential change in effect of information when comparing the immediate effect (step 1) and the longer-term effect (step 2). The intended time frame for the follow-up questionnaire was originally five months after the first questionnaire but because the data collection in step 1 was not finalized until mid September 2024 and to avoid multiple experiments being carried out at the same time, the second questionnaire was sent out 7 months after the first.

The experiments documented in the report are targeted towards farmers and designed and replicated across the diverse contexts of the five use cases (UC's), adapted to regional challenges and needs. This means, that it is the same type of intervention (information about a specific CSA) that is replicated across all five countries, but the CSA differ across countries and thereby also the precise information differs. Thereby, it is one experiment carried out in slightly different versions in the five countries.

The experiment is targeted to non-adopters. It is hypothesized that providing CSA-specific factsheets will increase the awareness, change the attitude towards and intention to adopt CSAs among non-adopting farmers.

The following hypotheses have guided the design of the questionnaire:

- H1: Providing relevant information about (a specific CSA) will increase awareness about CSA
- H2: Providing relevant information about (a specific CSA) will increase willingness to adopt CSA (outcome variable)
- H3: Providing relevant info about (a specific) CSA will increase the interest in learning about CSA
- H4: Farmers will engage in social conversation about CSA intervention after providing relevant information

2. Methodology

2.1. Overview

The modelling framework is a combination of the KAB model (knowledge and attitudes are used to explain behaviour) described in e.g. Schrader & Lawless (2004) and Tufa et al. (2023) and the TPB model (theory of planned behaviour) where attitudes, social norms and perceived behavioural control are used to explain behavioural intentions and behaviour (Ajzen 1991). We use knowledge, attitudes, and perceived behavioural control variables together with a social norm priming to try to explain non-adopting farmers' adoption behaviour. Moreover, we investigate the effect of the information-based intervention on these factors.

A two-step pre-post experimental design has been used to test the effect of information-based intervention on willingness to adopt CSAs. Using a pre-post-test experimental approach implies that the outcome variables are elicited before and after the intervention – thereby, the farmers function as their own control. Moreover, the two-step experimental approach implies that the experiment, includes testing the effect of the specific intervention on the outcome variables immediately after the intervention (step 1) as well as a testing potential longer-term effects of the intervention on changes in adoption behaviour after around seven months (step 2).

An overview of the experiment is shown in Figure 1

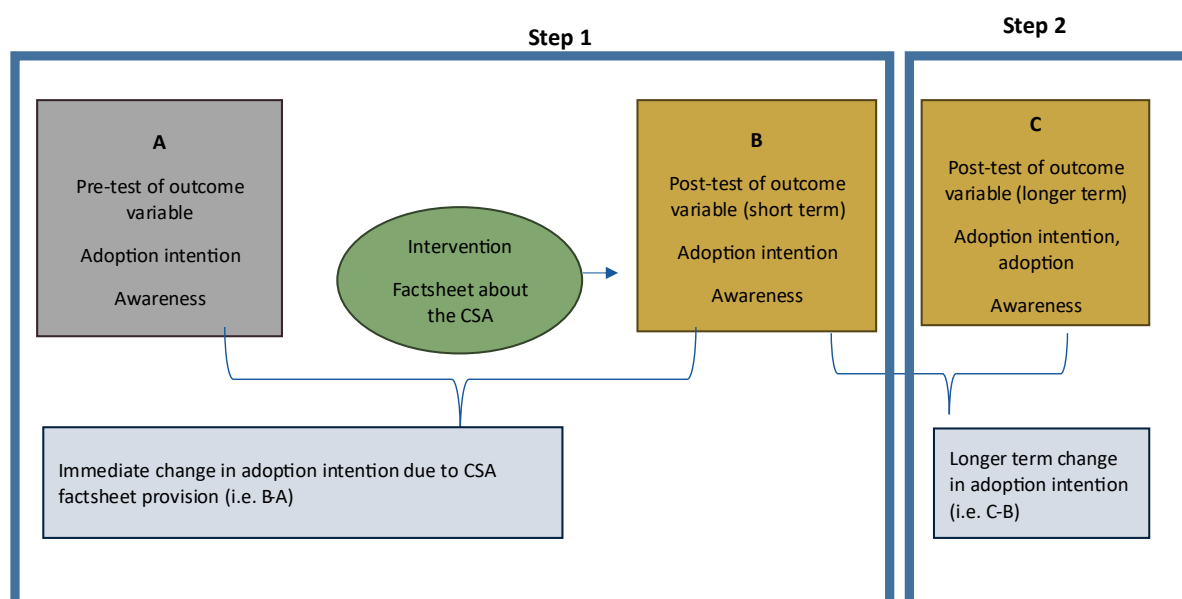


Figure 1: Overview of the pre-post-test design of farmer field experiment targeted non-adopters

Note: Step 1 involves 1) Pre-test of farmers' awareness, attitude, and intention to adopt the specific CSA 2) Intervention: each farmer receives a factsheet about a specific CSA practice and 3) post-test of the novelty of the information-based intervention, intention to adopt specific CSA practices. Step 2 involves follow-up questions regarding the novelty of the information provided in step 1 and follow-up questions regarding awareness, social networking and adoption behaviour.

More details about the experiments are provided below divided into short descriptions of the target group, the analytical framework, the pre-post design and two-step method, the questions posed in the questionnaires and the choice and formulations of the CSA information used in the factsheets.

The two questionnaires are shown in Appendix 1 (first questionnaire) and Appendix 2 (second questionnaire) and the CSA information for all 10 CSAs are shown in Appendix 3.

2.2. Target farmers

The experiments were targeted farmers who had not implemented a specific CSA. Thereby the farmer field experiments supplement the work conducted in WP4 of the BEATLES project where experiences from farmers having adopted certain CSAs were elicited through interviews, which supplement the farmer survey's conducted in WP1 of the BEATLES project where more general information regarding adopters and non-adopters of CSAs was obtained.

2.3. Experimental design

The objectives of the farmer field experiments are to investigate the effect of interventions in terms of CSA specific information on three outcome variables whereof two are the main outcome variables:

- 1) Farmers' awareness of a UC specific CSA (main outcome variable)
- 2) Farmers' adoption behaviour of a specific CSA (main outcome variable)
- 3) Farmers' interest in learning about CSA (outcome variable)

To capture awareness, we include two awareness variables (1: awareness of a specific CSA and 2: informational effect on awareness of a specific CSA). Question 2 was included because we feared that the participants would find it irritating with a repetition if we stated Question 1 again just after the short informational intervention. Instead, we were transparent about the goal of the question, namely to capture the perceived effect of the information.

To capture adoption behaviour, we include three variables related to adoption behaviour, 1: intention to adopt within the next five years, 2: adoption planning (having carried out some adoption related activities such as searching the internet or social networking and 3: actual adoption). The reason for including three questions regarding various steps of adoption was that the likelihood of actual adoption was expected to be low while the likelihood of taking introductory steps towards adoption (also called planning adoption) was considered more likely. Social networking is considered as taking introductory steps towards adoption since it involves behavioural change to start talking about CSA and / or start searching for information about CSA.

Finally, to capture learning, we included (1: my motivation to learn more about [a specific CSA] and 2: my general motivation for reducing climate impact). Two questions were included because the experiment focuses on only one specific CSA per farmer so it would be supportive to also gather information on climate concerns more broadly.

An overview of how the outcome variables are linked to specific question formulations in the questionnaires is found in table 1, while all questions are found in Appendix 1 and Appendix 2.

Table 1: Overview of questions used to represent outcome variables

Outcome variable	Specific question related to the outcome variable
Awareness	Q1.1 and G2.1 How much do you know about [a specific CSA]? Q1.5.1 and Q2.5.1 The information has made me more aware of the potential benefits of adopting [a specific CSA]
Adoption	
Adoption intention	Q1.2 and Q2.2 I will be implementing [a specific CSA] on my farm within the next five years.

Adoption planning	Q1.5.2 and Q2.5.2 The information has made it more likely that I will adopt [a specific CSA] within the next five years Q1.5.5. and Q2.5.5 It is not at all economically or practically possible for me to adopt [the CSA] Q2.6.2 I have taken the first steps to implement [a specific CSA] e.g. talked to people, searched for information, made investments, etc. Q2.6.3 I have decided to implement [a specific CSA] but I have not taken any steps yet Q2.6.4 I don't know whether I will implement [a specific CSA] Q2.6.5 I will not implement [a specific CSA] Q2.7 Have you discussed [a specific CSA] with others since last summer? If you have, then we would like to know whether you discussed it with any of the following groups? Q2.8 Have you searched for information about [a specific CSA]? If you have, then we would like to know where you have searched?
Actual adoption Learning	Q2.7.1 I have fully implemented [a specific CSA] Q1.5.3 and Q2.5.3 The information has increased my motivation to learn more about [a specific CSA] Q1.5.4 and Q2.5.4 The information has increased my general motivation for reducing climate impact

Note. The notation is as follows: In example Q2.6.2 refers to questionnaire 2, question 6 and sub-question 2. All questionnaires are shown in Appendix 1 and 2.

As mentioned, a pre-post design was used, which means that the participants are their own controls. There are pros and cons of using pre-post-tests of the same group of participants as opposed to having separate control and intervention groups. The ideal situation is to use sufficiently large samples of randomized representative control and treatment groups. In this study, the recruitment of farmers was a challenge and as farmers might differ in many respects, it was evaluated in the project group that the effect of the intervention will be very difficult to detect. By eliciting the outcome variables for the same group of respondents before and immediately after the intervention, then the only difference between responses with or without the intervention could be attributed to the intervention itself. It is noted though, that the issue of testing bias will have to be taken into account because the pre-test might itself affect the effect of the intervention. The questions regarding outcome variables (awareness, learning, adoption intention) are as far as possible identical across UC's so that only the specific CSA and information of [a specific CSA] differ.

To capture longer term effects of the intervention, the same participants will be asked again similar questions related to the outcome variables after seven months. Thereby, we can test whether farmers have reflected on, discussed the intervention with others or even forgotten the information presented in the first questionnaire. This approach has not been used before (to the knowledge of the authors) and will provide valuable input to understand how farmers' awareness

and / or adoption behaviours are affected by information factsheets provided in the questionnaire.

Moreover, the time lag between the intervention and the second questionnaire (step 2) allowed us to include additional questions in step 2 that could capture social networking effects. Finally, the time lag between the intervention and the second questionnaire (step 2) allows us to capture real behaviour of farmers (the D3 variable). Thereby, the two-step method with a time lag between the steps of 7 months provided triple benefits: such as testing longer term effects of intervention, testing the effect of social networking on adoption and testing not only adoption intention but also engaging in activities related to adoption and actual adoption.

A few additional questions were asked in the second questionnaire. In particular, the participants were asked to state their five top barriers and five top reasons for adopting [a specific CSA] from a list.

2.4. Choice of CSA

The intervention involves providing each farmer with a factsheet about a specific CSA. The factsheet includes information about the benefits, methods, and implementation of the CSA (see example of factsheet in Appendix 3).

In close collaboration with UC's and experience from other work packages, 2 CSAs have been chosen per UC. It is the experience from WP1, that recruiting farmers for experiments and involvements is challenging, so the choice of CSAs was based on a trade-off among options and satisfy a combination of different criteria. Firstly, it has to be relevant for the particular primary sector and use case. Secondly, it has to align with other parts of the BEATLES project. Thirdly, it should be possible for UCs to recruit farmers who have not adopted these initiatives. For the LCA analyses carried out in WP3, five CSAs per UC were identified and selected for further analysis. To align the studies across the WPs in the BEATLES project, these technologies and practices were used as a base for the selection in this farmer field experiment (see table 1). Two of these five CSAs were selected for in-debt policy analyses in WP5 and finally, some CSAs were investigated in interviews in WP4 whereby experiences and descriptions were already available for this CSA (see table 2). As the UC's represent very different practices, it was given a higher priority to identify CSAs that were relevant for that specific location than to investigating similar CSAs across countries. Table 1 gives an overview of the selected CSAs for the various work packages. CSAs that are marked with bold text have been selected for the experiments in WP2.

Table 2: Overview of the two CSAs investigated for each UC

UC	UC specific CSAs to be analysed
Denmark	1. Frequent discharge of slurry 2. Acidification of slurry 3. Use of biogas

Germany	4. Green protein for feed
	5. Technologies for ventilation
Lithuania	1. Organic production (Naturland)
	2. Feed conversion to 100% forage: feed from grassland and clover (no maize and grains)
Spain	3. Regional protein source: same as conventional but legumes in crop rotation instead of imported soy
	4. Breeding for longevity: reduced replacement rate of cows
Netherlands	5. Agri-photovoltaic systems
	1. Intercropping
	2. No-tillage system
	3. (Extensive) wetland management
	4. Solar energy
	5. Variable rate fertilisation
	1. Cover crops
	2. Floral bands
	3. Grazing
	4. Organic farming
	5. Solar energy
	1. Sustainable irrigation systems [including energy consumption of the systems (diesel, electricity, green electricity)]
	2. Green energy (ratio of green/grey energy)
	3. Precision fertilization and soil management
	4. Biodiversity measures (farm level)
	5. Crop protection (all IPM measures, total impact)

Note: CSAs that are marked with bold text have been selected for FIELD1. The 5 CSA practices and technologies per UC have been chosen to be in focus in the BEATLES project.

A short factsheet about each CSA was formulated. This was done based on existing literature and in close collaboration with other BEATLES partners in particular the UC's partners. The fact sheet (intervention) – was aimed to be around 175 words for the specific CSA and categorized according to:

- Background/description
- Current adoption
- Climate impact
- Economic impact
- Other impacts

The factsheets for each of the CSAs are shown in Appendix 3.

2.5. Data collection method

Data collection has been conducted online. For the first questionnaire, the questionnaire was set-up in Google form while SurveyXact was used for the second questionnaire. The questionnaire were distributed by the UC's using their network.

The two questionnaires were formulated in English and comments were invited from UC's and other BEATLES partners. Subsequently, translation to local languages was carried out by google translate and edited by UC's.

For each UC, the first questionnaire came in two versions where the only difference between the two versions being the CSA that the factsheet was informing about. The aim is to obtain from each UC, five participants for each of the two CSAs.

The number of observations is expected to be up to a total of 100 observations from the 5 different use cases, 50 observations of questionnaire in step 1 and step 2 respectively. More specifically, see table 3. The data collection in the first round took longer than expected and was finalized in September 2025. For practical reasons, the second round of questionnaires were moved from November 2024 – January 2025 till February – May 2025. The main reason for this being a priority that it was more important to carry out other experiments (LAB4-LAB6) in January-February 2025 because they targeted schools so it was important to engage teachers and student when a new course was starting – and the workload for the BEATLES partners would be too much if also FIELD1 round 2 should be carried out at the same time. We evaluated that the extension of the time-lag by 1-2 months would not affect the value of the field experiment.

Table 3: Overview over distribution of CSA factsheets and targeted number of participants in step 1 and step 2

Interventions (factsheet about a specific CSA)	Target number of participants in step 1 (first questionnaire)	Target number of participants in step 2 (second questionnaire)
Denmark (pig production) 1) acidification of slurry 2) using fava beans instead of imported soy	Target 10 participants - 5 observations for acidification of slurry - 5 observations for using fava beans	Target 10 participants - 5 observations for acidification of slurry - 5 observations for using fava beans
Germany (dairy production) 1) Increased forage feed instead of concentrate 2) Increased longevity	Target 10 participants - 5 observations for increased forage feed - 5 observations for increased longevity	Target 10 participants - 5 observations for increased forage feed 5 observations for increased longevity
Lithuania (wheat production) 1) Variable rate fertilization 2) Solar panels	Target 10 participants - 5 observations for variable rate fertilization - 5 observations for installing solar panels	Target 10 participants - 5 observations for variable rate fertilization - 5 observations for installing solar panels
Netherlands (potato and onion growers) 1) Precision irrigation 2) Solar panels	Target 10 participants - 5 observations for precision irrigation - 5 observations for installing solar panels	Target 10 participants - 5 observations for precision irrigation - 5 observations for installing solar panels
Spain (apple growers) 1) Apple growing 2) Solar panels	Target 10 participants - 5 observations for organic apples - 5 observations for installing solar panels	Target 10 participants - 5 observations for organic apples - 5 observations for installing solar panels
Total number of participants	50	50 (same participants as in step 1)

Data collection	July – September 2024	February – May 2025
-----------------	-----------------------	---------------------

The advantages of the chosen data collection method

include:

- It allows us to focus on UC specific CSAs identified thereby allowing for regional differences and securing relevance for the UC's.
- It was agreed with UC's that it is easier for them to recruit farmers to fill out a questionnaire than to recruit them for a workshop (the survey is more flexible whereas the farmer has to participate in a workshop at a specific time slot).
- By making the questions UC specific, we increase relevance of the survey and thereby the likelihood of farmers answering the second round of questionnaires.

A disadvantage of this distribution method is that the UC's are core in the recruitment of farmers. The questionnaires are distributed using online links which is easy to distribute but for some UC's we anticipated that it would be necessary to use phone interviews or use printed questionnaires.

Regarding data collection response rate, we have unfortunately not information about how many farmers, the UC's contacted. We know that the UC's had difficulties in recruiting farmers but we don't know how many they actually contacted. This is of course a drawback of the data collection method. However, we never intended the results to be representative but rather show a picture of the variety in what farmers might think, know and do at the moment.

3. Data analysis (results and discussion)

The 59 responses from round 1 corresponds to an 80% overlap in responses. To provide a quick overview of the results, the results are presented as quantitative data. In example as percentage of sample across countries and across CSAs. Note that 10% of the participants corresponds to 5 farmers. This approach comes with the risk that the data seem more representative than they are. We will (try) to interpret the data with appropriate care. Some statistical tests have been performed but much information is also provided by simply describing results.

3.1 Descriptive statistics of participants

Table 4 summarizes data for step 1 and table 5 summarizes data for step 2 for each of the 10 CSAs (each of the 10 interventions). Out of 59 participants in step 1 and 64 in step2, there were 48 overlapping participants that participated in both steps. Tables 6-8 show descriptive statistics at country level.

Table 4: Number of participants in step 1

Country	Number of participants	Percent
Denmark	11	18.64

Germany	14	23.73
Spain	10	16.95
Lithuania	10	16.95
Netherlands	14	23.73
Total	59	100.00

Note: 59 participants in step 1, 64 in step2 and 48 overlapping participants

Table 5: Number of participants in step 2

Country	Number of participants	Percent
Denmark	9	14.06
Germany	16	25.00
Spain	12	18.75
Lithuania	16	25.00
Netherlands	11	17.19
Total	64	100.00

Note: 59 participants in step 1, 64 in step2 and 48 overlapping participants

Table 6: Farm Size Distribution (% of sample)

Country	Less than 5 ha	5–10 ha	11–50 ha	51–100 ha	101–200 ha	201–500 ha	Over 500 ha	Total
Germany	0.0	14.3	21.4	50.0	14.3	0.0	0.0	100
Denmark	0.0	10.0	0.0	0.0	10.0	20.0	60.0	100
Spain	40.0	10.0	30.0	10.0	0.0	10.0	0.0	100
Lithuania	10.0	10.0	0.0	30.0	30.0	20.0	0.0	100
Netherlands	0.0	14.3	42.9	28.6	14.3	0.0	0.0	100
Total	8.6	12.1	20.7	25.9	1389	8.6	10.3	100

Note: 59 participants in step 1, 64 in step2 and 48 overlapping participants

Table 7: Gender of Participants (% of sample)

Country	Male	Female	Total
Germany	78.57	21.43	100
Denmark	63.64	36.36	100
Spain	90.00	10.00	100
Lithuania	66.67	33.33	100
Netherlands	75.00	25.00	100
Total	75.00	25.00	100

Note: 59 participants in step 1, 64 in step2 and 48 overlapping participants

Table 8: Farming Experience

Country	<6 Years	6–10 Years	11–15 Years	16–20 Years	>20 Years	Total
Germany	57.14%	0.00%	14.29%	21.43%	7.14%	100%
Denmark	27.27%	9.09%	0.00%	27.27%	36.36%	100%
Spain	10.00%	10.00%	10.00%	0.00%	70.00%	100%
Lithuania	10.00%	20.00%	30.00%	30.00%	10.00%	100%

Netherlands	14.29%	42.86%	0.00%	14.29%	28.57%	100%
Total	25.42%	16.95%	10.17%	18.64%	28.81%	100%

Note: 59 participants in step 1, 64 in step2 and 48 overlapping participants

3.2 Attitudinal results (awareness)

Awareness was one of the main outcome variables together with learning and adoption intention. Tables 9 and 10 capture farmers' awareness which was formulated as 'knowledge about [a specific CSA]'. The question was posed in step 1. pre-intervention and in step 2 post intervention. Overall, very similar shares of the participants in step 1 and 2, respectively, state to know something or a lot about [a specific CSA] (62% of the participants in step 1 and 69% in step 2). The share of participants stating to know nothing or a little reduced from 23% in step 1 to 10% in step2. This could indicate that the participants have gained some knowledge between step 1 and step 2 – maybe due to the questionnaire but also other exposures during the 7 months period. However, a t-test indicates that there is no difference between knowledge of CSA before the intervention in round 1 and after the time-lag in round 2 (Table 11).

Table 9: Country-wise distribution of participants' knowledge about CSA, step 1

Country	Nothing	Almost Nothing	A Little	Something	A Lot	Total
Germany	0.00%	0.00%	28.57%	42.86%	28.57%	100%
Denmark	9.09%	45.45%	18.18%	27.27%	0.00%	100%
Spain	0.00%	60.00%	0.00%	40.00%	0.00%	100%
Lithuania	0.00%	10.00%	0.00%	70.00%	20.00%	100%
Netherlands	0.00%	0.00%	21.43%	78.57%	0.00%	100%
Total	1.69%	20.34%	15.25%	52.54%	10.17%	100%

Note. N=59. Precise question formulation: How much do you know about [a specific CSA]?

Table 10: Knowledge About CSA by Country (%), step 2

Country	Nothing (1)	Almost Nothing (2)	A Little (3)	Something (4)	A Lot (5)	Total
Germany (DE)	0.00	12.50	0.00	37.50	50.00	100%
Denmark (DK)	0.00	0.00	33.33	33.33	33.33	100%
Spain (ES)	25.00	8.33	25.00	33.33	8.33	100%
Lithuania (LT)	0.00	0.00	31.25	50.00	18.75	100%
Netherlands (NL)	0.00	0.00	27.27	72.73	0.00	100%
Total	4.69	4.69	21.88	45.31	23.44	100%

Note. N=64. Precise question formulation: How much do you know about [a specific CSA]?

Table 11: Paired t-Test results on CSA knowledge (Before vs. After)

	R2 (After)	R1 (Before)	Difference (R2 - R1)	P value
	Mean (St.dev)	Mean (St.dev)	Mean (St.dev)	0.297
CSA knowledge level	3.83 (1.08)	3.63 (0.94)	0.21 (1.37)	
N	48	48	48	

Note: Mean is based on a five-point Likert scale

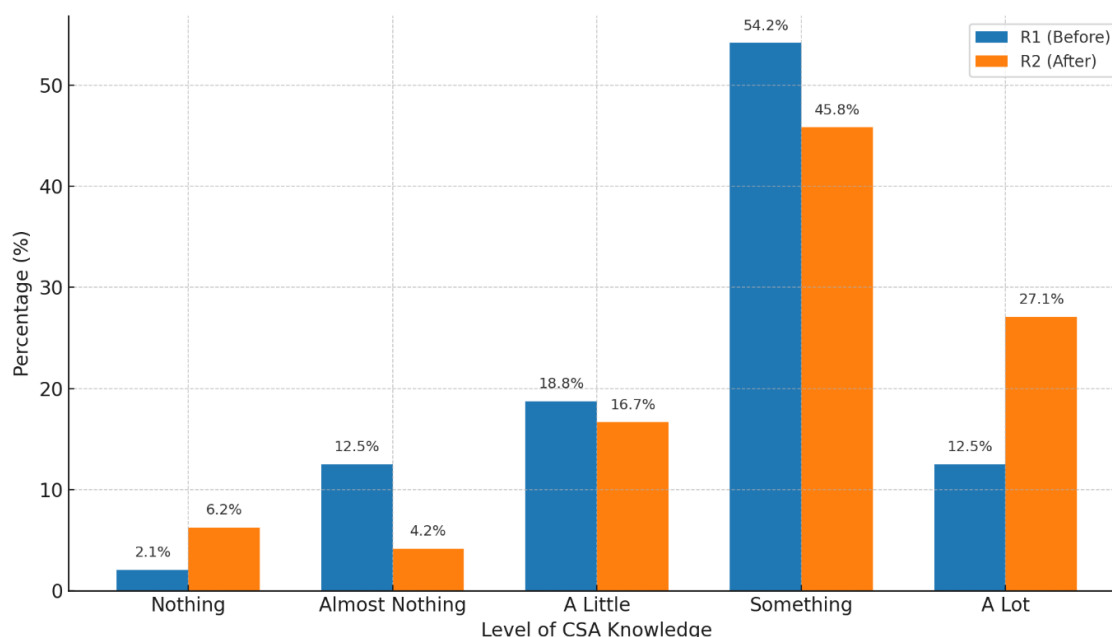


Figure 2: Distribution of participants' self-reported knowledge about CSA (N=48 merged sample)

Participants were asked for their perceptions about [a specific CSA] before the information sheet was provided. The overall results are provided below (detailed data shown in Appendix 4). Overall, the results can be summarized as:

- around 75% of the participants believed that [a specific CSA] decreased carbon footprint.
- Half of the participants believed that [a specific CSA] would have no effect on daily work
- Around 40% believed that agricultural yield was unchanged while 30% thought it would be higher and lower, respectively

Regarding awareness, the participants were asked questions about the effect of the information they received on awareness (see table 12-14). Table 12 presents the distribution among participants of their immediate reaction to the information sheet while Table 13 and 14 are their reaction 7 months later. Since the questions were not formulated identically, we have not tested for significant differences.

The immediate reaction to the information sheet was that 22% mostly or completely agreed that the information sheet had increased their awareness (table 12). We interpret that as 22% being rather positive about the information's ability to increase immediate awareness. Looking at the effect after 7 months, only 13% were rather positive about the information that was provided in the first questionnaire (table 14). So, the effect of information seems to decrease. It is difficult to interpret whether the participants had the whole questionnaire or the information sheet in mind when they answered the question about 'the information that you received

in the first questionnaire last summer'. But if they had the whole questionnaire in mind, this will just strengthen the result that the effect of the information seems to decrease.

Table 12: Distribution of participants' immediate reaction to the information sheet, step 1

Country	Complete ly Disagree	Mostly Disagr ee	Slightly Disagr ee	Neith er nor	Slightl y Agree	Mostl y Agree	Complete ly Agree	Tot al
Germany	50.00	7.14	14.29	7.14	21.43	0.00	0.00	100
Denmark	0.00	9.09	9.09	9.09	36.36	18.18	18.18	100
Spain	20.00	0.00	0.00	20.00	30.00	10.00	20.00	100
Lithuania	10.00	20.00	0.00	20.00	0.00	20.00	30.00	100
Netherlan ds	14.29	7.14	7.14	21.43	42.86	7.14	0.00	100
Total	20.34	8.47	6.78	15.25	27.12	10.17	11.86	100

Note: precise formulation of question: The information made me more aware of CSA Benefits for Adoption

Table 13: Distribution of participants' reaction to the information 7 months later, step 2

Statement	Com plet ely Disa gree (%)	Mostly Disagree (%)	Sligh tly Disa gree (%)	Neith er Agree nor Disa gree (%)	Slightl y Agree (%)	Mos tly Agree (%)	Comple tely Agree (%)
Made me more aware of CSA benefits	15	15	5	23.33	28.33	10	3.33
Made it more likely I will adopt CSA	14.75	13.11	4.92	26.23	26.23	9.84	4.92
Increased my motivation to learn more	11.29	9.68	4.84	27.42	12.9	27.4	6.45
Increased my general climate motivation	13.11	14.75	1.64	31.15	26.23	9.84	3.28
Not economically / practically possible to adopt	19.67	24.59	14.75	16.39	14.75	6.56	3.28

Precise question formulation: To what extent do you agree or disagree with the following statements about the information that you received in the first questionnaire last summer?

Table 14: Country-wise distribution of participants' reaction to the information 7 months later, step 2 (only positive reactions shown)

Country	More aware of CSA benefits	More likely to adopt CSA	More motivated to learn	More motivated to reduce climate impact	Not possible to adopt
Germany	12.5	12.5	43.75	12.5	12.5
Denmark	28.57	28.58	28.57	14.29	0
Spain	18.18	25	16.67	25	16.67
Lithuania	13.33	6.67	43.75	13.33	13.34
Netherlands	0	9.09	27.27	0	0
Total	13.3	14.8	33.9	13.1	9.8

Note. Precise question formulation: To what extent do you agree or disagree with the following statements about the information that you received in the first questionnaire last summer? The value in table is sum of mostly and completely agree. Total is calculated from table 13.

3.3 Behavioural results (adoption)

Adoption related variables include adoption intention, adoption planning and actual adoption. Regarding adoption intention: In the beginning of step 1, around 45% of the participants were to some extent positive towards adopting (stating slightly agree, mostly agree or completely agree to a statement that they will adopt [a specific CSA] within the next 5 years). The share of participants stating mostly or completely agree were 17%. After scaling the responses (0-completely disagree... to 6-completely agree) and carrying out a t-test, the results indicated that the informational intervention together with 7 months time-lag did not alter the adoption intention. Tables 15-17 show details of these results. Thereby, no statistical effect of the informational intervention (the information sheet).

Table 15: Country-wise distribution of participants' adoption intention pre-intervention, step 1

Country	Completely Disagree	Mostly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Mostly Agree	Completely Agree	Total
Germany	0.00	7.14	7.14	57.14	21.43	7.14	0.00	100
Denmark	27.27	0.00	9.09	63.64	0.00	0.00	0.00	100
Spain	20.00	10.00	0.00	0.00	40.00	10.00	20.00	100
Lithuania	10.00	0.00	0.00	10.00	80.00	0.00	0.00	100
Netherlands	7.14	7.14	0.00	28.57	14.29	28.57	14.29	100
Total	11.86	5.08	3.39	33.90	28.81	10.17	6.78	100

Precise question formulation: To what extent do you agree or disagree with the following statement. I will be implementing [a specific CSA] on my farm within the next five years.

Table 16: Country-wise distribution of participants' adoption intention, step 2

Country	Completely disagree	Mostly disagree	Slightly disagree	Neither agree nor disagree	Slightly agree	Mostly agree	Completely agree	Total
DE	20.00	20.00	13.33	0.00	26.67	6.67	13.33	100
DK	11.11	11.11	33.33	0.00	11.11	22.22	11.11	100
ES	25.00	16.67	0.00	8.33	25.00	16.67	8.33	100
LT	0.00	15.38	0.00	30.77	15.38	7.69	30.77	100
NL	9.09	9.09	0.00	27.27	27.27	0.00	27.27	100
Total	13.33	15.00	8.33	13.33	21.67	10.00	18.33	100

Precise question formulation: To what extent do you agree or disagree with the following statement. I will be implementing [a specific CSA] on my farm within the next five years.

Table 17: Test of difference between adoption intention in step 1 (pre-intervention) and step 2.

Variable	Mean (Step 1)	Mean (Step 2)	Difference	p-value
Intention to adopt	4.02	4.31	0.29	0.3148

Note: t-test based on 48 matched observations. Scale: 7 scales from 0 completely disagree to 6 completely agree.

Regarding actual adoption, our results indicate that only a few farmers in Germany have actually implemented CSA in the time span (none from the other countries), see table 15-17. Regarding adoption planning, we found that 46% of the sample had either just decided to implement without taking concrete steps or had taken the first steps. Results shown in Table 18 thereby indicate that decisions take time and that information regarding whether farmers have been taking the first steps or simply having decided to go forward with implementation is important to elicit in order to guide farmers in their decision process.

Table 18: Country-wise distribution of participants' adoption planning and actual adoption, step 2

Country	Fully Implemented (%)	First Steps Taken (%)	Decided to implement but no steps (%)	Don't Know Yet (%)	Will Not Implement (%)
Germany	12.5	18.75	25	18.75	25
Denmark	0	11.11	33.33	22.22	33.33
Spain	0	30	30	20	20
Lithuania	0	8.33	25	25	41.67
Netherlands	0	18.18	45.45	18.18	18.18
Total	3.45	17.24	31.03	20.69	27.59

Based on 48 responses. Precise question formulation: Could you tell us something more about your plans regarding implementing (specific CSA) or not implementing [a specific CSA] on your farm? Please tick off the statement that fits you best.

To allow participants to state their clear rejection of adopting the specific CSA, they were presented with the statement that it is not economically or practically possible to implement. In the first questionnaire, 21% mostly or completely agreed that it is not economically or practically possible to implement [a specific CSA] while in the second questionnaire only 10% agreed (Table 9 and 20). These results indicate that the vast majority of the participants actually found it to some extent possible to implement [a specific CSA] in both steps.

Table 19: Country-wise distribution of participants' reaction to the statement that [a specific CSA] is not at all economically or practically possible, step 1

Country	Completely Disagree	Mostly Disagree	Slightly Disagree	Neither Agree nor Disagree	Slightly Agree	Mostly Agree	Completely Agree	Total
Germany	21.43%	14.29%	7.14%	7.14%	21.43%	0.00%	28.57%	100%
Denmark	0.00%	9.09%	0.00%	45.45%	27.27%	9.09%	9.09%	100%
Spain	30.00%	0.00%	20.00%	10.00%	30.00%	0.00%	10.00%	100%
Lithuania	37.50%	0.00%	0.00%	12.50%	0.00%	12.50%	37.50%	100%
Netherlands	14.29%	0.00%	0.00%	78.57%	0.00%	7.14%	0.00%	100%
Total	19.30%	5.26%	5.26%	33.33%	15.79%	5.26%	15.79%	100%

Note. Precise formulation of question: It is not at all economically or practically possible for me to adopt [the specific CSA].

Table 20: Country-wise distribution of participants' reaction to the statement that [a specific CSA] is not at all economically or practically possible, step 2

Country	Complet ely Disagree	Mostly Disagr ee	Slightl y Disagr ee	Neithe r Agree nor Disagr ee	Slight ly Agree	Mostl y Agree	Complet ely Agree	Tot al
Germany	18.75%	25.00%	25.00%	12.50%	6.25%	12.50%	0.00%	100
Denmark	28.57%	14.29%	0.00%	14.29%	42.86%	0.00%	0.00%	100
Spain	8.33%	41.67%	8.33%	16.67%	8.33%	8.33%	8.33%	100
Lithuania	20.00%	20.00%	20.00%	20.00%	6.67%	6.67%	6.67%	100
Netherlands	27.27%	18.18%	9.09%	18.18%	27.27%	0.00%	0.00%	100
Total	19.67%	24.59%	14.75%	16.39%	14.75%	6.56%	3.28%	100

Note. Precise formulation of question: It is not at all economically or practically possible for me to adopt [the specific CSA]

The next group of results concern the social interaction of participants during the time period between questionnaires 1 and 2. Results shown in table 21. We see that Denmark is the country with the largest share of participants not having discussed the questionnaire (66% in Denmark and between 0 and 15% in the other countries). We note that it is common to discuss CSA ideas with farm advisors in all countries except Lithuania. And, in all countries it is common to discuss with fellow farmers. In Denmark and the Netherlands only one in ten farmers discussed it with their neighbors while in Germany, Spain and Lithuania it was the double or tribble amount of farmers.

Table 21: Country-wise distribution of participants' social interaction between step 1 and step 2

Countr y	Discussed CSA with farm advisor (%)	Discussed CSA with neighbour s (%)	Discusse d CSA with Family (%)	Discuss ed CSA with other Farmers (%)	Discuss ed CSA Via social media (%)	Discus sed CSA with others (%)	Not Discus sed (%)
German y	68.75	18.75	37.5	62.5	18.75	6.25	12.5
Denmar k	44.44	11.11	11.11	22.22	11.11	11.11	66.67
Spain	33.33	33.33	16.67	50	16.67	25	0
Lithuani a	6.25	25	50	68.75	31.25	25	6.25
Netherl ands	36.36	9.09	27.27	63.64	9.09	18.18	9.09
Total	37.50	20.31	31.25	56.25	18.75	17.19	15.63

Note. Precise formulation of question: Have you discussed [a specific CSA] with others since last summer? If you have, then we would like to know whether you discussed it with any of the following groups? Please select all that apply. If you have not talked to people about [a specific CSA] then you can always choose 'No, I have not discussed it'

Table 22 shows results regarding types of information sources used by the participants in the time between the two steps. In Germany, Denmark and Spain around 20% of the participants did not search for more information while less than 10% did not search at all in Lithuania and Netherlands. Otherwise, they all use a wide variety of information sources

Table 22: Country-wise distribution of participants' search for information about CSA between step 1 and step 2

Country	Farm Magazines (%)	Books (%)	Journals/Papers (%)	News Sources (%)	Farming Websites (%)	Other Places (%)	Not Searched (%)
Germany	75	6.25	25	18.75	18.75	31.25	18.75
Denmark	55.56	22.22	11.11	22.22	0	44.44	22.22
Spain	41.67	8.33	33.33	8.33	16.67	0	25
Lithuania	6.25	6.25	37.5	31.25	62.5	31.25	6.25
Netherlands	27.27	0	9.09	9.09	63.64	18.18	9.09
Total	40.63	7.81	25	18.75	34.38	25	15.63

Note. Precise question formulation: Have you searched for information about [a specific CSA]? If you have, then we would like to know where you have searched? Please select all that apply. If you have not searched for literature about [a specific CSA] then you can always choose 'No, I have not searched'

3.3 Attitudinal results (learning)

Participants' motivation to learn more about CSA and reducing their climate impact were elicited in both step 1 and step 2. We found that only 17% of the participants mostly or completely agreed that the information sheet immediately increased their interest in learning more about CSA (table 23) and 25% of the participants were rather motivated to reduce their climate impact as an immediate reaction (table 24).

After 7 months, 34% stated that they want to learn more and 13% stated that they are more motivated to reduce their climate impact (reported in table 24).

Table 23: Country-wise distribution of participants' motivation to learn more about CSA, step 1

Country	Completely Disagree	Mostly Disagree	Slightly Disagree	Neither nor	Slightly Agree	Mostly Agree	Completely Agree	Total
Germany	14.29	35.71	7.14	7.14	28.57	0.00	7.14	100.00
Denmark	0.00	0.00	0.00	63.64	27.27	9.09	0.00	100.00
Spain	40.00	0.00	20.00	20.00	10.00	0.00	10.00	100.00

Lithuania	40.00	0.00	0.00	10.00	0.00	0.00	50.00	100.00
Netherlands	14.29	0.00	14.29	42.86	14.29	7.14	7.14	100.00
Total	20.34	8.47	8.47	28.81	16.95	3.39	13.56	100.00

Note. Precise formulation of question: The information has increased my motivation to learn more about [a specific CSA]

Table 24: Country-wise distribution of participants' motivation reduce climate impact, step 1

Country	Completely Disagree	Mostly Disagree	Slightly Disagree	Neither nor	Slightly Agree	Mostly Agree	Completely Agree	Total
Germany	21.43	21.43	7.14	7.14	14.29	0.00	28.57	100.00
Denmark	0.00	0.00	0.00	27.27	54.55	9.09	9.09	100.00
Spain	30.00	20.00	10.00	20.00	10.00	0.00	10.00	100.00
Lithuania	20.00	20.00	0.00	20.00	0.00	20.00	20.00	100.00
Netherlands	14.29	0.00	7.14	14.29	35.71	28.57	0.00	100.00
Total	16.95	11.86	5.08	16.95	23.73	11.86	13.56	100.00

Note. Precise formulation of question: The information has increased my general motivation for reducing climate impact

4. Barriers and drivers of CSA adoption

As the last set of questions in questionnaire 2, the participants were asked to prioritize their five top barriers for implementing [a specific CSA]. Results indicate that expected economic risks are the top concerns (see Figure 3 and table 25).

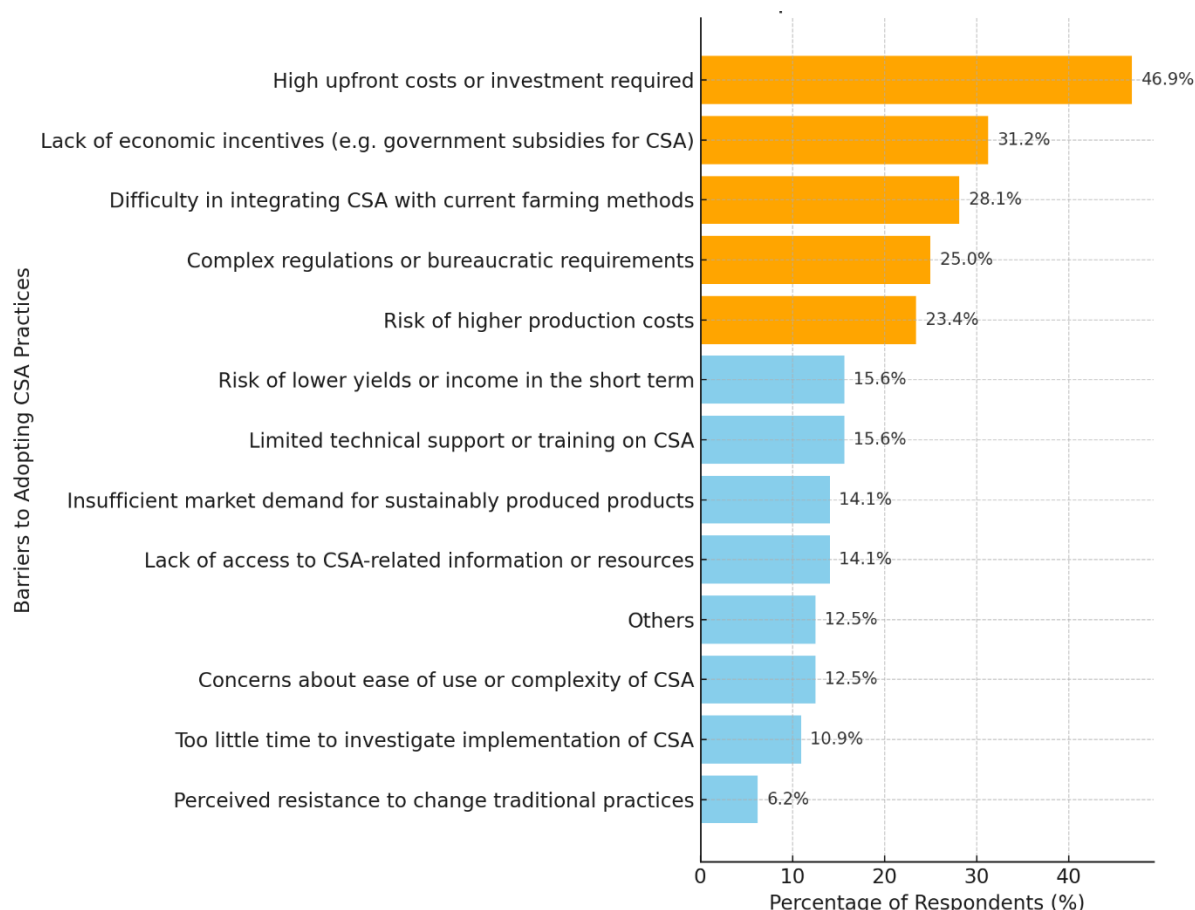


Figure 3: Participants' main barriers for CSA adoption from five countries (N=63)

Table 25: Country-wise distribution of barriers for adopting [a specific CSA], step 2

Barrier	DE	DK	ES	LT	NL	Total
High upfront costs or investment required	0.31	0.33	0.42	0.69	0.55	0.47
Lack of access to CSA-related information or resources	0.25	0.11	0.00	0.19	0.09	0.14
Limited technical support or training on [a specific CSA]	0.13	0.44	0.17	0.13	0.00	0.16
Risk of higher production costs	0.25	0.22	0.42	0.00	0.36	0.23
Risk of lower yields or income in the short term	0.31	0.00	0.25	0.13	0.00	0.16
Lack of economic incentives (e.g., government subsidies for CSA)	0.13	0.11	0.33	0.63	0.27	0.31
Complex regulations or bureaucratic requirements related to implementation	0.25	0.33	0.17	0.25	0.27	0.25
Insufficient market demand for sustainably produced products	0.31	0.00	0.25	0.13	0.00	0.14
Difficulty in integrating [a CSA practice] with current farming methods	0.13	0.11	0.08	0.06	0.36	0.28
Concerns about the ease of use or complexity of [a CSA practice]	0.25	0.22	0.00	0.06	0.09	0.13
Perceived resistance to change traditional practices in my network	0.06	0.33	0.00	0.00	0.00	0.06
Too little time to investigate implementation of [a CSA practice]	0.06	0.00	0.33	0.06	0.09	0.11
Others	0.19	0.11	0.17	0.06	0.09	0.13

Note: Barriers (yes = 1 only) and question formulation: What do you consider the top barriers to adopting [a specific CSA] practices on your farm? (Please select up to five options that are the biggest barriers to adoption for you)

Results regarding top five motivators for adopting [a specific CSA] indicate that economic benefits would be the top motivator. However, interestingly the farmers could also be motivated by knowing that the CSA adoption has environmental and climate benefits just as political or market pressure are mentioned as motivating factors (see Figure 4 and table 26).

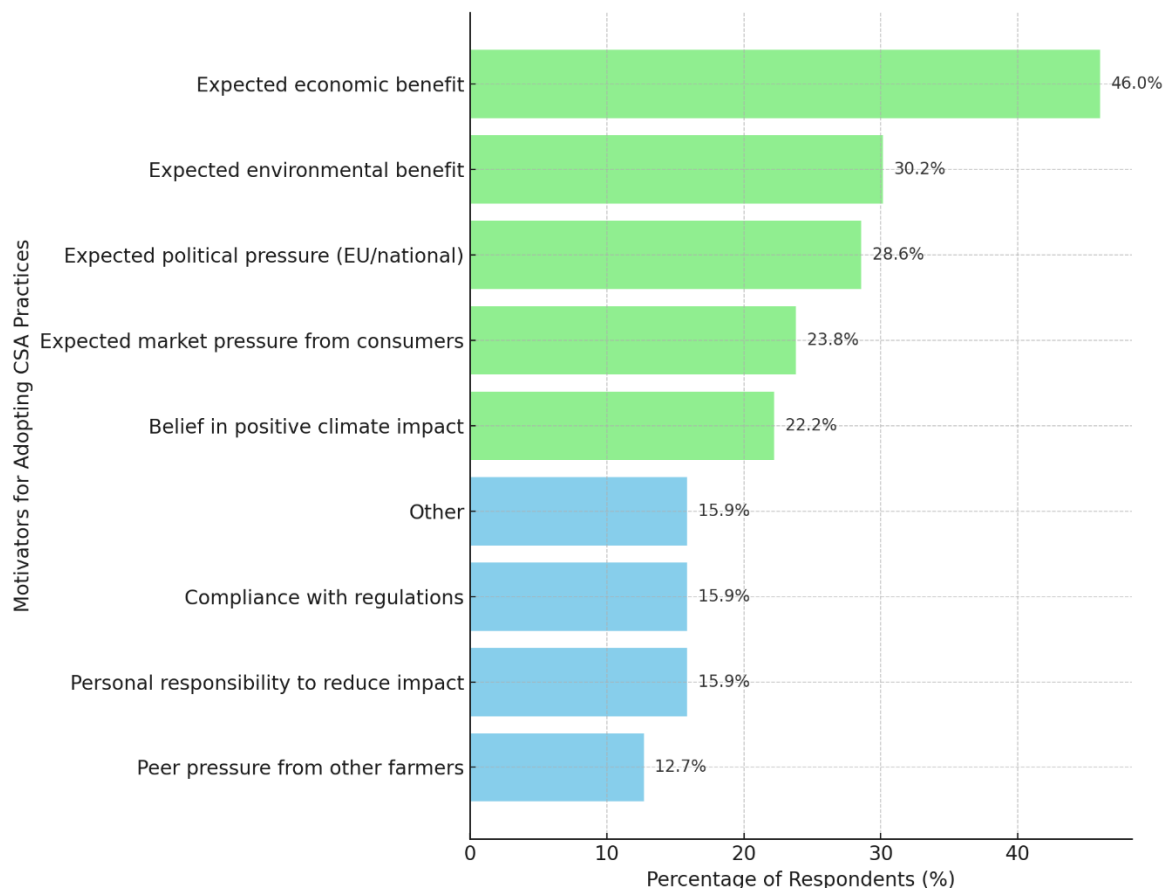


Figure 4: Participants' main motivators for adopting [a specific CSA] from five countries (N=63)

Table 26: Country-wise distribution of motivators for adopting [a specific CSA], step 2

Reason	Germany	Denmark	Spain	Lithuania	Netherlands	Total
Expected economic benefit	0.25	0.00	0.45	0.69	0.82	46.03
Expected environmental benefit	0.38	0.00	0.27	0.19	0.55	30.16
Expected political pressure (EU/national)	0.69	0.22	0.00	0.31	0.09	28.57
Expected market pressure from consumers	0.31	0.33	0.36	0.13	0.09	23.81
Belief in positive climate impact	0.00	0.22	0.09	0.31	0.55	22.22
Personal responsibility to reduce impact	0.38	0.11	0.00	0.06	0.00	15.87
Compliance with regulations	0.44	0.11	0.18	0.00	0.00	15.87
Peer pressure from other farmers	0.25	0.22	0.27	0.00	0.09	12.70
Other	0.06	0.00	0.36	0.19	0.00	15.87

Precise question formulation: What do you consider the top reasons that could make you consider adopting or has made you adopt [a specific CSA]? (Please select up to five options that would motivate implementation the most for you)

5. Conclusions

The experiment was targeted to farmers who had not adopted [a specific CSA] where 2 CSAs were chosen per UC. Thereby, being a non-adopter in the experiment does not necessarily mean that they are non-adopters of all kinds of CSA. It was hypothesized that providing CSA-specific factsheets would increase the awareness, change the attitude towards and intention to adopt CSAs among non-adopting farmers and increase interest in learning. **Providing CSA-specific factsheets is an informational intervention.** More specifically, the following hypotheses were posed – and the results are stated below:

- H1: Providing relevant information about (a specific CSA) will increase awareness about CSA

Response: There was no statistically significant difference between stated knowledge in questionnaire 1 and 2. Asked directly about the reaction to the information sheet, the immediate reaction was that 22% were rather positive about the information sheet's ability to increase immediate awareness. However, after 7 months only 13% were rather positive about the ability of the information provided in the first questionnaire to increase awareness. Statistical significance was not tested as the questions in step 1 and 2 were not formulated identically but there the numbers indicate a reduction in effect on awareness.

- H2: Providing relevant information about (a specific) CSA will increase willingness to adopt CSA.

Response: H2 could not be accepted when comparing willingness to adopt in step 1 and step 2. No statistically significant effect of the information sheet. However, asked directly about whether the information sheet had affected their willingness to adopt [a specific CSA], 22% were positive immediately after the intervention and 13% were positive after 7 months.

- H3: Providing relevant information about (a specific) CSA will increase the interest in learning about CSA.

Response: H3 could not be accepted when comparing interest in learning in step 1 and step 2. No statistically significant effect of the information sheet. However, asked directly about whether the information sheet had affected their interest in learning more about CSA, 17% of the participants stated immediately after the intervention that the information sheet increased their interest in learning more about CSA and 25% of the participants were rather motivated to reduce their climate impact as an immediate reaction. No clear picture of whether the interest in learning had changed after 7 months.

- H4: Farmers will engage in social conversation about CSA intervention after providing relevant information.

Response: Yes farmers did engage in conversation about CSA between step 1 and step 2. However, the design did not allow us to test whether the conversation had increased or changed. We found that a wide variety of communication channels were used. Denmark was the country with the largest share of participants not having discussed the questionnaire (66% in Denmark and between 0 and 15% in the other countries). The most common discussion channels for CSA ideas were farm advisors (except in Lithuania) and discussions with fellow farmers.

Below, we will highlight more of the lessons learned from the questions posted in the questionnaires. Lessons, from the attitudinal and or behavioural questions that are not linked to the intervention.

Regarding awareness, two out of three of the participants stated to know something or a lot about [a specific CSA] before the intervention.

Regarding adoption intention: Around 45% of the participants were to some extent positive towards adopting (stating slightly agree, mostly agree or completely agree to the statement that they will adopt [a specific CSA] within the next 5 years). Our results indicate that only a few farmers had actually adopted [a specific CSA] during the 7 months time span. However, 46% of the sample had either decided to adopt without taking concrete steps or had taken the first steps but not fully adopted. Thereby, including adoption planning of initial steps towards adoption were a valuable contribution and is a result worth pursuing. These results indicate that decisions take time and that information regarding whether farmers have been taking the first steps is important to elicit in order to guide farmers in their decision process.

To allow participants to state their clear rejection of adopting [a specific CSA], they were presented with the statement that it is not economically or practically possible to implement. Here, 21% mostly or completely agreed while in the second questionnaire only 10% agreed. These results indicate that most of the participants actually found it - to some extent possible - to implement [a specific CSA] in both steps.

Regarding barriers and motivators for CSA adoption, our results indicate that expected economic risks are the top concerns. The top motivators for adopting [a specific CSA] were economic benefits but also, quite interestingly, farmers could also be motivated by knowing that the CSA adoption has environmental and climate benefits just as political or market pressure are among the top concerns.

The participants were asked questions regarding the effect of the information they received in the first questionnaire. The most promising effect is that after seven months, 1/3 of the participants stated that it increased their motivation to learn more (mostly or completely agreed to the statement). Less encouraging were the results regarding increased awareness, increased likelihood of adoption and motivation to reduce climate impact where between 10 and 15% stated that they mostly or completely agree to these statements.

In short, two out of three of the participants stated to know something or a lot about [a specific CSA] before the intervention. The intervention (a factsheet with information about [a specific CSA]) did not have statistically significant effect on either awareness, willingness to adopt or interest in learning. The questionnaire might still have had an effect though because seven months after the first questionnaire, 1/3 of the participants stated that it increased their motivation to learn more about CSA.

Our results indicate that only a few farmers had actually adopted [a specific CSA] during the 7 months time span but almost half of the sample had taken the first steps to adopt. Thereby, including adoption planning of initial steps towards adoption were a valuable contribution and is a result worth pursuing. These results indicate that decisions take time and that information regarding whether farmers have been taking the first steps is important to elicit in order to guide farmers in their decision process.

All conclusions are of course given with reservations to conclude too strongly considering a relatively small group of respondents where altogether 48 farmers from five countries participated in both rounds of questionnaires. Future follow-up studies with more participants would enable us to conclude in more details.

6. References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179-211.
- Long, T. B., Blok, V. & Coninx, I. (2016). Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy. *Journal of Cleaner Production*, 112, 9-21, 10.1016/j.jclepro.2015.06.044
- Allcott, Hunt and Todd Rogers. 2014. "The Short-Run and Long-Run Effects of Behavioral Interventions: Experimental Evidence from Energy Conservation." *American Economic Review*, 104 (10): 3003–37.
- Chowdhury, A., Odame, H. H., Thompson, S., & Hauser, M. (2015). Enhancing farmers' capacity for botanical pesticide innovation through video-mediated learning in Bangladesh. *International Journal of Agricultural Sustainability*, 13(4), 326–349. <https://doi.org/10.1080/14735903.2014.997461>
- Chuang, J.-H., Wang, J.-H., & Liou, Y.-C. (2020). Farmers' Knowledge, Attitude, and Adoption of Smart Agriculture Technology in Taiwan. *International Journal of Environmental Research and Public Health*, 17(19), 7236. <https://doi.org/10.3390/ijerph17197236>
- Gemtou, M., Kakkavou, K., Anastasiou, E., Fountas, S., Pedersen, S. M., Isakhanyan, G., Erekaló, K. T., & Pazos-Vidal, S. (2024). Farmers' Transition to Climate-Smart Agriculture: A Systematic Review of the Decision-Making Factors Affecting Adoption. *Sustainability*, 16(7), 2828. <https://doi.org/10.3390/su16072828>
- Kernecker, M., Knierim, A., Wurbs, A., Kraus, T., & Borges, F. (2020). Experience versus expectation: Farmers' perceptions of smart farming technologies for cropping systems across Europe. *Precision Agriculture*, 21(1), 34–50. <https://doi.org/10.1007/s11119-019-09651-z>
- Kwasnicka, D., Dombrowski, S. U., White, M., & Sniehotta, F. (2016). Theoretical explanations for maintenance of behaviour change: a systematic review of behaviour theories. *Health Psychology Review*, 10(3), 277–296. <https://doi.org/10.1080/17437199.2016.1151372>
- Le Coent, P., Préget, R. & Thoyer, S. (2021). Farmers follow the herd: a theoretical model on social norms and payments for environmental services. *Environmental and Resource Economics*, 78 (2), 287-306, 10.1007/s10640-020-00532-y
- Long, T.B., Blok V., Coninx I., Barriers to the adoption and diffusion of technological innovations for climate-smart agriculture in Europe: evidence from the Netherlands, France, Switzerland and Italy, *J. Clean. Prod.* 112 (2016) 9–21, <https://doi.org/10.1016/j.jclepro.2015.06.044>.
- Myers, R. L., & Wilson, K. R. (2023). Farmer perspectives about cover crops by non-adopters. *Frontiers in Sustainable Food Systems*, 7, 1011201. <https://doi.org/10.3389/fsufs.2023.1011201>
- Pedersen S.M, Erekaló K.T, Christensen T, Denver S, Gemtou M, Fountas S, Isakhanyan G, Rosemarin A, Ekane N, Puggaard L, Ertinger M, Brinks H, Puško D, Adrián J B (2024): Drivers and barriers to climate-smart agricultural practices and technologies adoption:

Insights from stakeholders of five European food supply chains, Smart Agricultural Technology, Volume 8, August 2024, 100478

Polman, E. & Maglio, S.J. (2023). Nudges Increase Choosing but Decrease Consuming: Longitudinal Studies of the Decoy, Default, and Compromise Effects. *Journal of Consumer Research*, ucad081, <https://doi.org/10.1093/jcr/ucad081>

Schrader, P. G. & Lawless, K. A. (2004). The knowledge, attitudes, & behaviors approach how to evaluate performance and learning in complex environments. *Performance Improvement* 43(9):8 – 15. doi: 10.1002/pfi.4140430905

Tufa, T. B., Regassa, F., Amenu, K., Stegeman, J. A. & Hogeveen, H. (2023). Livestock producers' knowledge, attitude, and behavior (KAB) regarding antimicrobial use in Ethiopia. *Frontiers in Veterinary Science* 10:1167847. doi: 10.3389/fvets.2023.1167847

Appendix

Appendix 1: Questionnaire 1

Text and questions	Purpose																		
Thank you for agreeing to participate. This short questionnaire is about the potential use of [a specific CSA]: The study is carried out by researchers at the University of Copenhagen and [local partner]. It is part of a larger project (the BEATLES project) that is financed by the European Commission. The results of the survey are used only for research and for dissemination of results. Your answers are handled confidentially. You can always choose to withdraw from the survey during or after completing the questionnaire. If you choose to do so, your answers will be deleted. Q0 I hereby consent to the usage of my answers for research purposes and dissemination of results Yes No (if you check this box, the questionnaire ends)	Intro text and consent																		
1. How much do you know about [a specific CSA]? - Nothing - Almost nothing - A little - Something - A lot	Awareness before intervention																		
2. To what extent do you agree or disagree with the following statement. I will be implementing [a specific CSA] on my farm within the next five years. - Completely disagree - Mostly disagree - Slightly disagree - Neither nor - Slightly agree - Mostly agree - Completely agree - Don't know	Adoption intention before intervention																		
3. The following questions are about your opinion about [a specific CSA]. Think about your farm and your agricultural production when you answer the questions. <table border="1"> <thead> <tr> <th>How do you think that adopting [the CSA] will affect ...</th><th>Large decrease</th><th>Moderate decrease</th><th>Small decrease</th><th>No effect</th><th>Small increase</th><th>Moderate increase</th><th>Large increase</th><th>Don't know</th></tr> </thead> <tbody> <tr> <td>carbon emissions from</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>	How do you think that adopting [the CSA] will affect ...	Large decrease	Moderate decrease	Small decrease	No effect	Small increase	Moderate increase	Large increase	Don't know	carbon emissions from									Awareness before intervention
How do you think that adopting [the CSA] will affect ...	Large decrease	Moderate decrease	Small decrease	No effect	Small increase	Moderate increase	Large increase	Don't know											
carbon emissions from																			

production?										
daily workload?										
production costs?										
agricultural yield?										
farm profit?										
resilience to climate change?										
energy use?										
water use?										
biodiversity?										
Factsheet (information-based intervention) – around 175 words for the specific CSA if possible categorized according to: • Background/description • How common is the CSA? • Climate impact • Economy • Other impacts <i>See all descriptions in Appendix 2</i>										Intervention is intended to increase awareness, adoption behaviour and knowledge
4. We would like to know whether any parts of the information was new to you. Please state to what extent you agree or disagree with the following statements										Test of whether intervention has increased knowledge
	Completely disagree	Mostly disagree	slightly disagree	Neither nor	Slightly agree	Mostly agree	Completely agree	Don't know		
The information regarding how common it is to use [a specific CSA] was new										
The information regarding the costs of [a										

specific CSA] was new									
The information regarding climate impacts of [a specific CSA] was new									
The information regarding other effects of [a specific CSA] was new									
5. To what extent do you agree or disagree with the following statements?									Test of whether intervention has increased awareness adoption intention, general interest in climate reduction And allowing to state that the CSA is not applicable at all
	Completely disagree	Mostly disagree	slightly disagree	Neither nor	Slightly agree	Mostly agree	Completely agree	Don't know	
The information has made me more aware of the potential benefits of adopting [a specific CSA]									
The information has made it more likely that I will adopt [a specific CSA] within the next five years									
The informati									

on has increased my motivation to learn more about [a specific CSA]									
The information has increased my general motivation for reducing climate impact									
It is not at all economically or practically possible for me to adopt [the CSA]									
6. What would it take to make it more likely that you would adopt [a specific CSA] ? Please write here									Information about other levers than information
7. To what extent do you agree or disagree with the following statement?									To be able to place adoption intention of the specific CSA in the context of general interest in climate impact
	Completely disagree	Mostly disagree	slightly disagree	Neither nor	Slightly agree	Mostly agree	Completely agree	Don't know	
It is not important for me that my production has a low climate impact									
8. Farm specific questions [questions about size of farm are UC specific – please insert relevant categories]									Farm and farmer

What is your farm size in hectares? • less than 2 ha • 2 to 10 ha • 11 to 50 ha • 51 to 100 ha • 101 to 200 ha • 201 to 500 ha • more than 500 ha • Don't know 9. Only for Denmark and Germany: How many slaughter pigs do you produce annually / how many cows are you milking? 10. How many full time employees are there on your farm (in addition to yourself)? Please state the number here..... 11. What is your gender identity? • Male • Female • Other • Don't what to reveal/don't know 12. How long have you been working in farming? • less than 5 years • 5 to 10 years • 11 to 15 years • 16 to 20 years • more than 20 years	specific info
13. Do you have anything to add about the questionnaire Please write here	Allow general comments from participant

Appendix 2: Questionnaire 2

Questionnaire

Thank you for agreeing to participate. This short questionnaire is about the potential use of [a specific CSA].

The study is carried out by researchers at the University of Copenhagen and [local partner]. It is part of a larger project (the BEATLES project) that is financed by the European Commission.

The results of the survey are used only for research and for dissemination of results. Your answers are handled confidentially. You can always choose to withdraw from the survey during or after completing the questionnaire. If you choose to do so, your answers will be deleted.

0

I hereby consent to the usage of my answers for research purposes and dissemination of results

Note: If you choose "No" option, the questionnaire ends

(1) ☐ Yes

(2) ☐ No

1

How much do you know about [a specific CSA]?

(1) ☐ Nothing (2) ☐ Almost nothing (3) ☐ A little (4) ☐ Something (5) ☐ A lot

2

To what extent do you agree or disagree with the following statement. I will be implementing [a specific CSA] on my farm within the next five years.

Completely disagree Mostly disagree slightly disagree Neither disagree nor agree Slightly agree Mostly agree Completely agree Don't know

3

The following questions are about your opinion about [a specific CSA]. Think about your farm and your agricultural production when you answer the questions.

How do you think that adopting	Large decrease	Moderate decrease	Small decrease	No effect	Small increase	Moderate increase	Large increase	Don't know
--------------------------------	----------------	-------------------	----------------	-----------	----------------	-------------------	----------------	------------

[the CSA] will affect ...								
carbon emissions from production?								
daily work load?								
production costs?								
agricultural yield?								
farm profit?								
resilience to climate change?								
energy use?								
water use?								
biodiversity?								

4

Do you remember that you filled out a questionnaire about [a specific CSA] last summer? Please select the category that suits best

- | | | | | |
|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|
| (1) ☐ | (2) ☐ | (3) ☐ | (4) ☐ | (5) ☐ |
| Don't remember at all | Remember slightly | Remember to some extent | Remember clearly | Remember very clearly |

5

To what extent do you agree or disagree with the following statements about the information that you received in the first questionnaire last summer?

- | | | | | | | | |
|---------------------|-----------------|-------------------|----------------------------|----------------|--------------|------------------|------------|
| Completely disagree | Mostly disagree | Slightly disagree | Neither disagree nor agree | Slightly agree | Mostly agree | Completely agree | Don't know |
|---------------------|-----------------|-------------------|----------------------------|----------------|--------------|------------------|------------|

The information has made me more aware of the benefits of adopting [a specific CSA]	(1) ☐	(2) ☐	(3) ☐	(4) ☐	(5) ☐	(6) ☐	(7) ☐	(8) ☐

The information has made it more likely that I will adopt [a specific CSA] (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐ (8) ☐

The information has increased my motivation to learn more about [a specific CSA] (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐ (8) ☐

The information has increased my general motivation for reducing climate impact (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐ (8) ☐

It is not at all economically or practically possible for me to adopt [the CSA] (1) ☐ (2) ☐ (3) ☐ (4) ☐ (5) ☐ (6) ☐ (7) ☐ (8) ☐

6

Could you tell us something more about your plans regarding implementing (specific CSA) or not implementing [a specific CSA] on your farm? Please tick off the statement that fits you best.

- (1) ☐ I have fully implemented [a specific CSA]
- (2) ☐ I have taken the first steps to implement [a specific CSA] e.g. talked to people, searched for information, made investments, etc.
- (3) ☐ I have decided to implement [a specific CSA] but I have not taken any steps yet
- (4) ☐ I don't know whether I will implement [a specific CSA]
- (5) ☐ I will not implement [a specific CSA]

7

Have you discussed [a specific CSA] with others since last summer? If you have, then we would like to know whether you discussed it with any of the following groups? Please

select all that apply. If you have not talked to people about [a specific CSA] then you can always choose 'No, I have not discussed it'

- | | | | | | | |
|---|--|--|---|--|------------------------------------|--|
| (1) ☐ Farm
advisors | (2) ☐ Neighbors | (3) ☐ Family
members | (4) ☐ Other
farmers | (5) ☐ Social
media | (6) ☐ Other | (7) ☐ No, I
have
not
discussed
it |
|---|--|--|---|--|------------------------------------|--|

8

Have you searched for information about [a specific CSA]? If you have, then we would like to know where you have searched? Please select all that apply. If you have not searched for literature about [a specific CSA] then you can always choose 'No, I have not searched'.

- | | | | | | | |
|--|------------------------------------|--|---|---|---|--|
| (1) ☐ Farm
Magazines | (2) ☐ Books | (3) ☐ Journal
Papers | (4) ☐ Newspaper
s | (5) ☐ Farm
Websites | (6) ☐ Other
(Please
specify) | (7) ☐ No, I
have not
searched |
|--|------------------------------------|--|---|---|---|--|

9

What do you consider the top barriers to adopting [a specific CSA] practices on your farm?

(Please select up to five options that are the biggest barriers to adoption for you)

- (1) ☐ High upfront costs or investment required
- (2) ☐ Lack of access to CSA-related information or resources
- (3) ☐ Limited technical support or training on [a specific CSA]
- (4) ☐ Risk of higher production costs
- (5) ☐ Risk of lower yields or income in the short term
- (6) ☐ Lack of economic incentives (e.g. government subsidies for CSA)
- (7) ☐ Complex regulations or bureaucratic requirements related to implementation
- (8) ☐ Insufficient market demand for sustainably produced products
- (9) ☐ Difficulty in integrating [a CSA practice] with current farming methods
- (10) ☐ Concerns about the ease of use or complexity of [a CSA practice]
- (11) ☐ Perceived resistance to change traditional practices in my network
- (12) ☐ Too little time to investigate implementation of [a CSA practice]
- (13) ☐ Other

10

What do you consider the top reasons that could make you consider adopting or has made you adopt [a specific CSA]?

(Please select up to five options that would motivate implementation the most for you)

- (1) ☐ Expected economic benefit
- (2) ☐ Expected environmental benefit
- (3) ☐ Expected increased pressure to adopt CSA from national and EU politicians
- (4) ☐ Expected market pressure from consumer demand
- (5) ☐ Belief in positive climate impact of my actions
- (6) ☐ I feel it is my responsibility to reduce climate impact from my production
- (7) ☐ Compliance with present regulations
- (8) ☐ Perceived pressure from fellow farmers to reduce climate impact of my production
- (9) ☐ Other (specify) _____

Finally, we want to ask you a few farm specific questions

11

What is your farm size in hectares?

- less than 2 ha
- 2 to 10 ha
- 11 to 50 ha
- 51 to 100 ha
- 101 to 200 ha
- 201 to 500 ha
- more than 500 ha
- Don't know

12

Only for Denmark and Germany: How many slaughter pigs do you produce annually / how many cows are you milking?

13

How many full time employees are there on your farm (in addition to yourself)?

Please state the number here.....

14

What is your gender identity?

- Male
- Female
- Other
- Don't what to reveal/don't know

15

How long have you been working in farming?

- less than 5 years
- 5 to 10 years
- 11 to 15 years
- 16 to 20 years
- more than 20 years

6

Please provide the last three digits in your phone number you (you were also asked to do so in the first-round survey). This is solely for being able to link the 2 rounds of questionnaires and will be deleted afterwards

Please write them here:

17

Do you have anything to add about the questionnaire then we would highly appreciate your comments. *Please write here*

Thank you very much for taking the time to participate in the survey

Appendix 3: CSA descriptions

1) LT Solar energy (172 words)

Description In 2021, renewable energy accounted for 28% of the total final energy consumption in Lithuania. So far, under 2% of the renewable energy produced in Lithuania comes from solar panels. A growing trend in solar energy usage is observed and presents an opportunity for farmers.

How common is it to use solar plants? The same picture is seen in agriculture: solar panels are still quite rarely installed in Lithuanian farms, even with financial support provided by the state.

Climate effects Using solar plants to produce power reduces carbon footprint as solar energy production emits no greenhouse gases during operation and it improves air quality. As an example, investment in 500 m² solar panels (similar to the roof of a medium sized barn) could generate 100,000 kwh yearly. This would save several tons of CO₂ emissions in a year.

Economy The business environment for solar energy production in Lithuania is viable with the investment return in 4-7 years. As solar panels typically last 25 years there are many years of free energy.

2) LT Variable rate fertilization (175 words)

Description Variable rate fertilization (VRF) means applying fertilizers in such a manner that the application rate is varied based on precise location needs. This enables the farmer to maintain a balanced composition of nutrients in soil, reduce contamination of surface waters with excess nutrients, and in turn save the fertilizer costs. Applying VRF requires site-specific soil sampling and mapping, evaluation of crop needs. It also requires machinery equipped with sensors, controllers and satellite navigation systems (e.g., GPS) and fertilizer spreaders that are able to vary application.

How common is the use variable rate fertilization? No national data on VRF adoption but it is an increasingly adopted practice in bigger cereal farms in Lithuania.

Climate effects VRF enables farmers to increase yields with same or less input use. Indirectly it gives a saving of 100-300 CO₂ equivalent kg per hectare.

Economy The main advantages of VRF are improved fertilizer efficiency, increased crop yield, reduced harvesting time and costs, potentially reducing nitrogen, phosphorus, and potassium fertilizers. Farmers can potentially increase gross margins between 10 and 50 EUR/ha.

3) ES organic apples (171 words)

Description Organic apple production in Navarra follows agricultural practices aimed at nurturing ecosystem health and ensuring long-term sustainability. Organic apple farming does not rely on synthetic chemicals such as pesticides and fertilisers. Instead, organic apple farming prioritises the use of organic fertilisers like compost and green manure, crop rotation to improve soil structure, and integrated pest management techniques utilising natural predators and biological mechanisms.

How common is it to grow organic apples? In Navarra, 29% of apple production surface is organic.

Climate effect The climate impact from organic apples is estimated to be slightly lower than from conventional apples.

Economy Avoiding synthetic pesticides may be more time consuming and yields may initially be slightly lower in organic production. However, when the soil has adjusted to changed management and the natural pest and disease control systems have been established, then yields are comparable to conventional production. Apple prices vary with a lot of factors but organic production typically leads to higher prices.

Other effects Generally, organic has lower environmental impact on most categories.

4) ES Solar energy (175 words)

Background In 2023, renewable resources generated 50% of Spain's electricity needs.

Description Using solar energy in agriculture involves using sunlight to power various agricultural processes. Solar panels convert sunlight into electricity that can be used for powering irrigation systems, storage facilities, machinery, lighting, etc. Also, farmers can reduce reliance on fossil fuels.

How common is solar energy? In 2024, around 14% of total electricity consumption in Spain came from solar energy. There is a large potential for installing solar panels on farm buildings.

Climate effects For solar roof panels, investment in 500 m² solar panels (similar to the roof of a medium sized barn) could generate 100,000 kWh yearly. This would save several tons of CO₂ emissions in a year.

Economy The investment is paid back in 4-7 years. As solar roof panels typically last 25 years there are many years of free energy. By generating their own energy with solar panels, agricultural entrepreneurs can significantly reduce their energy costs. Public subsidies and tax benefits are available in Navarra for the installation of solar panels.

5) NL Precision irrigation (180 words)

Description Precision irrigation technology can reduce water usage in agriculture especially under droughts. With sensors, it can monitor soil moisture, temperature, and humidity. Computers can analyse the data and decide when, where, and how much water to apply to the crops. Automation systems such as drip irrigation and micro-sprinklers can deliver water precisely to the root zone.

How common is precision irrigation? Today, precision irrigation is only used by few potato and onion growers in the Netherlands. However, a rising demand for agricultural products will require further mechanisation and precision farming, including irrigation.

Climate effects Precision irrigation can reduce the use of energy and fertilizers, which reduces CO₂ emissions. In onion production, precision irrigation has been shown to reduce CO₂ emissions by 20-25%.

Economy Precision irrigation requires investment in new technology and software.

Other effects Precision irrigation systems can use water much more efficiently while maintaining or even increasing yield. Drip irrigation is often combined with precision fertilization which reduces nutrient run-off. Precision irrigation requires less work with machinery in the field reduces soil compaction and increases soil fertility.

6) NL Solar energy (180 words)

Description Solar energy powers agricultural processes by converting sunlight into electricity, reducing carbon emissions and energy costs, and decreasing fossil fuel reliance.

How common is solar energy? In 2023, solar panels provided around 20% of total electricity consumption in the Netherlands. Solar panel adoption among Dutch farmers increased dramatically from 17% in 2015 to 43% in 2020.

Climate effects Full-scale adoption of solar energy on rooftops in Dutch agriculture could offset 12% of total Dutch GHG emissions. As an example, investment in 500 m² solar panels (similar to the roof of a medium sized barn) could generate 100,000 kWh yearly. This would save several tons of CO₂ emissions in a year.

Economy The investment is paid back in 4-7 years. As solar panels typically last 25 years there are many years of free energy. There are subsidy schemes for solar panel installations. By generating their own energy with solar panels, agricultural entrepreneurs can significantly reduce their energy costs.

Other effects In sustainability certifications such as On the Way to Planet Proof, investment in solar energy contributes to environmental performance scores.

7) D Increased longevity (175 words)

Background Increased a milking cow's productive life (longevity) reduces the need for replacement heifer calves. In Bavaria, replacement heifers typically have their first lactation when they are 29 months.

Description The need for replacement heifers can be reduced by increasing the age of milking cows and by reducing the age for first calving. Also increasing the time between calvings can increase lifelong milk yield because cows are not milked 6 weeks before every calving.

How common is it to focus on longevity? Within the last decades, breeding for longevity and high milk yield during the cows' lifespan has increased slowly within especially organic farms.

Climate effect Reducing the age for first calving by 3 months can reduce climate impact of replacement heifers by 7 percent without negative effects for cow-calf. Increasing the time from 12 to 18 months between two calvings can reduce the climate impact by 5 percent.

Economic effects Improved longevity can improve economic performance. Economic advantages include reduced costs for replacement, reduced area and animal housing needs and reduced costs for feeding during rearing.

8) D Reduction of concentrate by increase quality of forage feed (179 words)

Description On most farms, it is possible to improve the quality of forage feed produced on farm according to the herd's specific requirement. Thereby, concentrate feed production or purchases can be reduced. If cows are fed too much concentrate, the roughage intake is displaced the concentrate due to cow's higher preferences for concentrate.

How common is it to increase quality of forage feed? Due to economic and societal pressure, improving the quality of forage feed and reducing the amount of concentrate is becoming more frequent.

Climate effect Production of forage feed from grassland is increasingly been seen as environmentally friendly due to the potential of grassland to store carbon. Furthermore, reducing concentrate will reduce greenhouse gas emissions from transportation and land use changes for the production of concentrate feed.

Economic effects Reducing the amount of bought-in concentrate can reduce feeding costs especially for the organic sector, since organic concentrate is costly. Furthermore, producing feed on grassland can be seen as less labour intensive than producing concentrate feed.

Other effects The use of concentrated feed potentially competes with human nutrition.

9) DK Acidification of manure in the barn (180 words)

Description Around 20% of the climate footprint of a fattening pig comes from the manure. Therefore, there is a great focus on, for example, the acidification of manure.

How common is acidification of manure Today, only approximately 2% of pig producers use barn acidification. A doubling of the use is expected until 2030 in Denmark.

Climate effect Emission of greenhouse gases (methane and ammonia) can be reduced by 60-70% by acidifying manure in the barn. This corresponds to reducing the climate footprint by approximately 22 kg of CO₂ from manure from each slaughter pig.

Economics Stable acidification requires a major investment and is typically only seen in total renovations. With a depreciation period of 15 years, the costs of acidifying manure are approximately DKK 1.5 Euros per pig for slaughter (in 2018 prices).

Other effects of barn acidification of manure Barn acidification can both reduce the emission of greenhouse gases and reduce nitrogen loss. With acidification of manure, the manure has a higher nitrogen content when it is spread in the field, and this can therefore reduce the need for chemical fertilizers. When manure is acidified in the barn, there is no requirement to cover the manure tank. Acidification of manure, however, limits the possibilities of using it in biogas production, as there will be a need for sulfur purification of the biogas.

10) DK Fava beans as feed protein (179 words)

Background Around 70% of the pigs' climate footprint comes from the feed. In particular, imported soy has a high climate footprint. Therefore, there is a great focus on replacing imported soy with locally grown fava beans as a protein source in pig feed.

Description By mixing 20% fava beans into the feed, a fattening pig producer can replace soybean meal as a protein source. The pigs' productivity is good when they are fed with fava beans rather than soybean meal, but overall it is more expensive today to feed them with fava beans due to higher production costs.

How common is it to use fava beans? So far, only a few pig producers have replaced soybean meal with fava beans in their pig feed.

Climate effect The climate footprint from the feed can be reduced by 22% per fattening pig (and up to 50% if the climate effect of deforestation in South America is taken into account) by using fava beans instead of soybean meal.

Economy It costs 0.5-0.6 Euros more per pig to replace soya with fava beans when feeding the pig from 30 kg up to slaughter.

Other effects If you grow the fava beans yourself, there is both a climate gain by replacing imported soy with Danish-grown fava beans, and a nitrogen gain because fava beans fix nitrogen, so the need for fertilizer is reduced. About 20,000 ha are cultivated with fava beans in Denmark.

Appendix 4: Participants' perceptions about [a specific CSA]

Participants perceptions about [a specific CSA] were elicited before the informational intervention. Overall,

- around 75% of the participants believed that [a specific CSA] decreased carbon footprint.
- Half of the participants believed that [a specific CSA] would have no effect on daily work
- Agricultural yield was expected to be unchanged by 40% while 30% thought it would be higher and lower, respectively

Detailed results presented country-wise are shown in the appendix tables below. The precise formulation of the questions were:

The following questions are about your opinion about [a specific CSA]. Think about your farm and your agricultural production when you answer the questions. How do you think that adopting [the CSA] will affect.....

Appendix table 4.1 How do you think that adopting [the CSA] will affect carbon emissions

Country	Large decrease	Moderate	Small decrease	No effect	Small increase	Moderate	Large increase	Total
Germany	14.29	35.71	42.86	7.14	0.00	14.29		100.00
Denmark	0.00	63.64	36.36	0.00	0.00	0.00		100.00
Spain	25.00	37.50	12.50	12.50	12.50	25.00		100.00
Lithuania	0.00	25.00	0.00	25.00	50.00	0.00		100.00
Netherlands	0.00	25.00	50.00	16.67	8.33	0.00		100.00
Total	8.16	38.78	34.69	10.20	8.16	8.16		100.00

Appendix table 4.2 How do you think that adopting [the CSA] will affect daily Work

	Large decrease	Moderate	Small decrease	No effect	Small increase	Moderate	Large increase	Total
Germany	7.14	0.00	28.57	57.14	0.00	7.14	0.00	100.00

Denmark	0.00	40.00	10.00	30.00	0.00	10.00	10.00	100.00
Spain	20.00	10.00	0.00	30.00	0.00	30.00	10.00	100.00
Lithuania	0.00	0.00	16.67	66.67	16.67	0.00	0.00	100.00
Netherlands	0.00	0.00	28.57	42.86	0.00	21.43	7.14	100.00
Total	5.56	9.26	18.52	44.44	1.85	14.81	5.56	100.00

Appendix table 4.3 How do you think that adopting [the CSA] will affect cost of production

Country	Large Decrease	Moderate Decrease	Small Decrease	No Effect	Small Increase	Moderate Increase	Large Increase	Total
Germany	14.29%	21.43%	28.57%	0.00%	21.43%	14.29%	0.00%	100.00%
Denmark	0.00%	18.18%	18.18%	9.09%	18.18%	27.27%	9.09%	100.00%
Spain	20.00%	10.00%	10.00%	10.00%	10.00%	20.00%	20.00%	100.00%
Lithuania	0.00%	0.00%	0.00%	33.33%	33.33%	33.33%	0.00%	100.00%
Netherlands	0.00%	7.69%	38.46%	15.38%	15.38%	7.69%	15.38%	100.00%
Total	7.41%	12.96%	22.22%	11.11%	18.52%	18.52%	9.26%	100.00%

Appendix table 4.4 How do you think that adopting [the CSA] will affect agricultural yield

Country	Moderate Decrease	Small Decrease	No Effect	Small Increase	Moderate Increase	Total
Germany	14.29%	35.71%	21.43%	7.14%	21.43%	100.00%
Denmark	18.18%	27.27%	36.36%	18.18%	0.00%	100.00%
Spain	50.00%	0.00%	30.00%	10.00%	10.00%	100.00%
Lithuania	0.00%	0.00%	87.50%	12.50%	0.00%	100.00%
Netherlands	0.00%	0.00%	50.00%	21.43%	28.57%	100.00%
Total	15.79%	14.04%	42.11%	14.04%	14.04%	100.00%

Appendix table 4.5 How do you think that adopting [the CSA] will affect profit

Country	Large Decrease	Moderate Decrease	Small Decrease	No Effect	Small Increase	Moderate Increase	Total

Germany	0.00%	14.29%	14.29%	21.43%	21.43%	28.57%	100.00 %
Denmark	9.09%	27.27%	36.36%	18.18%	9.09%	0.00%	100.00 %
Spain	11.11%	33.33%	22.22%	22.22%	11.11%	0.00%	100.00 %
Lithuania	0.00%	0.00%	0.00%	44.44 %	22.22%	33.33%	100.00 %
Netherlands	0.00%	0.00%	7.14%	28.57%	64.29%	0.00%	100.00 %
Total	3.51%	14.04%	15.79%	26.32%	28.07%	12.28%	100.00 %

Appendix table 4.6 How do you think that adopting [the CSA] will affect resilience

Country	Large Dec	Moderate Dec	Small Dec	No Effect	Small Inc	Moderate Inc	Total
Germany	0.00%	7.14%	7.14%	57.14%	14.29%	14.29%	100.00%
Denmark	9.09%	18.18%	9.09%	27.27%	36.36%	0.00%	100.00%
Spain	11.11%	22.22%	0.00%	0.00%	22.22%	44.44%	100.00%
Lithuania	0.00%	0.00%	0.00%	55.56%	22.22%	22.22%	100.00%
Netherlands	0.00%	0.00%	7.14%	28.57%	28.57%	35.71%	100.00%
Total	3.51%	8.77%	5.26%	35.09%	24.56%	22.81%	100.00%

Appendix table 4.7 How do you think that adopting [the CSA] will affect energy use

Country	Large Dec	Moderate Dec	Small Dec	No Effect	Small Inc	Moderate Inc	Large Inc	Total
Germany	0.00%	7.14%	21.43%	42.86 %	21.43%	7.14%	0.00 %	100.00 %
Denmark	0.00%	18.18%	0.00%	18.18%	36.36%	18.18%	9.09 %	100.00 %
Spain	20.00 %	10.00%	20.00 %	20.00 %	20.00 %	10.00%	0.00 %	100.00 %
Lithuania	0.00%	0.00%	0.00%	71.43%	28.57%	0.00%	0.00 %	100.00 %
Netherlands	0.00%	7.14%	42.86 %	21.43%	7.14%	14.29%	7.14%	100.00 %
Total	3.57%	8.93%	19.64%	32.14%	21.43%	10.71%	3.57%	100.00 %

Appendix table 4.8 How do you think that adopting [the CSA] will affect water use

Country	Large Dec	Moderate Dec	Small Dec	No Effect	Small Inc	Moderate Inc	Large Inc	Total
Germany	0.00 %	7.14%	7.14%	71.43%	0.00%	7.14%	7.14%	100.00 %
Denmark	0.00 %	20.00%	10.00 %	60.00 %	10.00%	0.00%	0.00 %	100.00 %

Spain	0.00 %	20.00%	0.00%	60.00 %	20.00 %	0.00%	0.00 %	100.00 %
Lithuania	0.00 %	14.29%	14.29%	57.14%	14.29%	0.00%	0.00 %	100.00 %
Netherlands	7.14%	21.43%	28.57 %	28.57%	14.29%	0.00%	0.00 %	100.00 %
Total	1.82%	16.36%	12.73%	54.55%	10.91%	1.82%	1.82%	100.00 %

Appendix table 4.9 How do you think that adopting [the CSA] will affect biodiversity

Country	Moderate Dec	Small Dec	No Effect	Small Inc	Moderate Inc	Large Inc	Total
Germany	35.71%	7.14%	42.86%	0.00%	0.00%	14.29%	100.00%
Denmark	9.09%	18.18%	54.55%	18.18%	0.00%	0.00%	100.00%
Spain	0.00%	0.00%	55.56%	33.33%	11.11%	0.00%	100.00%
Lithuania	22.22%	22.22%	55.56%	0.00%	0.00%	0.00%	100.00%
Netherlands	0.00%	21.43%	71.43%	7.14%	0.00%	0.00%	100.00%
Total	14.04%	14.04%	56.14%	10.53%	1.75%	3.51%	100.00%