Project: 101060645 — BEATLES — HORIZON-CL6-2021-FARM2FORK-01

BEATLES
BEHAVIOURAL CHANGE TOWARDS
Climate-Smart Agriculture

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

D2.4 Field experiments v1

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:	30/06/2024
Due date:	30/06/2024
Work package leader:	University of Copenhagen
Start date:	Month 12
Dissemination level:	Public

Document History

Version	Date	Modifications made by
draft	13/06/2024	UCPH
Version 1	30/06/2024	UCPH

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Executive Summary

There are several barriers for adoption of climate smart agricultural practices or technologies (hereafter referred to as CSA). In the present experiments, we focus on barriers for non-adopters related to the lack of CSA-specific information. The objectives of these farmer field experiments 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 adoption behaviour for CSAs. Data are collected in five countries across Europe using short online surveys. Ten farmers from specific agricultural case sectors in each country are recruited: organic 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 deliverable D2.2 reports the set-up and status of the first field experiments. In this deliverable focus is on the objectives, hypothesis, design and methodology. Data collection for this part will be conducted between July and August 2024 (step 1) and data collection for step 2 will be carried out in November 2024 through to January 2025.

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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 1: 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 options for how to do that.

In the present study, we test an intervention that involves a survey that includes 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. We found no studies on the potential differences between short- and long-term effects of an intervention. 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 that 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 within this area have not been investigated to the knowledge of the authors, we found no studies involving farmers and only a few on consumers, there was little inspiration as to when to expect an effect of an intervention to differ from the immediate effect.

To investigate the long-term effects, we measure change in awareness and adoption at two different points in time. Introducing a time lag between the intervention and the second measurement of behavioural change had opened up for two tests. First, the longer-term effect of an intervention could be tested. Second, it 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. The farmers are informed that a second survey will be send out, but they are not informed about that it is a follow-up study – whereby they will behave as if the experiment had ended in the time period between the two surveys. Due to this time lag between the two steps in the experiment, stated self-reported behaviour regarding social networking can be used 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 is five months after the first questionnaire but the precise time period between the two steps will be determined after analysing the data from step 1.

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: Increasing relevant knowledge about a CSA will increase awareness and increase willingness to adopt the CSA.
- H2: Information about a specific CSA will increase interest in learning more about that CSA.
- H3: Informing about benefits of the CSA will increase CSA adoption behaviour
- H4: If farmers engage in social conversation about the CSAs, then the effect of the intervention will increase over time (oppositely if the farmers do not engage in social conversation).

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 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 five months (step 2).

An overview of the experiment is shown in Figure 1

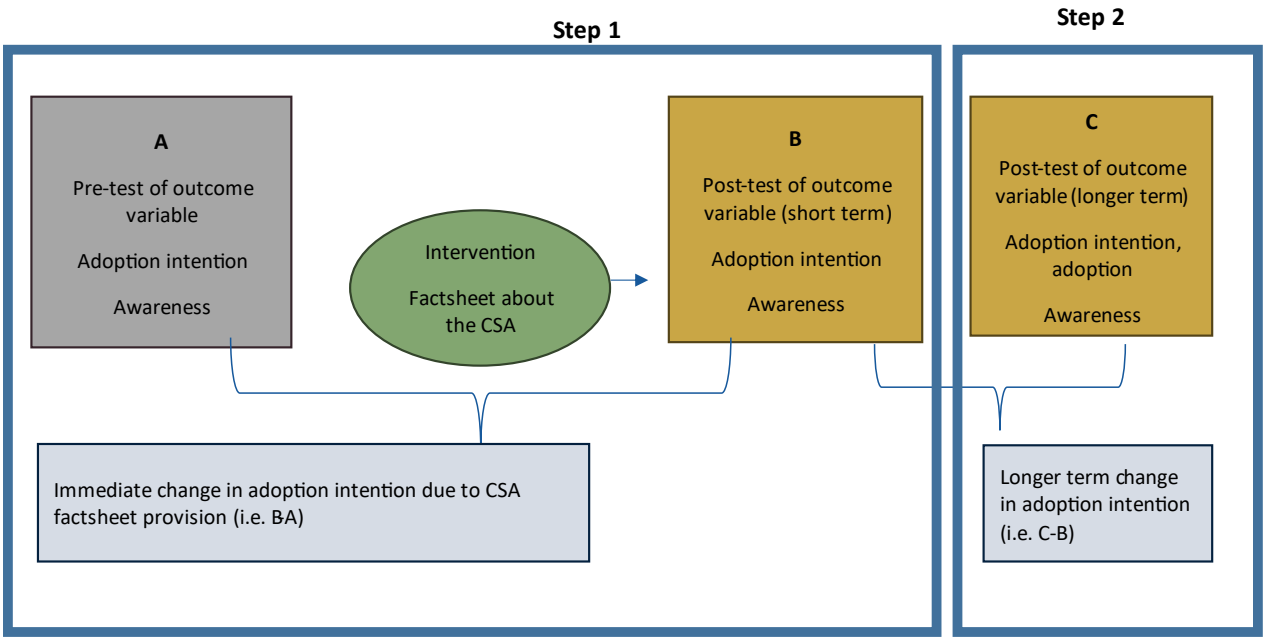

Figure 1: Overview of the pre-post-test design of farmer field experiment targeted non-adopters
Note: Step 1 involves 1) Pre-test of farmers´ awareness, attitude, and intention to adopt the specific CSA 2) Intervention: each farmer receives a factsheet about a specific CSA practice and 3) post-test of 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. The topics include short descriptions of 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 fact-sheets.

The two questionnaires are shown in Appendix 1 and the CSA information for all 10 CSAs are shown in Appendix 1 and 2.

2.2. Target farmers

The experiments were targeted farmers who had not implemented a certain 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 the two main outcome variables:
1) Farmers' awareness of a UC specific CSA
2) Farmers' adoption behaviour of a specific CSA

To capture awareness, we include two awareness variables (A1: awareness of a specific CSA and A2: awareness of climate impact of production in general). To capture adoption behaviour, we include three variables related to adoption behaviour, D1: intention to adopt within the next five years, D2: adoption planning (having carried out any adoption related activities such as searching the internet or social networking and D3: actual adoption).

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 a 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 have an effect on the effect of the intervention.

To capture longer term effects of the intervention, the same participants will be asked again similar questions related to the outcome variables after five 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 5 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.

The questions regarding outcome variables (adoption intention, awareness, attitude towards the CSA) are as far as possible identical across UC's so that only the specific CSA and information of [a specific CSA] differ.

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 2 CSAs chosen for each UC (out of the 5 CSA practices and technologies that are in focus in BEATLES*

UC	UC specific CSAs to be analysed
Denmark	1. Frequent discharge of slurry 2. **Acidification of slurry** 3. Use of biogas 4. **Green protein for feed** 5. Technologies for ventilation
Germany	1. Organic production (Naturland) 2. **Feed conversion to 100% forage**: feed from grassland and clover (no maize and grains) 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** 5. Agri-photovoltaic systems
Lithuania	1. Intercropping 2. No-tillage system 3. (Extensive) wetland management 4. **Solar energy** 5. **Variable rate fertilisation**
Spain	1. Cover crops 2. Floral bands 3. Grazing 4. **Organic farming**

	5. **Solar energy**
Netherlands	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 the experiments in WP2.

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 individual factsheets for the CSAs are shown in Appendix 2.

2.5. Data collection method

Data collection has been conducted online and set-up in Google form. The questionnaire will be distributed by the UC's using their network. The advantages of using this data collection option include:

- It allows us to focus on UC specific CSAs identified thereby allowing for regional differences and securing relevance for the UC's.
- Is 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 if 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. However, for some use-cases it may be necessary to use phone interviews or use printed questionnaires.

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.

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

Interventions (factsheets)	**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) Organic 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 – August 2024	November 2024 – January 2025

At the time of writing (June 27th) the status for data collection is that all UC's have received the online versions of the first questionnaire in their local languages including the factsheets. Next steps are to validate the local language used and start sending out questionnaires. The results of step 1 will be analysed in September and October 2024. The questionnaire in step 2 will be adjusted in October and November 2024 and data collection for step 2 will be carried out in November 2024 to January 2025.

2.6. Data analysis

The number of observations are expected to be up to 100 observations (2 observations from each participants). The data will be analysed qualitatively as well as quantitatively using descriptive statistics.

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Appendix

Appendix 1: Questionnaire 1 (Questions and purpose)

<table>
<tr><th>Text and questions</th><th>Purpose</th></tr>
<tr><td>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)</td><td>Intro text and consent</td></tr>
<tr><td>1. How much do you know about [a specific CSA]?
- Nothing
- Almost nothing
- A little
- Something
- A lot</td><td>Awareness before intervention</td></tr>
<tr><td>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</td><td>Adoption intention before intervention</td></tr>
<tr><td>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>
<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>
<tr><td>carbon emissions from production?</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>daily work load?</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>production costs?</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table>
</td><td>Awareness before intervention</td></tr>
</table>

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**

See all descriptions in Appendix 2

Intervention is intented 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 extend you agree or disagree with the following statements

	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								

Test of whether intervention has increased knowledge

CSA] was new									

5. **To what extent do you agree or disagree with the following statements?**

	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 information 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]								

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

6. What would it take to make it more likely that you would adopt [a specific CSA] ?

Information about other

<table>
<tr><td>Please write here …….</td><td>levers than information</td></tr>
<tr><td>7. To what extent do you agree or disagree with the following statement?
<table>
<tr><th></th><th>Completely disagree</th><th>Mostly disagree</th><th>slightly disagree</th><th>Neither nor</th><th>Slightly agree</th><th>Mostly agree</th><th>Complete-ly agree</th><th>Don’t know</th></tr>
<tr><td>It is not important for me that my production has a low climate impact</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
</table></td><td>To be able to place adoption intention of the specific CSA in the context of general interest in climate impact</td></tr>
<tr><td>8. Farm specific questions [questions about size of farm are UC specific – please insert relevant categories]

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</td><td>Farm and farmer specific info</td></tr>
<tr><td>13. Do you have anything to add about the questionnaire

Please write here …….</td><td>Allow general comments from participant</td></tr>
</table>

Appendix 2: Questionnaire 2 (preliminary)

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)

1. **Do you remember that you filled out a questionnaire about [a specific CSA] a few weeks ago?** Please tick off the category that suits best

Don't remember at all	Remember slightly	Remember to some extend	Remember clearly	Don't know

2. **How clearly do you remember the different parts of information about a specific CSA] ?**

	Don't remember at all	Remember slightly	Remember to some extend	Remember clearly	Don't know
The information regarding production costs of [a specific CSA] was new					
The information regarding environmental benefits of [a specific CSA] was new					
The information regarding the climate impact of [a specific CSA] was new					
The information regarding how many that use [a specific CSA] was new					

3. **Did you discuss the information about [a specific CSA] with any of the following groups?** Please tick off the groups you discussed with.

Farm advisor	Neighbours	Family members	Other farmers	Social media	Other	Don't know

4. **DIVIDE INTO 2 QUESTIONS (HAVE YOU SEARCHED AND IF YES, THEN WHERE)**
   Have you searched for other information about [a specific CSA] in any or more of the following places?
   Please tick off the sources you have searched.

Farm Magazines	Books	Journal papers	newspapers	Farm websites	Other	None

5. **To what extent do you agree or disagree with the following statements about the information that you received in the first questionnaire a few weeks ago?**

	Completely disagree	Mostly disagree	slightly disagree	Neither nor	Slightly agree	Mostly agree	Complete-ly agree	Don't know
The information has increased my interest in adopting [a specific CSA]								
The information has made it more likely that I will adopt [a specific CSA]								
The information has increased my interest in knowing even more and or discussing [a specific CSA] with others								
The information has increased my general interest in reducing climate impact								

6. Do you have anything to add about the questionnaire
Please write here …….

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 relying 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 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 CO_2 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 analyses 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 CO_2 emissions. In onion production, precision irrigation has been shown to reduce CO_2 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.