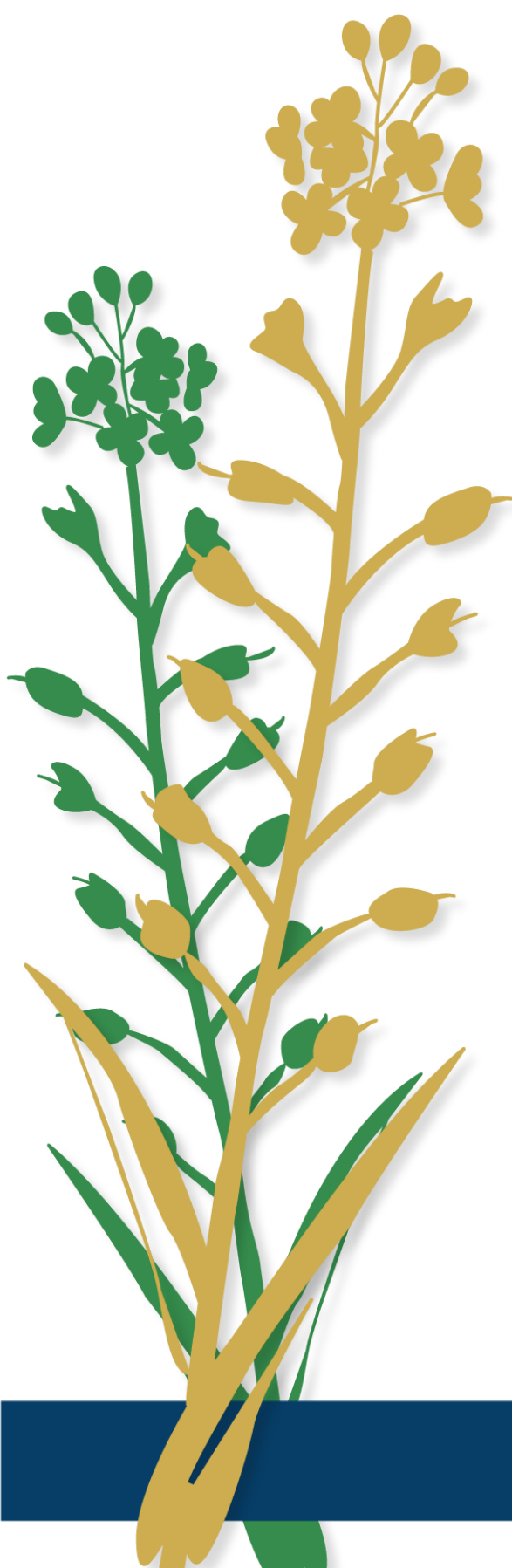


Data collection protocol

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Abstract

This document shows the data collection protocol to perform the sustainability assessment of different 4CE-MED cropping systems by applying life cycle thinking methodologies. Within 4CE-MED project, WP4 will select 3 countries and trials will be selected to compare the sustainability performance of current situations with the introduction of 4CE-MED cropping systems. The cases will belong to three major camelina cropping models presented in the project: Model A introduces Camelina to replace fallow in winter cereal sole-cropping systems, in marginal areas with very dry climate; Model B considers Camelina as a double-cropping cultivation in autumn, to precede typical Mediterranean summer crops; and Model C uses Camelina as a double-cropping in late spring/early summer in colder areas to follow winter pulses (e.g. pea) or cereals harvested as fodder. The selected cases would have followed the experimental protocol presented in WP2. This protocol is based on the Methodological framework to develop life cycle thinking assessment on 4CE-MED systems (D4.1).

A literature review was also conducted for this deliverable, which allowed to observe there is limited LCA, E-LCC and S-LCA studies of the Camelina crop in Mediterranean regions. Most of the information found is referred to the application of Camelina as biofuel, while some articles even highlighted that camelina is not used as food.

The definition of a goal and scope, expressed in the methodological framework for the assessment, expects to conduct a cradle-to-farm gate assessment with functionality based mostly on yield, and a perspective based on the crop succession. Functional unit is expected to be mass based, with derivations towards the environmental, economic and social impact categories of interest. The environmental dimension will refer to midpoint categories, with a consistent use as in most of the studies of Global Warming Potential, Eutrophication Potential and Terrestrial Acidification Potential. Regarding the economic dimension, cost categories, income and net margin will be observed, and the social dimension will include impact categories that range from endpoint to midpoint categories, where human rights, working conditions and community are to be addressed.

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1 Background and objectives of the Data Collection Protocol

The 4CE-MED project aims at developing Mediterranean innovative, diversified and resilient farming systems not competing for land with actual food chain by growing camelina as a cash cover crop or double crop. This is based on the fact that Mediterranean dry-farming systems mostly rely on sole-crop cereal production, due to a lack of other intercropping alternatives that are intensive in terms of agronomic inputs, and consequently highly impacting on the environment, and vulnerable to climate change. Conservation agriculture (CA) entails principles and benefits that could increase crop diversification while reducing soil erosion and nitrogen leaching, making Camelina a well-suited candidate to CA systems. Therefore, Work Package 4 (WP4) will assess the sustainability of the local tailor-made 4CE-MED systems through Life Cycle Thinking (LCT) approach composed by Life Cycle Assessment (LCA), Environmental Life Cycle Costing (E-LCC), and Social Life Cycle Assessment (S-LCA).

The general objective of W4 is to develop an integrated sustainability assessment by:

- Developing a dedicated methodological framework to perform a life cycle thinking assessment on innovative oilseed Mediterranean crops.
- Identifying and quantifying the impacts (economic, social, and environmental) of the proposed 4CE-MED systems on the cereal-based Mediterranean agro-ecosystem.
- Maximizing the positive impact of 4CE-MED systems through the provision of objective and comprehensive information regarding the main sustainability aspects (environment, society and economy) of the planned systems adopting a robust, consistent and science-based analytical framework.

The Data Collection Protocol, based on the Methodological Framework presented in Deliverable 4.1, includes data collection tools and related basic use guidelines, to lead aspects related to the responsible actors for that data gathering, calendar and guidelines for the filled instruments, among others, in close correspondence with the intended impact categories to address once inputs and outputs would be inventoried and assessed in coming tasks. This will aid in retrieving relevant information of the life cycle of the system and identify primary information availability and quality, as well as secondary information requirements. Once the framework is defined (Deliverable 4.2), as a second and final stage of this task, a validated and communicated data collection protocol with the rest of the team will be the base ground for assessment, allowing the WP to move into the subsequent tasks.

2 4CE-MED models and methodological approach

The three 4CE-MED innovative Camelina models, expected to be assessed for its sustainability, consist of:

- Model A: to be developed in Tunisia, Morocco, Algeria and Spain, this model entails the introduction of Camelina to replace fallow in winter cereal sole-cropping systems, in marginal areas with very dry climate.
- Model B: to be tested in Italy, Greece and Southern France, where Camelina is introduced as a double-cropping cultivation in autumn, to precede typical Mediterranean summer crops, e.g. sunflower, soybean, sorghum etc, in milder climate with adequate precipitation during summer.
- Model C: set in Northern France, where Camelina is introduced as a double-cropping in late spring/early summer in colder areas to follow winter pulses (e.g. pea) or cereals harvested as fodder.

Selected cases from the models will be assessed under the Life Cycle Thinking approach presented in the methodological framework of the Integrated sustainability assessment of 4CE-MED. As part of the steps of the LCT methods to be applied for the assessment, first the goal and scope are defined, as a cradle-to-farm gate of the system of cereal cultivation (and succession) assessment with functionality based mostly on yield.

Functional unit is expected to be mass based, with derivations towards the environmental, economic and social impact categories of interest. The environmental dimension will refer to midpoint categories, with a consistent use as in most of the studies of Global Warming Potential, Eutrophication Potential and Terrestrial Acidification Potential. Regarding the economic dimension, cost categories, income and net margin will be observed, and the social dimension will include impact categories that range from endpoint to midpoint categories, where human rights, working conditions and community are to be addressed.

3 Data collection protocol sections

The protocol is structured in a Microsoft® Excel file consisting of 5 worksheets, an introductory sheet containing the index of the corresponding sections and basic indications sheet to address as general guidelines before initiating the data collection.

The first introductory sheet summarizes the highlights of the assessment, based on LCT and the corresponding methods. Then, the following are the sections of the data collection protocol:

- Basic Indications
- Trial description
- Current/Baseline cereal crop
- Camelina crop
- Succession cereal crop
- Stakeholders-related data

Since there is a cropping system perspective within the assessment, the inputs and outputs data collection sections, namely “Current/Baseline cereal crop”, “Camelina crop” and “Succession cereal crop” are separated in order to obtain data from the full succession cropping system. Sections 3.3 ,3.4 and 3.5 will mostly support

the required data for the environmental and economic dimensions of the assessment, while section 3.6 will provide data for the social and socio-economic dimension.

3.1 Basic indications

A list of nine indications to initiate the data collection are presented in the second sheet, and reported ahead:

- 1 All inputs and outputs are to be considered, according with crop management techniques to be assessed. It is advised to include additional inputs or outputs that are considered as relevant by the person in charge of the data collection, even when not mentioned in the spreadsheets of this deliverable. In that case, insert rows when necessary.
- 2 System boundaries are set from cradle-to-farm gate, therefore the inventory shall include all inputs and outputs of the operations within those system boundaries.
- 3 The assessment is foreseen as consequential; this means it is important to keep close track of materials or processes that would be substituted by Camelina, or the increased or decreased needs of certain inputs in regards to current practices after introducing Camelina; therefore, a close look of the current situations is required as well (both at field and macro levels for technical, environmental, economic and social dimensions). This is the reason for presenting similar spreadsheets, one related to the usual pre-camelina cereal, another for the camelina cultivation, and one more for the post-camelina cereal.
- 4 For social and environmental benefits a potential ecosystem service evaluation (willingness to pay). Any potential information partners could add as knowledgeable of their context will be useful.
- 5 Please, always add the units of reference. Examples of the usual units for each input or output item are placed in the spreadsheets; however, if the person in charge of data collection uses different ones, the specification is required so that proper calculations or conversions can be applied for the inventory analysis and impact characterisation phases. Whenever possible, use data also in reference to area (ha), indicating the number of affected area.
- 6 There should be one excel file per trial, therefore, it is important to carefully look into all of the spreadsheets and complete the required information.
- 7 Responsible parties for each trial should send one inventory per trial to WP4 partner in charge of this task T4.3 Inventory.
- 8 Each time a complete cycle of cropping (baseline crop-camelina-succession crop) is finished, the completed file should be submitted. The deadline for T4.3 is established at Month 30; however partial advancements are preferred periodically upon request of the responsible partner for this task. This will allow to review the data collection tool and consider limitations or further adjustments.
- 9 Sections in grey colour are the ones to be used to fill-out with the collected data from each trial. The remaining different colours are used only to highlight sections or specifically explained in the spreadsheets.

Additional contact information is provided in case users have questions or feedback for the task leaders, WP4 leaders and partners.

3.2 Trial description

A general description per trial is required for proper organization of the data and further analysis. The spreadsheet consists of the following structure and content:

TRIAL DESCRIPTION			
Partner in charge			
	(name)		
Contact information			
	(name)	(e-mail addresses)	(other contact info)
Location of trial			
	(Country)	(Region or area)	(coordinates)
Description			
	(climate, geography, demographics)		
Trial variables			
	(name, description, units)*add as many rows as necessary		
Qualitative description			
	(description)		

3.3 Current/Baseline cereal crop

This spreadsheet aims at collecting data to construct the inventory (inputs and outputs) of the current cereal that is used in the area of the trial. It begins with a basic heading, and then specific sections for each stage of the life cycle of the cereal. The following is a view of the heading:

BEFORE COMPLETING THE TABLE, IDENTIFY THE COST BEARERS (note that we used euros to simplify, but you are free to use your local currency)

BASELINE CEREAL CROP
Cereal (crop) name: _____ Area (in ha): _____ Timeframe (dates from sowing to harvest) _____

Brief description of the crop, such as size, type of irrigation, seasonality, etc.	<i>ITALY: Rainfed winter cereal (wheat/barley) - summer cereal (corn/sorghum) based systems in both areas</i>	
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A distinction is made in green colour to indicate data that would be preferred to obtain but not strictly necessary. The next pages present the view of the life cycle stages sections to be completed.

Life cycle stages	CURRENT SITUATION solutions - ONE SECTION PER CROP	Unit (this might change according with your data availability, such as liter instead of kg)	(your data here)**add as many columns and rows you might need
(inputs)	Purchasing or land rental Material description 1: For example: pipe for irrigation 1, type, material, origin, cost, brand or model, commercial name Material description 2 Material description 3... Machinery involved: excavator, tractor, etc. Relevant information here shall include years of the machinery, model, horse power, km and type of fuel utilized, as well as the specification of the use of that machinery: land preparation, sowing, any other in this early cropping stage Number and cost of seeds Personnel: Workforce Other	€/year/ha €/unit and num/ha €/unit and num/ha €/unit and num/ha description of traits L/km and number of km/ha €/kg of seeds/ha/yr €/ha or €/production cycle or €/year hours/person per day, week, or production cycle gender type of tasks description origin-local or migrant units you might already use (describe method and add reference)	

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<p>Production and harvesting (inputs)</p>	<p>Energy consumption and precise type of energy source (fossil fuel, biofuel, renewable source, etc) Reason or area where that energy is used for Water consumption (amount and source) If data for water consumption is not available indicate if irrigation is used or not. If it is used, describe technical characteristics of the system (source, type of dripper or splasher, pumping equipment and capacity, hours used/productive cycle)</p> <p>Personnel: Workforce</p> <p>Machinery involved- technical info: tractor, etc. INCLUDE IF RENTAL OF MACHINERIES IS NEEDED. Relevant information here shall include years of the machinery, model, horse power, km and type of fuel utilized, as well as the specification of the use of that machinery: maintenance of crop, irrigation, pest control product application, or any other in this stage</p>	<p>kwh/yr/ha/ and € /yr/ha/ describe m3/ha and €/yr or €/ha description and data €/ha or €/production cycle or €/year hours/person per day, week, or production cycle gender type of tasks description origin-local or migrant L/km or L/ ha and €/km or €/ha</p>	
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Fuel consumption -in the case of additional engines or pumps (specify type, source and place of origin)	L/ ha and €/km or €/ha	
OPEX	€/yr	
Pesticides (Precise trade name, quantity of each product and unit price, as well as origin and packaging type)	€/unit and num of units/ha (units as in kg, L)	
Fertilizers (N, P, K input + liming materials, specify if providing quantity from the trade product or final active ingredient, if possible provide formula and origin)	€/unit and num of units/ha (units as in kg, L)	
Herbicides (Precise trade name, quantity of each product and unit price, as well as origin and packaging type)	€/unit and num of units/ha (units as in kg, L)	
Rate of nutritional removal or recovery	kg/ha or kg/m ³	
Rate of pesticide removal	kg/ha or kg/m ³	
Erosion rate/soil coverage (such as: https://sciencing.com/calculate-erosion-rate-6118473.html)	kg/yr/ha	
Transport of crop to farm gate if apply (type of vehicle) - and cost correspond to the distance between plot and farm? + transport of crop to collecting agency/storage organization (country elevator)? if the culture is not developed in the region, transportation to collecting agency/storage organization or processor can be (very) long.	km/ha and L of fuel/yr or ha and €	
Other	units you might already use (describe method and add reference)	

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Harvest (inputs)	Personnel: Workforce	€/ha or €/production cycle or €/year hours/person per day, week, or production cycle gender type of tasks description origin-local or migrant	
Outputs	Crop yield and market price Seeds sold Biomass production and how it is managed - biofuel? Waste? Bioproducts: type, amount Waste Disposal system for waste (distance, responsible party, etc) Losses: water filtration, seeds or pesticides (due to atmospheric or other natural phenomena) for example, indicator of water quality (nitrate, phosphorus, residue of pesticide)	€/kg/yr and kg/ha/yr and € (cost or revenue) €/kg/yr and kg/ha/yr and € (cost or revenue) €/kg/yr and kg/ha/yr and € (cost or revenue) description and data €/kg/yr and kg/ha/yr and € (cost or revenue) description and data €/kg/yr and kg/ha/yr and € (cost or revenue) description and data €/kg/yr and kg/ha/yr and €(cost or revenue) description and data	
	opportunity/valorisation of the product and quantity for each market Other	description and data units you might already use (describe method and add reference)	

3.4 Camelina crop

This section will have the same basic view as section 3.3, except for the heading as presented ahead.

BEFORE COMPLEATING THE TABLE, IDENTIFY THE COST BEARERS (note that we used euros to simplify, but you are free to use your local currency)

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CAMELINA CROP	
<i>Cereal (crop) name:</i>	CAMELINA, VARIETY:
<i>Area (in ha):</i>	
<i>Timeframe (dates from sowing to harvest)</i>	

3.5 Succession crop

This section will have the same basic view as in section 3.3, and expects to collect the data from the succession crop (same as the baseline) after camelina was introduced in the system, to allow the observation of differences in the amount or type of inputs needed as well as outputs.

3.6 Stakeholders-related data

This final section of the data collection protocol collects, through a series of open questions, data regarding five groups of stakeholders. The following chart provides an overview of this section, which will be repeated for these stakeholder groups: farmers, community, consumers, research centres and workers. A brief description of each accessed stakeholders, number of participants and the method of interview is requested.

<p>Indicators - here it is in positive but it must be also in negative as SLCA assess both</p>	<p>(responses here)**</p>
<p>Does the scenario improve social (community) development? And how? Does the scenario improve workers/farmers wage or labour conditions? Does the scenario improve consumers' access to food? And how? Does the scenario improve food quality? And how? Does the scenario improve community health? And how? Does the scenario improve community wellbeing? And how? Does the scenario reduce vulnerable groups' gap? And how? Does the scenario improve community/farmers' engagement? And how? Does the scenario improve economic development? And how? Does the scenario improve knowledge sharing? To whom? And how? Does the scenario reduce gender gaps? And how? Does the scenario promote local work? And how? Does the scenario improve water quality? And how? Does the scenario improve profits for the farmer? How much? Does the scenario improve the quality of the soil? And how?</p>	

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