D1.1

D1.1: Description of CARINA Lighthouses

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1. Executive summary

One of the objectives of CARINA is to demonstrate that more diversified cropping systems including either camelina or carinata are resilient, easy to adopt, productive, and environmental and economically sustainable. The workpackage 1 (WP1) of CARINA is entitled “Designing and implementing innovative and sustainable farming systems”. Its main objective is to design and implement new site-specific primary farming systems including either camelina or carinata on farm-scale. In CARINA, social innovation is a central aspect of the project's operation, thus new farming systems will be created using a bottom-up app with farmers and local advisors in entities called “lighthouses”.

This deliverable aims at describing the creation process and functioning of lighthouses in CARINA. The lighthouses are “innovation containers” developed by farmers and advisors to gather success stories obtained from demonstration fields testing innovative cropping systems including either camelina or carinata. There will be 9 lighthouses in total in CARINA, one per country involved in the project (France, Italy, Spain, Greece, Serbia, Morocco, Poland, Bulgaria and Tunisia). The innovative cropping systems will be built from regional co-design workshops. Methods and practices available to co-design farming systems have been widely described and proved successful in former European projects. WP1 partners will adapt the methodology presented during a specific training in Paris to their situation and follow a minimum set of steps:

- Description of the main constraints of the reference system
- Description of the innovative system objectives
- List of agronomic levers available and their combinations
- Description of the cropping systems designed.

Ex-ante assessments will be performed by partners, when possible, to explore different scenarios and improve the innovative cropping systems over time. Innovative and reference cropping systems will be implemented in demonstration fields whose number per country will vary depending on the possibilities offered to the partners. Demonstration fields will be set on large fields (> 0.5 ha) to allow use of farm equipment and mimic farming conditions. Success stories will be analysed from the results of the demonstration fields. Target indicators would have been identified with farmers.

It is important to keep in mind that the wide diversity of situations encountered in CARINA in terms of experience, pedoclimate and socio-economic conditions will require some flexibility in the way the co-design workshops and lighthouses are conducted. WP1 leaders will make sure that all partners have sufficient information to efficiently manage their co-design workshop and lighthouses throughout the project duration.

2. Introduction

One of the objectives of CARINA is to demonstrate, at local level, that more diversified cropping systems including either camelina or carinata are resilient, easy to adopt, productive, and environmental and economically sustainable.

Camelina (*Camelina sativa* L. Crantz) and carinata (*Brassica carinata* L. Brown) are oilseed crops that have proven to be suited to nearly all European pedo-climatic conditions. They can be inserted into cropping systems in different ways, as mono-, inter- or relay-crops and be grown as cash- or cover-crops. Both species have high similarities to the widespread oilseed rape in term of vegetative habitus and crop management which should ease the process of adoption by farmers. In CARINA, given the objective of producing low-iLUC feedstock and improving productivity, camelina and carinata will be grown as inter or relay-crop, i.e., in addition to another cash crop in the same field and year. This should contribute to an increased revenue for farmers compared to their local reference. In addition, the increase in the number of species grown in the field should also result in the well-known environmental benefits of increased soil cover and functional biodiversity.

The workpackage 1 (WP1) of CARINA is entitled “Designing and implementing innovative and sustainable farming systems”. Its main objective is to design and implement new site-specific primary farming systems including either camelina or carinata on farm-scale. In CARINA, social innovation is a central aspect of the project's operation, thus new farming systems will be created using a bottom-up app with farmers and local advisors in entities called “lighthouses”.

This deliverable aims at describing the creation process and functioning of lighthouses in CARINA.

2.1 Definition

The **lighthouses** are “innovation containers” developed by farmers and advisors to gather **success stories** obtained from **demonstration fields** testing innovative cropping systems including either camelina or carinata. It will be in fact a network of actors concerned with the cultivation of these crops. The innovative cropping systems will be built from **regional co-design workshops (**

Table 1**)**. There will be 9 lighthouses in total in CARINA, one per country involved in the project (France, Italy, Spain, Greece, Serbia, Morocco, Poland, Bulgaria, and Tunisia).

Table 1 Participants, frequency and objectives of the co-design workshops, demonstration fields and lighthouses

	Co-design workshop	Demonstration field	Lighthouse
Participants	Farmers, advisors	Farmers, advisors	Farmers, advisors
Frequency	2 per year including field visit	As much as possible with good conditions	1 per year
Objectives	**Identify:** - reference cropping system; - main constraints of the reference system; - objectives of the innovative system; - library of solutions. **Design:** - new cropping systems including camelina and Carinata.	**Test:** - both the reference and innovative systems including double cropping systems, intecropping and production on marginal land.	**Identify:** - success factors from demonstration fields; - issues from regional workshops; - share and transfer the success factors.

2.2 Objectives

The main objective of a lighthouse is to spread success stories of innovative cropping systems including either camelina or carinata among farming communities. Success stories will emerge from concrete observations obtained in demonstration fields within a specific country and from the analysis of the issues and solutions identified in co-design workshops. Therefore, the knowledge shared within a lighthouse will be primarily agronomic and economic.

Farmers and advisors participating to the lighthouse will identify success factors for the innovative cropping systems. Given the scope of CARINA, successes will be achieved through improved economic, social, and environmental performances discussed in the regional workshops. However, the definition and the level of the factors will depend on local pedoclimatic and socio-technical contexts, which greatly vary between countries involved in the project.

In CARINA, learnings acquired in lighthouses will also be used in living and policy innovation labs (WP4 and WP5).

Given the innovative approach to the farming systems and the relatively limited experience of farmers with the camelina and carinata, it is likely that some experiments will end in failures, especially in the first years. However, the co-design workshops will have to identify the reasons of

the failures and improve every year, as far as possible, the farming practices to obtain the success stories that will be shared at the lighthouse level.

2.3 Lighthouse functioning

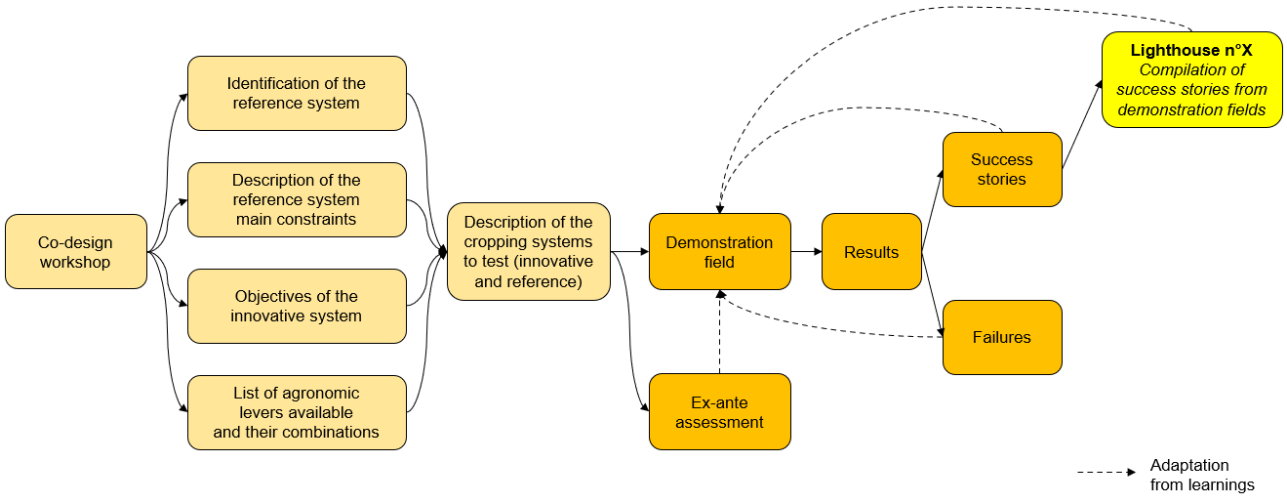

Figure 1 CARINA Lighthouse concept

As stated in 2.1, there will be one lighthouse per country involved in CARINA. The core of the lighthouse is the demonstration fields that will emerge from co-design workshops (Figure 1). The number of demonstration fields per country will depend on the possibilities offered to the partners.

2.3.1 The co-design workshops

The co-design workshops aim at **creating innovative cropping systems** adapted to their local pedoclimatic and socioeconomic contexts, which include either camelina or carinata and that have **improved sustainability performances compared to their local reference**. Methods and practices available to co-design farming systems have been widely described (Reau et al., 2012; Meynard et al., 2012) and proved successful in former European projects (e.g., in H2020 DiverIMPACTS, see for instance, "Co-designing innovative cropping systems through long-term on-farm experiments", https://zenodo.org/record/6488766#.ZEfpU3ZByUk).

To adopt a common approach in WP1 regarding lighthouses design, a 2-days training was organised for WP1 partners in Paris on the 14th and 15th of February 2023. The training was made by the WP1 leaders (Arvalis). The objectives of the training were to:

- develop a common understanding on lighthouses and co-design workshops;
- share knowledge and methods on co-design of cropping systems;
- introduce partners to the use of the SYSTERRE tool to collect data for the integrated assessment of cropping systems in CARINA.

Co-design workshop methodology requires trained facilitators to be successful. Partners cannot be expected to master it in such a short time if they do not know it first. Also, partners may not have sufficient resources (e.g., local network of farmers or time) to follow a comprehensive co-design methodology for every demonstration field planned. Therefore, partners will adapt the methodology presented during the Paris training to their situation and follow a minimum set of steps. This should ensure sufficient consistency in lighthouses methodology.

The co-design workshop will **involve farmers and advisors.** It will be **organised and facilitated by the CARINA local partner**. The **amount of people per workshop should not exceed 8-10** to

ease discussions. CARINA local **partner will set-up and maintain the network of participants** throughout the project.

It is important to follow several principles in co-design workshops:

- A workshop is a participatory meeting;
- The farmers design the ideas, and the technicians accompany them;
- There are no good or bad ideas: there is no self-censorship, no judging of others' ideas.

The facilitator has a key role in the process as he or she is responsible for:

- the framework and the smooth running of the workshop and;
- the creation of a positive ambiance that enhance creativity, making sure that all participants have had a chance to speak = "talking stick" manager.

If possible, it is recommended that the CARINA local partner gathers different profiles at the co-design workshop to get the most of the discussions:

- Facilitator (local CARINA partner)
    - Organizes the collective activities;
    - Distributes the tasks;
    - Ensures the smooth running of the design activity.
- Change leader (inventor)
    - Leads the group towards new ideas;
    - Encourages the exploration of possibilities.
- Localized knowledge scientist
    - Gathers knowledge on current system in the context studied;
    - Ensures the consistency of agricultural practices, technical results and context and the consistency and feasibility of the proposed new cropping systems.
- Exploratory knowledge scientist
    - Brings together the knowledge and know-how already available or about to be developed;
    - Proposes new paths (agronomic concepts, reference techniques).
- Evaluation operator
    - Carries out the evaluation from the description of the prototypes;
    - Helps analysing the context and the priorities and defines the framework of the assessment

The following sub-parts describe the minimum set of steps that partners will achieve for the co-design workshops.

Identification of the reference cropping system

Table 2 Description of the reference cropping system

Reference system information				
General information	Country	**…**		
	Localisation	**…**		
Pedoclimatic context	Climate	**…**		
	Soil type	**…**		
	Average annual rainfall (mm)	**…**		
Farm context	Location	**…**		
	Type of farm (arable, livestock)	**…**		
	Size (ha)	**…**		
	Workload (full time equivalent)	**…**		
	Tillage used (none, surface, plough)	**…**		
	Most common crop rotation	**Crop 1**	**Crop 2**	**Crop n**
	Average yields (t / ha)	**…**	**…**	**…**

- First step of co-design is to **define the characteristics of the reference system** and the issues that the innovative system should solve to improve performances;

- Table 2 is an example of descriptors of the reference system. Partners will adapt them to their situation.

Description of the main constraints of the reference system

A second step consists in identifying issues of the reference cropping system: technical issues (agronomic, pedoclimatic, …), economic (profitability, competitiveness, …), environmental and organisational issues (regulation, diversification, workforce organisation, …), (Table 3).

Table 3 Example of cropping system issues

Main constraints			
Technical	**Policy**	**Economical**	**Environmental**
Weeds (type of weed)	Soil coverage	Competitiveness	Pesticide pressure
Desease	Diversification target	Profitability	Soil nitrogen residual content
Pests	**…**	**…**	**…**
Fertility			
Erosion			
Organic content			
Water balance			
…			

Description of the innovative system objectives

In CARINA, Camelina and B. Carinata can be grown in 3 different ways:

- cash cover crops to allow double cropping with typical primary crops;
- intercropping with food crops;
- main crop in marginal land.

Table 4 Innovative system objectives

Criteria	**Indicators**	**Target value**
Economic	Gross product (€ / ha)	≥ reference
	Yield (t / ha)	≥ reference
	…	…
Social	Workload	= reference
	…	…
Environmental	Greenhouse gases emissions (kgCO2eq / ha)	< reference
	Mineral nitrogen use	< reference
	Pesticide use	< reference
	…	…

Once the reference system is described with its issues, the participants must set targets for the innovative cropping system (Table 4). Targets should belong to all three dimensions of sustainability, i.e., economic, social and environmental.

Table 4 is an example of indicators and target values that will be used to monitor the performances of the cropping systems. Partners will adapt them to their situation.

List of agronomic levers available and their combinations

Table 5 Library of possible solutions for the innovative cropping system

		Expected impacts on the objectives of the innovative cropping system					
Function	**Solution**	**Gross product**	**Yield**	**Workload**	**Mineral nitrogen use**	**Pesticide use**	**…**
Add nitrogen	Use legumes cover crops			X			
Reduce tillage	Use direct sowing						
Produce biomass	Use multiple cropping	X	X				
Reduce weed pressure	Increase soil coverage					X	
…	**…**						

After defining indicators to monitor performances, participants will have to work on solutions to use in the innovative cropping system. The solutions must consider all the indicators mentioned in the previous step (Table 4).

Table 5 is an example of solutions to implement in order to improve the performances of the innovative system. Partners will adapt them to their situation.

Cropping systems designed

Different tools or animation methodologies could be used depending on the habits of the partner country. This part aims at building new cropping systems including camelina and B. Carinata. Innovative crop rotations and crop management of each crop will be described for a first analysis (Table 6). These crop rotations will be compared and discussed before their implementation in demonstration fields.

Table 6 Description of the innovative system to test

Innovative system			
Size (ha)			
Tillage used (none, surface, plough)			
Crop rotation	**Crop 1**	**Crop 2**	**Crop n**
Target yields (t / ha)			
Target fertilisation use (kg / ha for each element)			
Target pesticide use (kg or l / ha for each product)			

2.3.2 Ex ante assessment

Ex-ante assessment is an integrated assessment that allows to compare the performances of arable cropping systems by considering the economic, social and environmental dimensions of sustainability. This method is an interesting way to evaluate cropping systems designed before their implementation in demonstration fields. Results of this assessment are also a tool that allows farmers

to adapt their cropping system. This assessment could be carried out after a first workshop and presented in a second to adapt and perform the systems.

An ex-ante assessment can be done using Systerre. In the Paris training, partners were introduced to the use of the SYSTERRE tool to collect data for the integrated assessment of cropping systems in CARINA, including ex-ante and ex-post assessments. As for the co-design workshop methodology, partners will not have the resources to perform ex-ante assessments on all demonstration fields. They will select the most suitable demonstration field, in terms of availability of data and high success potential to perform the ex-ante analysis. An advantage of the use of Systerre is that once a cropping system is registered, it is easy to modify parameters, such as yields or prices and that allow to explore different scenarii. Consequently, it should be possible for partners to perform ex-ante analysis throughout the project duration.

2.3.3 Demonstration fields

Demonstration fields will be set on large fields (> 0.5 ha) to allow use of farm equipment and mimic farming conditions. Reference and innovative systems could be grown in strips on the same field to allow fair comparisons of performances. Camelina and Carinata fields could also be grown in specific fields and compared to a reference cropping system managed in the farm. If possible, partners may add plots to assess the impacts of both systems on soil erosion, nutrient cycling, water storage or other ecosystem services of interest.

Cropping systems will be managed as:

- double cropping (T1.2), including relay cropping.
- intercropping (T1.3)
- whole crop in marginal land (T1.4)

Visits will be organised in the frame of workshops and for any other opportunity to share good crop management.

Visits could be organised during the first in order to structure co-design workshop and develop farmers netwok mainly for new crops such as carinata.

2.3.4 Success stories

Success stories will be analysed from the results of the demonstration fields. Target indicators would have been identified with farmers (Table 4). Other agronomic parameters could complete this analysis: plant density, yield, weed and pest pressure…

Ex-Post assessment

An ex-post assessment will be carried out with the demo field conditions and the indicators compared to the target. This assessment will be a tool to discuss with farmers about the ways to improve the systems. The criteria for the ex-post assessment will be site-specific in terms of indicators and target values (Table 4), considering the wide range of situations explored in CARINA. The results of the analyses will be presented and shared by partners, farmers and advisors into the annual lighthouse and field visit. Note that the data acquired in the WP1 will be used in WP3 for the Carina integrated assessment. Adaptation of the chosen indicators and target values for the ex-post assessment in WP1 will part of the T3.1 and T3.5.

3. Work organisation and agenda

First co-design workshops will be organised by partners as soon as possible also considering B Carinata lack of knowledge. The aim is to maximize farmer's involvement. **Group of farmers could be organised in one or different areas**. This **network of each partner will be completed all over the project**.

Regional workshops and national lighthouses will be moderated by local partners. A leader will moderate discussions, time and steps of these meetings. A monitor will support him to register outcomes of the discussions.

Regional workshops will be organised t*wice a year, mainly in the first 2 years of the project.*

As living entities, the lighthouses will develop throughout the project informal interactions among their members. However, at least one formal meeting will be held at the national level per year, and more if necessary. The 1st one will be organised until 2024.

Table 7 Agenda of WP1 CARINA's first year

Agenda	Event	Outcome
Spring 2023 to Autumn 2023	1st co design workshops and / or National Lighthouse	Baseline cropping system, issues, target indicators, library of solutions, prototype of cropping system Choice of the demonstrated cropping systems for 2023/2024
Summer 2023 – Winter 2023	1St Round of ex-ante assessment	Collect of data Assessment of prototypes
Autumn 2023 – Winter 2023/2024	1st National lighthouse carried out Second workshop	Field visit for the emergence First year results (2022/2023) + assessment Adaptation of the cropping systems
Spring 2024		1 National lighthouse carried out + 2 regional workshops

-

All the tables 2, 3, 4, 5, 6 will be adapted, filled in by the partners during workshops and stored into the drive of the project to carry out the analysis of success factor.

4. Conclusion

Demonstration fields and lighthouses are at the core of the CARINA project as they will provide the data about the performances of innovative cropping systems including either camelina or brassica carinata and the material for the tasks of other workpackages (e.g. WP2). The methodology implemented in WP1 for the co-design of the innovative systems, based on scientific evidence and former H2020 European project DiverIMPACTS will increase the chance of success of the lighthouses. However, it is important to keep in mind that the wide diversity of situations encountered in CARINA in terms of experience, pedoclimate and socio-economic conditions will require some flexibility in the way the co-design workshops and lighthouses are conducted. WP1 leaders will make sure that all partners have sufficient information to efficiently manage their co-design workshop and lighthouses throughout the project duration.

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