D4.3

Policy needs in the countries with demonstration fields

Policy challenges and opportunities for bio-based value chains in Europe: insights from 10 Policy Innovation Labs

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ABBREVIATIONS

ACEMs	*Agri-environment-climate measures*
CAP	*Common Agricultural Policy*
ESCA	*Emission Savings from Soil Carbon Accumulation*
EU-ETS	*EU Emissions Trading System*
GAEC	*Good Agricultural and Environmental Conditions*
iLUC	*Indirect Land Use Change*
PIL	*Policy Innovation Lab*
RED	*Renewable Energy Directive*
SAF	*Sustainable Aviation Fuel*

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Executive summary

CARINA project focuses on new sustainable and diversified farming systems including two new intermediate oilseed crops, camelina (*Camelina sativa L.)* and carinata (*Brassica carinata L.),* able to provide multiple low iLUC feedstocks for the bio-based economy. To facilitate the deployment of innovative systems, through the activities of Work Package 4 (WP4), the project also aims at developing policy recommendations and unveiling synergies in sectoral strategies for the provision of certified low iLUC feedstock for bio-based value chains.

The results described in this deliverable (D4.3) includes the insights emerged from the 10 Policy Innovation Labs (PILs) conducted in all the countries involved in the CARINA project (Italy, France, Spain, Bulgaria, Germany, Serbia, Poland, Tunisia, Greece and Morocco). They brought together various stakeholders from different countries and contexts for the identification of policy gaps and opportunities in the adoption of camelina and carinata.

These results are presented in the form of country factsheets, organised into two macro-groups according to the stage of development of the value chains for camelina and carinata. Each factsheet provides an overview of the existing policy context and a recap on the main challenges and opportunities emerged from the discussions, together with a broader analysis of the general European trends.

Insights from the Policy Innovation Labs were also connected to the main findings of the first version of the CARINA deliverable D6.6 – Policy Brief and a description on how the identified challenges and opportunities can be effectively addressed through the implementation of the proposed policies is provided.

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1. Introduction

CARINA is a cross-national 4-year long Innovation Action (01/11/2022-31/10/2026), supported by the European Union within the framework of the Horizon Europe programme.

The project focuses on new sustainable and diversified farming systems including 2 new intermediate oilseed crops, camelina and carinata, able to provide multiple low iLUC feedstocks for the bio-based economy. CARINA aims to demonstrate that increasing the diversification of cropping systems by adopting a well-thought and effective crop combination can enhance yield stability, farmers' revenue and the overall sustainability of farming systems, and, at the same time, to supplement the bioeconomy sector.

To facilitate the deployment of innovative systems, through the activities of Work Package 4 (WP4), the project will also aim to develop policy recommendations and unveil synergies in sectoral strategies for the provision of certified low iLUC feedstock for bio-based value chains.

Task 4.3 includes the organisation of 10 Policy Innovation Labs (PILs) in the project's countries with demonstration fields to engage stakeholders in the identification of policy gaps and opportunities, ensuring that the recommendations are practical, relevant, and aligned with sector needs, both upstream – farmers, seed producers, cooperatives – and downstream – transformation industry. PILs were identified as key tools for the codesign of a supportive EU policy framework for the adoption of camelina and carinata with all the relevant stakeholders.

Deliverable 4.3 (D4.3) aims to present the main results emerged from the implementation of this task contributing to the development of country policy factsheets and recommendations for the promotion of camelina and carinata as strategic low-iLUC feedstock. The following chapter provides an overview of the European policy landscape in the context of the CARINA project, with a specific focus on barriers and solutions which have been identified in relation to the adoption of camelina and carinata. In Section 3 the methodology used in the PIL is described, both for what concerns the implementation of the workshops and the framework to interpret results. In Section 4, the results for the 10 target countries are presented, focusing on the country-specific policy context, challenges and solutions. At last, Section 5 discusses findings by identifying common trends, trade-offs and lock-ins to inform the development of overarching policy recommendations.

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2. European policy context

2.1 Current policy framework

When examining the European policy landscape, it becomes evident that the cultivation of cover or intermediate crops like camelina and carinata can have a multifaceted impact on the environment, energy systems, and the rural economy. For this reason, the key EU policies affecting those different systems should be considered when seeking to forecast the transformative impact of adopting camelina and carinata. These policies include the Common Agricultural Policy (CAP), the Emissions Trading System (EU-ETS) (European Commission, 2023), the Nitrates Directive (European Commission, 2008), and the Renewable Energy Directive (RED) (European Commission, 2018).

The European Union's Common Agricultural Policy (CAP), covered in Regulation (EU) nr. 2021/2116 (2021), is a well-established and comprehensive policy aimed at supporting and regulating agricultural production, trade, and rural development within the EU. CAP provides financial assistance to farmers, promotes sustainable agriculture practices, ensures food security, and fosters rural growth and employment. Through direct payments, market interventions, and rural development initiatives, CAP seeks to balance agricultural productivity with environmental protection and social welfare objectives.

Within the CAP framework, there are two primary avenues for incentivising the adoption of cover and intermediate crops. Firstly, compliance with "Good Agricultural and Environmental Conditions" (GAEC), specifically GAEC 5 and 6, which focus on soil protection through the maintenance of permanent grassland and the establishment of minimum soil cover. Secondly, additional payments are available through CAP's "second pillar" for cover and intermediate crops that provide additional environmental or climate benefits, such as improved biodiversity or enhanced soil health.

The EU Emissions Trading System (EU ETS) covered in Directive nr. 2003/87/EC (2003), is the world's largest carbon pricing mechanism, established by the European Union to reduce Greenhouse Gas (GHG) emissions from industry and power sectors. It operates on a "cap and trade" principle, where a cap is set on the total amount of emissions allowed, and companies receive or buy emission allowances which they can trade with one another. Currently, emissions from agriculture are not included in the system, creating an imbalance where emission-heavy agricultural practices may gain a competitive advantage over low-emission systems.

The EU Nitrates Directive, covered in Directive nr. 91/676/EEC (1991) updated in 2008, is a legislation aimed at reducing water pollution caused by nitrates from agricultural sources. It sets limits on the application of nitrogen-based fertilisers, manure management practices, and other measures to prevent nitrate pollution in water bodies. The implementation of camelina and carinata as cover or intermediate crops could potentially contribute to meeting the objectives of this directive by serving as partial substitutes for nitrogen fertilisers. This alignment with the Nitrates Directive also intersects with both the EU-ETS and CAP, particularly in the context of CAP's goals of protecting bodies of water from agricultural pollution.

The EU Renewable Energy Directive (RED), covered in Directive (EU) 2023/2413 (2023), plays a pivotal role in promoting renewable energy in the EU by aiming to increase renewable energy use and reduce GHG emissions. EU Member States are required to develop national renewable energy action plans outlining their strategies for achieving these targets, including measures such as financial incentives, support schemes, and regulatory frameworks. The directive promotes the development and deployment of renewable energy technologies across the EU, contributing to energy security, environmental sustainability, and the transition to a low-carbon economy. On 14 March 2024, the Commission adopted a list of new feedstocks to be added to the RED Annex IX list of advanced and waste-based biofuels (European Commission, 2024a). This text significantly increases the number of feedstocks in the Annex, with the inclusion of i) Intermediate crops, such as catch crops and cover crops, and ii) Crops grown on severely degraded land. These crops are aligned with camelina and carinata crops as assessed in CARINA project. The Commission is developing a guidance to better define feedstocks included under Annex IX in an Implementing

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Regulation to enable their correct verification and certification. This guidance is expected to be published during 2025.

Lastly, on 6 December 2024, the Carbon Removal and Carbon Farming Certification (CRCF) Regulation (European Commission, 2024b) was approved. This is a voluntary certification which main aim is to establish a Union certification framework for permanent carbon removals, carbon farming, and carbon storage in products. This framework is designed to ensure transparency, reliability, and sustainability in carbon removal practices across the EU. This regulation supports sustainable practices in carbon farming, benefiting camelina and carinata crops by encouraging their use in carbon sequestration. Currently the methodology for CRCF regulation is being developed by the EC and start of certification is expected by 2026.

2.2 Overarching challenges

Within this complex policy landscape, many different challenges arise for camelina and carinata cropping systems: issues connected with competitiveness, legal requirements, technological readiness, and property rights are interacting with more structural challenges related to social and cultural factors and information distribution. An overarching analysis of the European context was performed in T4.1 and T4.2, analysing policy landscapes and certification monitoring, reporting and verification in biobased value chains. The key points from these two analyses are summarized below to help in framing the country-specific insights collected with the Policy Innovation Labs (PILs).

2.2.1 Competitiveness

The lack of competitiveness of innovative feedstocks like camelina and carinata is a key challenge to address. One important issue is that the positive externalities connected with these crops are not correctly rewarded. This mirrors an inherent difficulty in quantifying the total benefits of cropping systems due to the manifold benefits potentially provided and the high context-specific variability. Many of these benefits are also not immediate and can take whole or multiple growing seasons to come to fruition. When it comes to monetary payments through CAP, trying to shape systems to account for these benefits can be extremely difficult. For instance, the application process to receive CAP payments, in which the main incentives for adopting these new cropping systems lie, can be extremely complex and time-consuming, hindering farmers to resort to these sources of funding. Regarding the CAP, a key concern is the potential for farmers to abandon beneficial practices once CAP payments would cease, potentially reverting to environmentally harmful methods. Oftentimes CAP payments are framed merely as offsetting "negative costs", disregarding the long-term benefits of sustainable management practices.

This need is mirrored by the recent focus of the 2024 "Draghi Report" which highlights integrating digital innovation, greener agricultural practices, and strategic investments to ensure resilience and long-term productivity of the agricultural sector. This approach aligns with EU’s goals to enhance resource efficiency and reduce environmental impact, fostering a competitive edge for oilseed crops in global markets. Future prospects for European competitiveness in oilseed crops are expected to be shaped by sustainability-oriented policies within the updated Common Agricultural Policy (CAP) (European Commission, 2024c).

A pragmatic and easy to implement guidance for Voluntary Schemes, under the EU Renewable Energy Directive secondary legislation, would allow for the certification of significant volumes of intermediate crops. This would provide a significant incentive for these crops to scale-up across the European Union and provide clarity to farmers and the industry.

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2.2.2 Technology

The high investment costs of new technology, which could include new machinery, fertilisers, pesticides, represent an important challenge, coupled also with the need to adopt new management practices and behaviours. Without the needed upgrades, potential yields and profits could be lacking, therefore creating a negative feedback loop that could hinder this system's implementation. Also, although the potential of utilising camelina and carinata for biobased products is well acknowledged, high investment costs and competitiveness could hinder camelina and carinata adoption.

2.2.3 Property rights

Property rights, particularly in the context of land leasing, present another significant challenge. Farmers often lease land on a short-term basis, typically for a year. However, the benefits of implementing cover or intermediate crops often take more than a year to materialise. Convincing farmers to adopt these practices within such a limited timeframe can represent an important challenge.

2.2.4 Social and cultural factors

Some farmers are reluctant to innovate and collaborate. There is a prevalent distrust in the farming community towards new technologies and innovations, coupled with a mindset of sticking to traditional practices that have historically worked. Fostering a sense of community and cooperation among farmers is crucial for the adoption of innovative feedstocks such as camelina and carinata.

2.2.5 Information distribution

Despite the potential benefits, cover or intermediate crops are not a widespread practice yet, leading to a knowledge gap among farmers. Farmers may not be aware of the long-term benefits of these systems and view the costs as higher than they may be. Also with new innovative feedstocks, farmers may be unsure of their use in industry and supply chain. Even with the potential to have advisory boards to better educate farmers, there is currently a lack of qualified educators but even more importantly a lack of access and lack of trust in these services.

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3. Methodological framework

To identify and investigate needs and gaps with current policy approaches on topics related to feedstock provision and certification in CARINA bio-based value chains, ten Policy Innovation Labs (PILs) were established in Italy, France, Spain, Bulgaria, Germany, Serbia, Poland, Tunisia, Greece and Morocco involving different stakeholder categories.

3.1 Policy Innovation Labs (PILs)

Policy Innovation Labs (PIL) are defined as "approaches that adopt creative, design, or user-oriented perspectives" (Wellstead, 2020). This approach enables engaging and bringing together views and perspectives from various stakeholder groups to contribute more effectively to the development of policy recommendations. Advantaging of design thinking methods, PIL uses experimental approaches to test efficacy of policies providing evidence for policymaking by adopting a user-centric approach (Lee & Ma, 2020). This approach emphasises the importance of stakeholder engagement into the design process and ensures that policies are shaped from a wide range of different perspectives and grounded in the realities of those directly involved in or affected by them.

The organisation of the PIL focused on the identification of the main challenges and opportunities associated with the value chains of oilseed crops, with a special focus on the possible benefits of promoting camelina and carinata as environmentally friendly raw materials. These crops are, in fact, considered to be promising due to their adaptability to marginal soils, lower environmental impact and potential contribution to the development of a sustainable bioeconomy.

The activity was structured maintaining the focus on countries, while allowing localisation according to specific regional challenges. Each partner involved in the project conducted a PIL in the respective country, involving local experts according to a predefined format and thematic focus. Each country focal point – a partner of the CARINA project – adapted the format to meet the countries' specificities: moderators could engage experts via email, face to face or by posting a call for experts. After selecting experts from policymaking, academia, public administration, industry, non-governmental organisations (NGOs), and agricultural sector, moderators (country project partners) chaired the PIL – conducted in national language - and then elaborated minutes, translated in English to facilitate the analysis. Although the value chains for camelina and carinata are featured by different stages of consolidation across the target countries, it was deemed essential to include the various perspectives to ensure a comprehensive understanding of their potential and challenges.

The format of each PIL was designed as a multi-stakeholder expert consultation combining focus group with semi-structured interviews, divided into three distinct sessions:

- **Interactive session (45 min)**: participants were engaged in an open discussion addressing five key themes related to oilseed crops. This session aimed to elicit detailed stakeholder insights on challenges and opportunities within the value chains of oilseed crops, with particular attention to existing market dynamics, environmental impacts, and socio-economic factors affecting production and use.
- **Presentation session (10 min)**: a brief presentation was given on the specific challenges and opportunities associated with camelina and carinata, compared to the more diffused oilseed crop in the countries based the experience of CARINA project. These two crops were presented as alternatives to more widespread oilseed varieties, highlighting their potential benefits as strategic low-indirect land use change (iLUC) feedstocks.

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- **Feedback session (10 min)**: participants were asked to complete a survey using the Qualtrics platform. This survey aimed to collect stakeholder opinions and preferences, complementing the insights gathered during the interactive discussion. The results of the survey supported the analysis of stakeholder attitudes towards different policy scenarios and the feasibility of promoting alternative oilseed crops.

More details on the topics and questions covered during the Policy Innovation Labs can be found in the Annex A to this Deliverable.

For each workshop, in addition to the moderators, at least five experts were involved, each representing a key stakeholder category: i. policymakers, ii. academia or public administration, iii. industry representatives, iv. non-governmental organisations (NGOs), and v. farmers. This multi-stakeholder composition aimed to ensure a balanced representation of interests and expertise, fostering a holistic understanding of oil crop value chains from different perspectives.

The PIL approach was proved to be a robust framework for integrating stakeholder knowledge into policy-making processes (Lee & Ma, 2020). The results of these consultations were processed into country factsheets highlighting the specific policy context and the main challenges and opportunities related to innovative oilseed crops. This information provided useful insights for future policy recommendations able to contribute to a coordinated strategy to improve the sustainability and competitiveness of oilseed crop value chains in different regions.

Data collected from the interactive and feedback sessions in the PIL were extracted as individual text lines and a content analysis (Neuendorf, 2017) was performed. The concepts were categorised through an adapted STEEP (Social, Technological, Economic, Environmental, and Political) framework elaborated to assess the bio-based economy taken by Dace et al. (2024): the framework distinguishes among cultural, technical, economic, environmental, governance, and structural barriers and opportunities, and is aimed at supporting policymakers and practitioners in exploring, assessing, and improving existing policies.

4. Country factsheets

This chapter presents the outcomes of the 10 PILs.

The 10 PILs were organised into two macro-groups according to the stage of development of the value chains for camelina and carinata in the respective country: the first group gathers countries where the camelina and/or carinata value chains are more consolidated; the second those where the two crops' value chains are more incipient, but the oilseed crop sector is well established.

For each country, a factsheet based on the PIL results was developed providing an overview of the existing policy context and a summary of the main results emerged from the PIL discussion in terms of challenges and opportunities.

4.1 Countries with more consolidated value chains

As hinted above, this section explores the policy needs in the countries where the camelina and carinata value chains are more consolidated – namely France, Spain, Italy, Germany and Poland.

4.1.2 France

Policy Context

In examining the French policy landscape, a critical aspect emerged during the French PIL discussion is related to the "Good Agricultural and Environmental Conditions" (GAEC), EU standards included within the framework of the Common Agricultural Policy (CAP) to promote sustainable agriculture. Compliance with these conditions is critical for farmers to qualify for CAP payments, with GAEC 6 and 7 emerging as particularly vital for France. GAEC 6 pertains to maintaining soil cover during sensitive periods, while GAEC 7 mandates the cultivation of land in an agroecological manner. Notably, the latter requires a minimum land allocation of 7% to regenerative practices. Given the characteristics of camelina and carinata cultivation, it exists a potential to fulfil both requirements, thereby ensuring eligibility for CAP payments. However, despite these potential applications, challenges are still present, notably regarding farmers choosing to explore alternative practices to meet GAEC obligations. For instance, farmers may opt to leave portions of their land fallow or diversify their crops in other ways, viewing these options as simpler or more cost-effective. Consequently, there arises an opportunity to consider the inclusion of cover crops in the definition of fallow land, enabling farmers to meet fallow land requirements while still having the ability to gain profit from these innovative feedstocks. This approach allows for the continued use of potentially productive land that would otherwise be left fallow, thereby minimising any financial losses.

Main challenges

Stakeholders unanimously identified production as the most challenging stage in the value chain. Low productivity and insufficient research emerged as the primary concerns within this system. These responses are consistent with the novelty of this farming system and these crops, indicating a lack of understanding regarding their optimal integration.

Agronomic challenges featured prominently during the PIL. Some farmers reported a potential need for a high sowing rate to offset concerns about low productivity, while field trials show that more seeds per hectare would not unambiguously increase productivity. While swathing machine, classic

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cereals seeder and harvester are already adapted for cultivating camelina¸ new equipment would be needed. Additionally, farming practices and improved irrigation are essential for better crop emergence, all of which entail certain costs that may raise concerns among stakeholders. Crop performance may also vary depending on the region and the climate conditions (for example lack of precipitation at sowing, drought during the growing cycle, humidity at harvest etc.), with Southern France facing specific challenges: low rainfall resulted in low crop emergence of oilseed crops. Adaptation of camelina and carinata to local conditions is crucial for optimal performance and addressing concerns about low productivity.

In addition, there is insufficient knowledge about the resistance of camelina and carinata - both brassica crops - to diseases affecting other brassica species. Another major issue is to harvest the crop early, in order to be able to sow the next crop in time (especially for camelina as a winter cash crop, but not only). Hence, specific farming practices to ensure early harvest, such as windrowing, add to the cost structure and complexity. The risk of emergence failure due to excess straw from previous crops poses a logistical barrier, given the required 24-hour turnaround time for removal before seeding. Camelina's rapid germination time necessitates efficient harvesting and grain cleaning processes.

Adopting these new crops requires not only acquiring new knowledge and skills, but also potentially investing in the optimization of equipment for seed harvesting and cleaning, and in establishing new practices, which can be both costly and time-consuming. As these crops are likely to be used in tandem with other crops within the intercropping system, there are some negative effects to consider, such as the potential for competition between crops in the intercropping system. For instance, a farmer reported that interplanting camelina with lentils and harvesting together led the harvested lentils to acquire a "*broccoli-like*" smell transferred from camelina, leading them to downgrade the seeds.

Currently most barriers and challenges when it comes to these innovative feedstocks lie with the producers upstream in the system. All these challenges cause camelina and carinata to not be viewed as competitive or profitable when compared to conventional systems or other farming practices that farmers may choose instead to comply with the current EU policy landscape.

Other challenges identified were related mainly to policy and regulatory challenges. Currently the requirements to meet the Emission Savings from Soil Carbon Accumulation (ESCA) (European Commission, 2022) are strict and unclear, and the current standards are not consistent making compliance difficult. According to policy experts, this scheme fails to consider whether farmers had already adopted beneficial farming methods prior to 2008, potentially resulting in an underrepresentation of enhancements in soil carbon storage. As camelina and carinata can be cultivated as an intermediate crop under Annex IX of the EU Renewable Energy Directive (RED), it opens an opportunity to use these innovative feedstocks in the expanding Sustainable Aviation Fuel (SAF) sector which could be very profitable for farmers and an incentive for these crops' adoption; however, the current regulation is excluding the eligibility of camelina and carinata for biofuel production when grown as a main crop or intercrop. Most stakeholders identified and were aware of the possibility to use these crops as biodiesel and saw future implementation of these crops as being more widespread and known However, the quantity needed to be economically viable would be extremely high. This would pose future barriers as increased infrastructure creation would be necessary to keep up with possible future demands as current storage is not adequate for the potential quantities needed.

Most of the challenges identified relate to the fact that these two feedstocks are new and are still being developed to be the most effective, efficient, and economically viable, and there is the need

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for large levels of investment to sufficiently establish these crops as viable options for stakeholder adoption.

Main opportunities

When shifting focus onto the opportunities associated with camelina and carinata, the attention goes to farming practices and the environmental benefits of these cropping systems.

These crops were identified by stakeholders as very hardy. They have a high drought tolerance and can withstand water stress which makes them extremely beneficial when it comes to economic gains from utilising less irrigation. Added to this, these crops have a low input requirement and are resistant to many diseases and pests. This again allows for farmers to lessen their dependence on fertilisers, pesticides, and herbicides which can help with reducing farming costs but also alleviate stress as many EU policies have been pushing for a reduction in these agrochemicals across the board.

Also, when it comes to interactions between other crops in the cover/intercropping systems, farmers reported that less mechanical work is needed such as tillage due to camelina's deep rooting system that can contribute to water up-movement from deep soil but also aerating the soil after termination. The integration of camelina into already established systems also can be quite easy, specifically when planted before cereals. When intercropped with lentils, these crops have the beneficial effect of reducing lodging and even increasing the lentil plant height. While no trials have been conducted in France, it has been reported that the ability for these crops to thrive growing on contaminated marginal land could be an especially important opportunity. This could be extremely beneficial for farmers and allow for the use of more land that may have previously been abandoned or deemed unsuitable for growing. This again might have the potential to increase potential revenue for farmers. Many of these opportunities can be linked to current policy demands which should be exploited to allow stakeholders to benefit from adopting these innovative feedstocks while also benefiting from support from these policies.

Another area of opportunity identified is the potential of the biofuel sector with these crops. The aviation sector is currently being pushed to decarbonise, and this leaves an opening for these intermediate crops to integrate themselves in the market. Intermediate crops are included in the crops that can be used for biofuel production and in general for this market there is a high demand and need for new raw materials to produce enough fuel for this industry. Demand will not be a concern in this sector with camelina and carinata. Many stakeholders identified biodiesel as one of the main markets for these crops, highlighting that there is a known connection and potential in promoting the use of these crops in biodiesel production. There is the challenge of having to store enough seed to last the entire year which would require a large amount of storage and infrastructure, but specifically in France, there is the opportunity to utilise currently present Storage Organisations to hold excess quantities.

Overall, when assessing all the identified opportunities, it becomes clear that there is a lot of untapped potential when it comes to these crops in the field but in future markets. Initial and overall investments could be much lower than anticipated due to the overall low input requirements needed for these crops, and with the possible expansion into the Sustainable Aviation Fuel sector there could also be a large financial profit available for those willing to invest into these new innovative farming systems. These benefits could counteract many of the identified barriers that often revolve greatly around the financial concerns with adopting new systems. There is also a great potential to utilise the current EU policy landscape to stakeholders' advantage. Both crops can fulfil multiple requirements for certain policies, CAP GAEC 6 and 7 for example in France, and allow for financial

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support that would again mitigate the potential costs that may deter stakeholders from integrating these crops in the value chain.

Key messages from the French PIL

	CHALLENGES	OPPORTUNITIES
CULTURAL	• *Need for engaged farmers and diversified practices* • *Lack of information*	• *Integration potential for camelina and carinata of biodiesel and biofuel market*
TECHNICAL	• *Need for innovative equipment and practices* • *Crop performance strongly linked to the context and the climate conditions of the year*	• *Low input requirements* • *Adaptability to marginal or contaminated lands*
ECONOMIC	• *High costs associated with acquiring new knowledge, and practices* • *Insufficient storage infrastructure for large-scale adoption*	• *Increased competitiveness* • *New markets* • *Crop diversification* • *Current untapped potential of the biofuel sector with these crops (e.g. aviation and marine sectors)*
ENVIRONMENTAL	• *Risks of emergence failure due to environmental conditions, such as low rainfall or excess straw (summer cash crops)* • *Potential negative interactions in intercropping systems, such as crop competition*	• *Resistance to pests, bioaggressors and diseases* • *Drought tolerance* • *Need for few inputs*
GOVERNANCE	• *Camelina not eligible for biofuel if produced as main crop or intercrop (RED)Strict Carbon sequestration (ESCA)*	• *Both crops can fulfil multiple requirements for certain EU policies*
STRUCTURAL	• *Need to higher development of camelina and carinata value chains*	• *Expansion of these crops into new market opportunities, such as SAF and biodiesel*

Table 1: Key messages from the French PIL.

4.1.3 Spain

Policy Context

The key policy discussed during the Spanish PIL was the Common Agricultural Policy (CAP), particularly the Agri-Environment-Climate Commitments (AECC) payment scheme (European Network For Rural Development, 2015). AECC, part of CAP's "second pillar," focuses on providing financial incentives for farmers who adopt beneficial farming practices. The CAP is particularly relevant due to the large percentage of subsidies recipients in Spain: the total number of hectares declared in the CAP Single Application 2024 is 22,174,117.54 ha. The number of applications submitted, and therefore of potential beneficiaries, is 598,151. While the surface area remains relatively stable with respect to the SU 2023, the number of beneficiaries falls moderately, by 3.9%. The total amount of support amounts to €4,882 million, a figure very similar to that of 2023. Moreover, 77% of recipients, and 87.79% of Basic Income Support areas have availed themselves of an eco-scheme (Ministerio de Agricultura, Pesca Y Alimentaciòn de España, 2024). These payments compensate farmers for potential losses or expenses incurred by adopting practices such as organic farming, increasing carbon sequestration, using cover crops, and implementing diverse crop rotations, which directly relate to crops like camelina and carinata. Farmers in Spain could qualify for AECC payments by allocating at least 10% of their land to soil-improving crops like camelina and carinata.

A challenge with this scheme is its voluntary nature, which means farmers may choose not to participate. For many farmers, the policy landscape can be intimidating due to its logistical and administrative complexities. The process of applying for these payments, understanding the necessary paperwork, and meeting monitoring and *reporting requirements can deter farmers from participating in the scheme and, consequently, from adopting camelina and carinata. This challenge is further exacerbated in Spain, where the harvesting of cover or intermediate crops may* occur earlier than the administrative monitoring checks, causing farmers to miss out on AECC payments entirely. As a result, farmers may not see the incentive to adopt these crops in the first place. There is a possible solution of making the monitoring requirement more flexible or earlier in the season so that farmers may still qualify for the AECC payment scheme.

Main challenges

One of the main challenges identified by stakeholders for the implementation of camelina and carinata lies in the market, particularly with regard to the indirect monopoly of fuel present in Spain. Stakeholders identified biofuels as the strongest future market for camelina and carinata (coherently with the actual destination of the whole camelina and carinata production), but this poses a challenge when the current fuel market could greatly inhibit the adoption of biofuels. Even with policies, such as RED, aimed at increasing the use and production of biofuels, when the market itself is not open or willing to adopt these new materials, their adoption remains a challenge.

The stakeholders also seem to have a lower level of "confidence" when it comes to the implementation of these crops in 2050. Most consider these crops as still being in development or only utilised in certain markets. The combination of this perspective and the barrier of the market not being hospitable for these crops poses a large concern for their acceptance. With this lack of "confidence" in the future potentials of these crops, there is a lower chance that stakeholders will wish to implement them in the present. This hesitancy can stifle their long-term growth and adoption, limiting their ability to establish themselves in the marketplace.

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For most of the stakeholders, it is evident that these crops are novel and therefore many challenges are related to this. There is a perceived lack of competitiveness in both the farming of these crops but also the potential marketplace. In particular, the most popular market among those identified is biofuels.

When discussing the reasons why political support might be needed for these two crops, one of the top three reasons was competitiveness. This possibly indicates that the current perception held by stakeholders is that camelina and carinata, currently, are not competitive in the market or against other crops.

Main opportunities

Both camelina and carinata are seen as low input, resilient, and environmentally friendly crops. This positive perception can be a critical point for the more widespread adoption of these crops in the future. They can be grown in many environments that may have not been farmed previously due to harsh conditions. This allows for the possible expansion of farming areas, leading to an increase in economic gains for farmers and stakeholders. Fewer stakeholders identified economic viability as a key quality of camelina or carinata, but it was identified nonetheless, which can be seen as a potential future focus. Promoting the idea that these innovative feedstocks offer the possibility to be economically viable would greatly increase their adoption rates, as the main concern of any new system is the potential economic stress of these changes. Highlighting the economic viability of these crops and the existence of potentially profitable future markets that can be tapped will make it clear to stakeholders that there are many opportunities when it comes to their adoption. In this sense, value chains contracts are key to ensure economic viability: commercial companies in Spain sell camelina and carinata seeds ensuring farmers an agreed and foreseeable profitability. These companies also supervise all the growing stages, provide agronomic assessment, and arrange the logistics so the grain can be transported to the crusher facilities.

The prospective markets are also extremely diverse and have significant room for expansion. For example, stakeholders identified bioproducts as one of these opportunities, though this sector does not currently utilise these crops for production. This only means that in the future there is an opportunity to adopt carinata and camelina in a market that could be extremely profitable and expansive. Also, with biofuels and SAF becoming a more and more prevalent topic these crops could become critical raw materials for that production, again establishing camelina and carinata as critical to that market landscape. All this potential expansion links directly to economic gains for all stakeholders involved in implementing these innovative feedstocks. There are so many future opportunities that can be linked to these crops that need to be exploited and highlighted, as it is these opportunities that will incentivise and entice stakeholders to adopt carinata and camelina in the long term and on a large scale.

Key messages from the Spanish PIL

	CHALLENGES	OPPORTUNITIES
CULTURAL	• *Lack of stakeholder confidence*	• *Highlighting their potential economic and environmental benefits could increase stakeholder confidence*
TECHNICAL	• *Agronomic conditions* • *Territorial differences in performance*	• *Crop diversification*

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ECONOMIC	• *Perception of low economic profitability compared to existing crops or systems*	• *Increased competitiveness*
ENVIRONMENTAL	• *No direct environmental challenges mentioned*	• *Resistance to pests, bioaggressors and diseases* • *Drought tolerance* • *Need for few inputs*
GOVERNANCE	• *RED policy restrictions*	• *Evolutive policy framework to expand crops used for biofuels* • *Promoting competitiveness through strategic support* • *Market diversification initiatives*
STRUCTURAL	• *Market dominance by fuel monopolies*	• *Access to diverse future markers*

Table 2: Key messages from the Spanish PIL.

4.1.4 Italy

Policy Context

In Italy, the primary policy framework of relevance is the Common Agricultural Policy (CAP), which seeks to improve the competitiveness and sustainability of the country's diversified agricultural sector and rural areas. The CAP strategy is designed to address the diverse needs of various territories. Although the previous regional Rural Development Programs have been consolidated into a single national CAP Strategic Plan, regions will still be key players in the implementation of rural development interventions.

Italy currently imports 80% of its oilseed requirements, primarily soybean, sunflower, and rapeseed. Soybean dominates the market, being mainly used for edible oil and lecithin production, but domestic output falls short of demand, especially for soybean meal. Recently, soybean byproducts have also found use in power engines under the megawatt. Sunflower seeds, instead, are used for feed and biodiesel, facing competition between food and non-food applications. Rapeseed cultivation benefits from European policies but is limited by low meal utilisation, while rapeseed oil is primarily used as a food ingredient.

Camelina faces low profitability compared to other crops, limiting its appeal for widespread cultivation. However, it offers promising prospects for by-products, particularly in circular economy applications. Despite its potential, the management and market development for camelina oil remain underdeveloped, hindering its broader adoption. Carinata presents opportunities in biodiesel and energy production, aligning with renewable energy goals. However, current production levels are insufficient to support significant industrial applications, limiting its role in large-scale energy or biodiesel markets.

Main challenges

Several challenges that were highlighted are connected to the need for farmers to be eased in the process of incorporating camelina and carinata in their cropping rotations. Farmers would need technical and economic support. In fact, a barrier against the adoption of the crops can be the hesitation in regards with investing on camelina and carinata, due to the high initial costs connected with the adoption of such crops, a lack of technical knowledge, and a sense of uncertainty about

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long-term benefits associated to the investment, both economic and environmental. Policy experts claimed that such challenges could be addressed with a more prevalent role of local authorities in this crop diversification strategy.

A priority must be the necessity to avoid competition among value chains and find a way of presenting camelina and carinata's products and byproducts as alternative value chains rather than creating competition with the existing ones. In Italy the oil byproduct needs specific strategies to achieve market embeddedness and valorisation considering the well-consolidate other existing oil value chains.

Main opportunities

Despite these barriers, camelina and carinata present significant opportunities for sustainable agriculture in Italy. Stakeholders recognised that the two crops do offer remarkable environmental benefits, such as improving soil stability and reducing the need for chemical inputs like herbicides. In addition, these crops also have shown a significant carbon sequestration potential, providing significant ecosystem services and proving to be valuable tools for managing phenomena such as soil erosion and fertility degradation.

Policies aligned with European priorities, such as circular bioeconomy models and CAP reforms, could provide key support, including financial incentives tied to measurable and effectively documented soil improvements. There is also market potential, particularly for biodiesel and renewable energy applications for carinata, while camelina's by-products hold promise for integration into circular economy systems. Furthermore, promoting these crops as dedicated supply chains could reduce competition with other oil crops, while valorising by-products would increase economic viability. Stakeholders also pointed out that concrete research initiatives such as the CARINA project offer further promise, helping to define optimal conditions for adoption and demonstrating measurable benefits to both farmers and policymakers. This could also facilitate dialogue with bodies such as the Standing Committee on Agricultural Research (SCAR) group. In this sense, it has been highlighted that is an emerging urge for targeted funding to support such projects.

Key messages from the Italian PIL

	CHALLENGES	OPPORTUNITIES
CULTURAL	• *Farmers' hesitation due to uncertainty about long-term benefits*	• *Promoting these crops as dedicated supply chains to reduce competition and foster adoption*
TECHNICAL	• *Lack of technical knowledge required to incorporate camelina and carinata into production.* • *Need for strategies to embed and valorise oil by-products in Italy's existing oil value chain*	• *Concrete research initiatives, like the CARINA project*
ECONOMIC	• *Farmers' hesitation due to high initial costs* • *Competition with existing value chains*	• *Promising applications for biodiesel and renewable energy, particularly for carinata* • *Circular economy opportunities for camelina's by-products*

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ENVIRONMENTAL	• *Uncertainty about long-term benefits*	• *Significant environmental contributions and ecosystem services*
GOVERNANCE	• *Insufficient support from authorities* • *Need for targeted policies to encourage integration into agricultural practices*	• *Strengthened dialogue with European bodies to align with broader agricultural goals*
STRUCTURAL	• *Lack of established markets for by-products*	• *Possible coexistence with current agricultural systems through dedicated supply chains*

Table 3: Key messages from the Italian PIL.

4.1.5 Germany

Policy Context

In Germany, the main policy of interest that has been discussed in the PIL is related to the second pillar of the Common Agricultural Policy (CAP), which – differently from the first – was deemed to have stronger links with the agroecological transition and rural development. A major strategy focal point includes the so-called Agri-Environment-Climate Measures (ACEMs) (European Network for Rural Development, 2016), and financial tools, like the provision of subsidies. This kind of approaches aims to boost competitiveness within the agricultural market and produce a shift in farmers' behaviour toward more sustainable practices. This happens with the latter being made economically accessible. Along with the above-mentioned, another goal is the creation of a system in which farmers cooperate, and skills acquisition is fostered through knowledge transfer. Part of the first pillar of the CAP, on the other hand, is the implementation of a series of greening measures to ensure that agricultural practices become increasingly sustainable in Europe, thus guaranteeing long-lasting positive impacts.

However, among the major weaknesses attributed to the CAP is the fact that payments are shaped mostly on conventional agriculture and take too little account of the environmental benefits assured by agroecology. In addition, CAP has been criticised for its unequal distribution of resources, whose provision is based on hectares. This leads to favouring large farms, at the expense of smaller ones, which inevitably face income insecurities (Bateman & Balmford, 2018). Moreover, criticism has also been raised against the high administrative burden, the lack of adaptability to local contexts and the too low profitability of sustainable practices.

In parallel with the guidelines dictated by the CAP, the BMEL (Germany's Federal Ministry of Food and Agriculture) has developed a plan to rise the production of German- and EU-grown legumes, known as the Protein Crop Strategy (EPS). This has the potential to increase the national protein provision without threatening the environment or the economy.

Main challenges

Carinata is generally not grown in the country because of the unsuitable German climate: temperatures are too low in winter. Camelina, on the other hand, is cultivated, but with little industrial demand, having only one company purchasing it for processing purposes (for the production of varnishes and paints). A consequence of the low demand is also the high transportation costs. In the bioenergy market, rapeseed is seen as a cheaper alternative. In addition, when it comes to

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intercropping or cover crops, farmers prefer rapeseed or winter wheat to camelina, mainly because of their greater adaptability to harsher weather conditions. Added to this are the complex regulations imposed by the CAP, which restrict the use of camelina and carinata in cover crop and intercropping (e.g., GAEC standards limiting pesticide use and cover crop growth).

In terms of cultivation levels and profitability – except for the summer period – camelina requires significant amounts of fertiliser to achieve optimal yields, thus increasing input costs. Furthermore, according to farmers' experience, this crop variety appears to be sensitive to herbicides, so their use is often avoided to prevent crop damage. However, despite this sensitivity, the development of specialised pesticides is not seen as an attractive option due to the low demand of camelina in Germany.

The low profit margins of this crop variety, whose income is barely sufficient to cover production costs, limit its attractiveness: financial gains are negligible unless camelina is sold for higher value markets. Another aspect that adds to this reality is the lack of cooperation between farmers, which results in a further reduced marketing potential.

Stakeholders' forecasts are pessimistic: there is a sense of uncertainty in future market demand related to camelina and carinata, with limited growth expected, other than for industrial uses related to paints and varnishes that were reported to be well established in Germany [1]. The perceived limited usability connected with the specific functional features of the two crops was deemed as a potential hindering factor.

Main opportunities

A key aspect is that selling camelina to oil mills for the production of high-value organic cooking oil has the potential to generate higher income. This provides an opportunity for farmers to target premium organic markets, where demand for environmentally friendly products is rising. In addition, camelina boosts soil organic carbon and supports ecological functions such as promoting beneficial soil microbiota and natural pest control (e.g., fly larvae fight lice infestations). These environmental benefits are in line with the CAP eco-scheme goals, thus ensuring that farmers meet land cover requirements while improving land quality. More general support for mixed crops, insect-friendly practices, and less intensive agriculture could indirectly foster camelina cultivation. There is growing political interest in biodiversity and soil protection, which could align with the ecological benefits of this crop variety.

As mentioned, camelina is already being used by a company in the paint and varnish industry. The survey evidenced also that this could represent a growing market sector for this crop variety, and, if active work is done to highlight its potential, camelina's industrial demand could increase, providing more opportunities for farmers and introducing new innovative projects, such as the production of biofuels or bioplastics.

Some stakeholders have put forward the idea of creating a market for camelina/carinata grown on marginal lands. Although these lands cannot support two crops (main crop and second crop), they could be an opportunity to increase land use efficiency.

[1] Paints and varnishes obtained from camelina are not biobased products studied in the CARINA Project.

Key messages from the German PIL

	CHALLENGES	OPPORTUNITIES
CULTURAL	• *Uncertainty in future market demand for camelina and carinata*	• *Opportunity to develop locally rooted industries, promoting regional cultural identity*
TECHNICAL	• *Camelina's need for fertilisers and herbicides sensitivity* • *Intercropping limitations*	• *Camelina supports ecological functions* • *Support for less intensive agricultural practices* • *Harvest flexibility*
ECONOMIC	• *Low profit margins* • *No economic incentives and lack of cooperation*	• *Potential for innovation* • *Niche markets for organic products*
ENVIRONMENTAL	• *Potential suboptimal yield with low inputs, besides summer season*	• *Soil health and environmental benefits* • *Marginal land utilisation*
GOVERNANCE	• *Complex CAP regulations*	• *Complex CAP regulations restricting the use of camelina and carinata in cover cropping and intercropping (e.g., GAEC standards).*
STRUCTURAL	• *Limited market and demand* • *Competition with consolidated crops*	• *Potential for uses in the paint and varnish industry*

Table 4: Key messages from the German PIL.

4.1.6 Poland

Policy Context

In the last 10 years, Poland's oilseed market has been significantly influenced by the demand for biofuels, with rapeseed being the primary oilseed crop. The country's policies are shaped by both domestic and European Union (EU) regulations aimed at increasing the share of renewable energy sources in energy production and for the transport sector (biofuels). This has led to a substantial increase in rapeseed production, largely driven by the domestic biofuel sector, which has been expanding due to EU mandates on renewable energy (Chibowski et al., 2016). This led to a primal economic significance of rapeseed in the Polish agricultural sector, with much higher income per hectare compared to other crops like wheat, triticale, and rye (Gradziuk et al., 2021). However, this led to a subsequent oversupply phenomenon. In the last years, oilseed production in Poland has been declining, due to a fall in prices, and a general unfavourable policy environment that makes it difficult to grow rapeseed with high input and phytosanitary requirements. Participants in the PIL reported that the surface of rapeseed declined of more than 10% in 1 year (from 1 010 thousand ha in 2023, to approximately 988 thousand ha in 2024). In particular, policy experts highlighted that the EC directive restraining the use of certain pesticides that were a standard in the industry (European Commission, 2009), and the increasingly shorter duration of action of new preparations, affected greatly yields and costs, hindering the expansion of the rapeseed sector in Poland. The focus on advance biofuels sought by the RED II directive (European Commission, 2018) has also negatively impacted the use of rapeseed for biofuel production, highlighting the urge to find alternatives that resonate with the EU strategy. Similarly, the initial expansion of sunflower crops observed in the recent decade in Poland has slowed down in the last two years: difficulties with drying, high costs of herbicide treatments and problems with sclerotia rot have discouraged many growers to grow the crop. Soybean cultivation is instead steadily growing in Poland, as many farmers have looked for crops with low fertilisation and protection requirements that could easily be sold in the market to cope

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with the corn and cereals cropping crisis. Camelina is traditionally grown in Poland as a niche crop for cold-pressed oil for cooking. No esterification for biofuel purposes has been reported. Carinata, instead, is not known in Poland.

Main challenges

The participants in the Polish PIL reported that the oilseed sector in Poland is currently dominated by the cultivation of winter rapeseed. This market dominance on a single crop highlights systemic issues in the sector, including limited diversification, insufficient incentives for farmers, and market constraints that discourage the adoption of alternative oilseed crops. Other crops, such as camelina or sunflower, remain marginal, primarily due to low awareness of their agronomic value and economic potential. Policy experts deemed that farmers' reluctancy to experiment with these alternatives comes largely from a lack of incentives both at policy and market level to offset the perceived risks associated with transitioning away from the well-established rapeseed. Another significant challenge lies in the uncertainty surrounding markets for alternative oilseed species. For many farmers, the lack of guaranteed sales channels for crops like camelina is a substantial deterrent: policy experts reported that farmers, while responsive to markets, might be reluctant to adopt innovative crops. Without a clear and reliable path to profitability, producers are hesitant to invest in cultivating species that do not yet have strong demand. Large processing companies, which dominate the sector, show little interest in less common crops, as these are perceived to lack the scalability and infrastructure needed to make them viable on an industrial scale. For instance, camelina oil is primarily processed by small family-owned businesses for edible purposes, limiting its potential to compete with the widespread and industrialised rapeseed market. In this sense, the sector also faces broader challenges in balancing food and non-food uses of oil crops: the competition in land use between these supply chains often creates conflicts that hinder the growth of industry in Poland: the low iLUC practices explored in CARINA project are expected to tackle this issue.

Main opportunities

The participants of the Polish PIL stressed that to ensure the long-term viability of the oilseed sector, it is essential to position them as complementary to food production rather than competing with it, promoting dedicated supply chains focused on non-food purposes, such as biofuel production. This approach helps avoid creating competition with established crops like rapeseed, which dominates large-scale cultivation and processing due to its established market and infrastructure. Unlikely from rapeseed and soybean, camelina and carinata can thrive in marginal soils, such as the one-third of arable land in Poland categorised as poor-quality soil. Moreover, these crops can serve as rotation breakers, improving biodiversity, soil health, and compliance with Good Agricultural and Environmental Conditions (GAEC). Crops apt to be integrated in conservation agriculture practices like camelina and carinata are particularly interesting in regions like Poland where their adoption remains limited, and soil quality is decreasing. In this sense, policy experts highlighted also the environmental advantages of camelina and carinata, which can contribute to soil stability, reduce the need for chemical inputs such as herbicides, and enhance ecosystem services like carbon sequestration, improvements in soil fertility and crop biodiversity. Camelina performs particularly well in organic farming systems and can reduce the use of plant protection products, while reducing agricultural reliance on chemicals. Another interesting opportunity is stemming from the changing climate and weather conditions in Poland, which are coherent with those of other countries in the temperate pedoclimatic zone. Growing seasons are extending due to global warming, and therefore

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camelina and carinata can be introduced to complement existing agricultural systems. This would of course require breeding resilient varieties, essential to mitigate risks from late frosts, droughts, and other weather anomalies.

Key messages from the Polish PIL

	CHALLENGES	OPPORTUNITIES
CULTURAL	• *Low awareness of the agronomic and economic potential of camelina and other alternative crops.* • *Farmers' reluctance to adopt alternatives due to perceived risks and lack of familiarity*	• *Promoting camelina and carinata as complementary to food production* • *Encouraging conservation agriculture and organic farming adoption*
TECHNICAL	• *Limited scalability and infrastructure for less common crops like camelina* • *Insufficient processing capacity for alternative crops, mainly limited to small businesses*	• *Breeding resilient varieties for climate challenges* • *Providing farmers with knowledge for better crop management*
ECONOMIC	• *Lack of guaranteed markets and reliable sales channels for alternative oilseeds* • *Insufficient financial incentives to offset risks of transitioning from rapeseed cultivation* • *Competition for land between food and non-food oil crop supply chains*	• *Utilising marginal soils efficiently* • *Reducing costs by lowering reliance on chemical inputs*
ENVIRONMENTAL	• *Adaptation of oilseed crops to changing climate conditions*	• *Improving soil stability, fertility, and biodiversity* • *Enhancing carbon sequestration and reducing chemical use*
GOVERNANCE	• *Limited policy incentives to promote diversification and adoption of alternative crops*	• *Aligning policies with GAEC standards and organic farming goals* • *Supporting dedicated non-food supply chains*
STRUCTURAL	• *Dominance of rapeseed in the sector, discouraging diversification and innovation* • *Market constraints caused by the preference of large processing companies for rapeseed*	• *Establishing supply chains for biofuel production* • *Adapting systems to leverage extended growing seasons*

Table 5: Key messages from the Polish PIL.

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4.2 Countries with less consolidated value chains

Group B includes the countries with less consolidated camelina and carinata value chains, which have however traditionally strong oilseed crop value chains. This group includes Bulgaria, Morocco, Tunisia, Serbia and Greece.

4.2.2 Bulgaria

Policy Context

According to a report from the US Department of Agriculture's Foreign Agricultural Service (FAS), Bulgaria's oilseed crop estimated production in 2023-2024 is about 2.48 million tonnes mainly due to the average yields of rapeseed and sunflower (Reidy, 2024).

Sunflower represents the most relevant crop in the country, with an estimated production of around 2.2 million tonnes. Sunflower is generally cultivated on large areas in the country, even if it is affected by unstable yields due to unpredictable drought.

Also rapeseed production contributes to the total oilseed production with about 275,000 tonnes. Rapeseed production in Bulgaria is estimated to decline due to reduced cultivation areas and increased production insecurity.

The oilseed crops sector is currently significantly affected by trade policies, especially related to the import prohibition from Ukraine due to political instability in Europe, which have contributed to disruptions in the supply chain, leading to a reduction in processing activities (Reidy, 2024).

The sector's dependence on sunflower as the main oil crop has, therefore, exposed the country to the risk of unstable yields due to drought and other climatic or political barriers. Diversification towards stress-resistant crops and the development of new marketable end products could mitigate these risks and help stabilise the sector. However, current price levels and export-oriented sales are insufficient for many farmers to maintain a positive economic balance, underlining the need for supportive policies to increase resilience and sustainability. Finally, it emerged that the process of introducing camelina and carinata into the oilseed crops market in the country is still at a preliminary stage.

Main challenges

The participants of the Bulgarian PIL agreed on the identification of a list of challenges focused on market barriers and instability, policy and subsidy issues, infrastructure deficiencies, cultural and awareness gaps as well as climatic and agronomic challenges.

Firstly, participants highlighted the limited demand for energy crops in the local market, necessitating a focus on foreign markets. This challenge is coupled with high export requirements, which demand large quantities of seeds sold at low prices that fail to cover production costs and yields. Additionally, climatic and agronomic challenges were emphasised, particularly the difficulty of cultivating camelina and carinata as second or cover crops during the summer without irrigation. Stakeholders involved in the PIL also stressed the need for crop rotation to include new crops and varieties with shorter vegetation periods and improved drought tolerance. Another aspect that has been identified as a major challenge in the adoption of camelina and carinata concerns the lack of information for the large audience on these crops; in fact, there is still a limited knowledge about non-food uses of these

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oil crops and a high level of consumer conservatism towards alternative oil products, resulting in sporadic sales and small-scale production.

The absence of specific subsidies for energy crops, double cropping, or relay cropping coupled with a lack of financial incentives for the end products of these crops were considered as other key challenges in the adoption of these crops.

Main opportunities

During the discussion among experts, a strong focus on dissemination of camelina and carinata benefits emerged as a way to support the adoption of the two crops and to overcome the main barriers identified. Moreover, a stronger policy support and steady investments in research and development were identified as key opportunities to improve crop varieties, yields, resistance, and processing technologies. Stakeholders stressed the need to introduce subsidies for energy crops, marginal land cultivation, and double/relay cropping systems as well as an alignment with European goals for renewable energy and sustainable agriculture to attract investment and integrate these crops into broader bioeconomic strategies.

4.2.3 Morocco

Policy Context

Historically, Morocco had about 200,000 hectares of oilseed crops in the 1990s. However, over the past few years, the cultivated area has been gradually declining as these crops have proven less profitable than others. Currently, cooking oil production in the country is held under a monopoly by the French company Lesieur Cristal, which imports almost all of its edible oilseeds and oilcake demand, with the majority of them coming from South America. To deal with this dependency, in March 2024 Morocco's Fédération Interprofessionnelle des Oléagineux (FOLEA) announced an ambitious plan to expand oilseed cultivation. This initiative aims to strengthen food security of edible oils, a staple food in Morocco, with the goal of achieving a self-sufficiency rate of about 15%. In addition, as a follow-up to the so-called Green Morocco Plan – which was launched in 2008 and met most of its objectives – in 2020 the country introduced a further farming development strategy: the Green Generation 2020-2030. Through it, Morocco plans to cultivate approximately 80,000 hectares of oilseeds by 2030, of which 30,000 are earmarked for rapeseed and 50,000 for sunflower. The country's demand for vegetable oil is substantial, with a local market of about 37 million people requiring around 622,000 tonnes per year, of which only 1.3% is produced nationwide (Al Mouahidi, 2024; Atalayar, 2024). Presently, the annual local price for rapeseed and sunflower is equal to 6 MAD/kg (i.e. 0.55 euros/kg), slightly higher than the international market price. In order to compensate for the loss to the oil producer, the Moroccan government is committed to contribute the difference between the local and the international market price, between 1.5 and 2.5 MAD/kg, based on actual market price fluctuations. This system works only for rapeseeds and sunflowers, while no value chain is currently available for camelina and carinata.

Morocco also looks at sustainable energy transition with opportunities for biomass-based biofuels, but not food crop-based biofuels (Sapp, 2020). As a part of the wider policy that is focused on significantly increasing investment in renewable energy, Morocco sees the greening of transport through waste-based biodiesel and green hydrogen pilot projects (Sapp 2020). A push to include underutilized resources for energy production, especially biomass and waste, such as agricultural waste, waste animal fats, and waste vegetable oils is envisioned, while also banning the use of crop-

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land for biofuel feedstocks due to concerns about food security (Sapp 2020). *Kilimanjaro Environnement* (http://www.ekogeste.com) is an ecological company based in Casablanca operating in the sector of the collection and valorization of used -edible oils (mainly frying oil), to biodiesel (Ouanji et al., 2016).

Main challenges

The above-mentioned policy tools are not interesting for small farmers, who prefer to grow grains for family consumption level rather than oilseeds. The latter, in fact, require a major number of inputs and are more easily exposed to diseases, as well as problems with birds and pests, which are difficult and expensive to manage. In addition, this small-scale production might be unattractive for the market, and therefore risky for the farmers. Small-scale enterprises niche mainly occupied by small cooperatives, which focus more on healthcare and cosmetic products, do not have required land and capacity to grow these oil seed crops. Therefore, they do not have potential to contribute for out-scaling camelina and carinata as oil seed or energy crops.

As stated above, unlike rapeseed and sunflower seeds, camelina and carinata currently lack an established market in Morocco. In addition, international prices for oilseed crops are too low to attract farmers and for camelina and carinata have not yet been set, which further diminishes their appeal. Added to this is the exclusion of camelina and carinata from the list of national crops (as part of the Green Generation plan), potentially limiting access to policy protections and resources, and placing them at a significant disadvantage compared to established oilseed crops.

Furthermore, a lack of awareness and understanding of the potential uses and value-added opportunities for camelina and carinata limits interest among related stakeholders. With limited knowledge regarding planting, crop management and harvesting techniques, successful cultivation of these crops remains challenging for most farmers. On the consumer and industry side, instead, the absence of marketing efforts or accessible information means there is little demand or perceived value.

Main opportunities

The main opportunity identified by stakeholders is the potential for integrating camelina oilseeds into small cooperatives, specifically for the production in healthcare and cosmetics. This outlet allows small-scale businesses to add value to local agricultural products, create jobs and reduce rural unemployment, benefiting women and young people. Camelina, unlike other oilseeds such as sunflower or rapeseed, is more suitable for these enterprises, due to its unique potential in specialised, high-value products. These could be an attractive proposition for cooperatives, which already have expertise in health and cosmetics sectors and could use camelina as a premium product to expand their lineup, partly because of its high-value properties.

Moreover, small-scale enterprises can play a crucial role in upscaling camelina during the initial adoption phase, creating local awareness and providing the foundation for wider production. In this sense, linking farmers with small scale oil producers (e.g. cooperatives) and small and medium enterprises and linking large- farmers with large enterprises (*e.g.,* Lesieur Cristal, agro-industrial leader for oil production in the Moroccan market) could be key to meeting industrial demand and building a more stable market for the crop in the long run. In this way, camelina could be placed as a versatile oil crop for industrial processing, thus diversifying the oilseed market in Marocco and potentially reducing its dependence on imports.

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4.2.4 Serbia

Policy Context

Oilseed crops have a significant role in the Serbian agricultural economy, where sunflower, soybean and rapeseed represent the most important crops in terms of production.

Following an increasing number of scientific studies highlighting the need of supportive policies able to support production and trade in these crops, their relevance has been recognised by the Serbian government as well. Sunflower, soybean, and rapeseed have a key role also in the oilseed market, contributing significantly to agricultural value, mainly due to the high potential for biodiesel production from oilseed crops in Serbia (Kiss et al., 2024). Furthermore, the increase in global oil crop prices have pushed Serbian farmers to expand oilseed cultivation (Popovic et al., 2016).

Main challenges

The main challenges identified during the Serbian PIL discussions concern market access barriers for camelina and carinata and insufficient government support for diversification of oilseed cultivation. More in details, during the discussion, the lack of clear policies promoting oilseeds as strategic crops and their low indirect impact on land use change (iLUC) was highlighted. Existing policy instruments were briefly discussed, with participants noting the need for new initiatives and better implementation of current policies to support minor crops.

Main opportunities

The growth of oilseed crops is accompanied by the debate on the possible use of edible oils in areas such as biodiesel. Consequently, it is becoming increasingly important to open the debate to the exploration of non-edible raw materials.

4.2.5 Tunisia

Policy Context

In Tunisia, the agricultural sector plays a key role in supporting the country's economy, food security and employment objectives, despite contributing a relatively small share to the national GDP compared to other sectors. Over recent decades, agriculture's relative importance in the economy has reduced due to the expansion of industrial sectors, along with challenges like land fragmentation and resource constraints. Small farms of less than 5 hectares now prevail, thus limiting economies of scale and hampering agricultural development.

Tunisia's agricultural policies face significant challenges. While a food security policy exists, it often undermines the development of the broader agricultural sector, by reducing profitability for farmers and fostering resource depletion. Furthermore, current policies have been criticised for being both unfit and inequitable, unintentionally exacerbating unemployment and regional disparities (World Bank, n.d.).

Focusing on the oilseed value chain, Tunisia has seen notable progress in canola production, which has been the most widely grown oilseed crop in the country since 2014. This sector benefits from active support by the Ministry of Agriculture and strategic partnerships with private companies such as Carthage Grain, a major player in the canola value chain. It provides seed and fertiliser to farmers

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and financial assistance during the growing season, along with support in the collection and processing of harvested seeds. Despite these advancements, a need for diversification in Tunisian oilseed market stands out, in order to reduce import dependency and boost the agricultural sector's competitiveness.

Main challenges

Among the main challenges identified by stakeholders for the implementation of camelina and carinata is the lack of technical expertise and knowledge regarding their cultivation and management practices. Without specialised guidance, yields remain inconsistent. In addition, selecting the optimal areas for cultivating these crops is also critical, as not all regions provide the ideal conditions for their growth. Climate change exacerbates these challenges, with unpredictable weather patterns that negatively further negatively impacting crop yields.

The sector is also hindered by an unclear policy framework and a monopolistic structure, with only one company currently purchasing the harvested seeds from farmers. This limits competition and diminishes farmers' bargaining power. Moreover, the fluctuations in seed prices established by the purchasing company add a further layer of economic uncertainty for farmers. Lastly, the reliance on imported canola seeds for planting introduces risks in terms of seed quality and availability.

Main opportunities

Despite the challenges mentioned, there are significant opportunities for the development of the camelina and carinata sectors in Tunisia. The need for clear national policies is emerging, especially ones that promote crop diversification, with a focus on these oilseeds.

A more active role by the Ministry of Agriculture in supporting seed production, stabilising their prices and providing incentives for crop diversification could help mitigate many of the problems currently faced by the country. In addition, simplifying contracts between farmers and the purchasing company would foster a more transparent and secure environment, encouraging more farmers to start cultivating camelina and carinata. By tackling both technical and policy gaps, Tunisia has the potential to advance the sustainability and competitiveness of these emerging oil crops.

4.2.6 Greece

Policy Context

The oilseed crop sector in Greece is characterised by a focus on sunflower and rapeseed, which are considered the most suitable in the Mediterranean region. There is also a considerable presence of soybean farming (Vlachos et al., 2014), to obtain both oil and protein crop. Recently, due to the peculiar market conditions and long-term drought impacting rapeseed yields, Greek farmers have shown particular interest in growing sunflower more than rapeseed (AgFlow, 2023). The cultivation of sunflower and rapeseed had been connected with biofuels production and is organised through contractual agriculture between the biodiesel companies and farmers. The analysis of the Greek context highlighted that new oilseed crops could be integrated in the national effort for conservation agriculture; in the last years, other oilseeds had been also tested, including safflower, camelina, carinata and castor bean.

The particular conditions of soil erosion and marginalisation of land in Greece pushed researchers and institutions to focus on conservation practices: minimum tillage was noted to be appealing to

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agricultural producers due to its capacity to yield comparable or even superior outputs relative to conventional tillage, as well as its potential to lower production expenditures, safeguard soils against erosion and compaction, and enhance soil moisture retention. Noteworthy reductions in fuel, labour, and machinery expenses are observed through the implementation of conservation practices. As far as camelina cropping is concerned, as evidenced by in the more temperate climates of central Greece, (Zanetti et al., 2021) elucidated the viability of cultivating camelina as a winter cover crop preceding the cultivation of maise (*Zea mays L.).*

Furthermore, companies producing biofuels are constantly looking for low iLUC oilseeds and thus camelina is gained a great attention by several oil companies for advanced biofuels productions. On the top of this there is a special subsidy from the CAP after 2023 (through the national strategic plan) of 600 euros per ha (the subsidy of 600 euros per ha is agreed to be given to nine more annual crops like quinoa, flax, etc.). This subsidy helped a lot to make the camelina more attractive as oilseed for biofuel production. Several oil companies running demo fields throughout Greece to test the crop productivity and the cultivation protocol. During the main agricultural exhibitions in Greece, camelina is the only oilseed that gained so high attention from the farming community (union of farmers, farmers, cooperatives). Thus, RED III and the special subsidy played a key role to increase the publicity of camelina. It should be noted that no other applications have been studied at large. Carinata looks like rapeseed thus it looks familiar to the farmers growing already rapeseed or in areas that rapeseed is important (central and north Greece). Several demo fields had been carried out and the concerns from the farming community are the followings: similar diseases and enemies with rapeseed, lack of seed in the Greek market, longer cycle compared to camelina but similar to rapeseed, while the positive observations were the high yields (double compared to camelina). For the oil companies both crops are in accordance with RED III and look attractive. Camelina has a special subsidy that help to compensate the lower seed yields and due to short cycle can give the opportunity for double cropping after camelina harvest (sorghum/corn as intermediate crop and/or sunflower). Carinata has higher yields that can cover the subsidy lack and it's very hard to find seeds to grow the crop

Main challenges

The CAP reforms have affected the agricultural sector in Greece by reducing subsidies and altering production quotas. This has led to fluctuations in agricultural production, including oilseed crops, and increased reliance on imports to meet domestic demand (Paskhalidis et al., 2018). There are significant regional disparities in the efficiency of arable crop production, including oilseeds, which need to be addressed to improve overall productivity and align with the CAP's single area payment scheme. The CAP reforms have led to a shift in agricultural practices, impacting the production and efficiency of oilseed crops (Vlachos et al., 2014).

Other challenges include ensuring a reliable provision of seeds and addressing the lack of alternative markets for both crops. Limited access to high-quality seeds can hinder widespread cultivation, while the absence of diverse market opportunities beyond biofuel production reduces the economic incentive for farmers to invest in these crops.

Main opportunities

The cultivation of oilseed crops like camelina for biodiesel production is gaining traction in Greece. This aligns with policies aimed at increasing local biofuel production, offering a sustainable energy source and reducing dependency on fossil fuels. Proper management of oilseed crops and their

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residues can enhance the production of vegetable oil and bioenergy, supporting the cohesion of agricultural, energy, and environmental policies in Greece. This approach can increase domestic raw material production for the bioenergy industry. The integration of oilseed crops into biofuel production presents a promising opportunity for Greece to enhance its energy sustainability and agricultural productivity.

4.2.7 Key messages from the countries with a less consolidated value chain

The key messages from the countries with a less consolidated value chain (Bulgaria, Morocco, Tunisia, Serbia, Greece) were aggregated and summarised into the table below:

	CHALLENGES	OPPORTUNITIES
CULTURAL	• *Limited public knowledge about non-food uses of oil crops* • *Limited consumer and industry demand due to minimal marketing efforts and accessible information*	• *Increased awareness through cooperatives can promote local knowledge of camelina's value*
TECHNICAL	• *Lack of technical knowledge between farmers and difficulty in selecting optimal cultivation areas* • *Climate change challenges* • *Difficulty in using camelina and carinata as second or cover crops during summer without irrigation*	• *Expertise in health and cosmetics sectors within cooperatives can be leveraged for product development* • *Potential for collaborative knowledge-sharing between small and large-scale enterprises*
ECONOMIC	• *Price fluctuations and economic uncertainty for farmers* • *Limited local demand for energy crops* • *Absence of established markets for camelina and carinata*	• *Crop diversification reducing import reliance*
ENVIRONMENTAL	• *Climate change impacts germination, growth, and yield*	• *More transparency through potential simplification of contracts between farmers and purchasing companies* • *Diversification of the oilseed market could reduce countries' dependence on imports and promote local resilience*
GOVERNANCE	• *Unclear policies and lack of support* • *Limited government involvement*	• *Development of national policies promoting crop diversification and supporting oilseeds like camelina and carinata could address existing gaps*
STRUCTURAL	• *Monopolistic structure limiting competition and bargaining power*	• *Boosted competitiveness in regional markets* • *Strengthening local seed production systems could reduce reliance on imports and enhance supply chain stability*

Table 6: Key messages from PILs in the countries with a less consolidated value chain.

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5. Discussion

The analysis of the country factsheets highlighted a wide range of interconnected challenges and leveraging targeted opportunities.

Overall, common trends emerged at the European level, although some differences in the prioritisation of these barriers emerged in relation to the level of consolidation in the value chains. These differences may be related to different perceptions of the value chain but also to structural differences emerging between different contexts and countries.

As shown in the graph (Figure 1), the top-rated barriers for the adoption of camelina and carinata emerged from the PILs surveys conducted in countries with a more consolidated value chains (France, Spain, Italy, Germany and Poland) are connected to economic, market, agronomic, related to the lack of information/knowledge and technical obstacles.

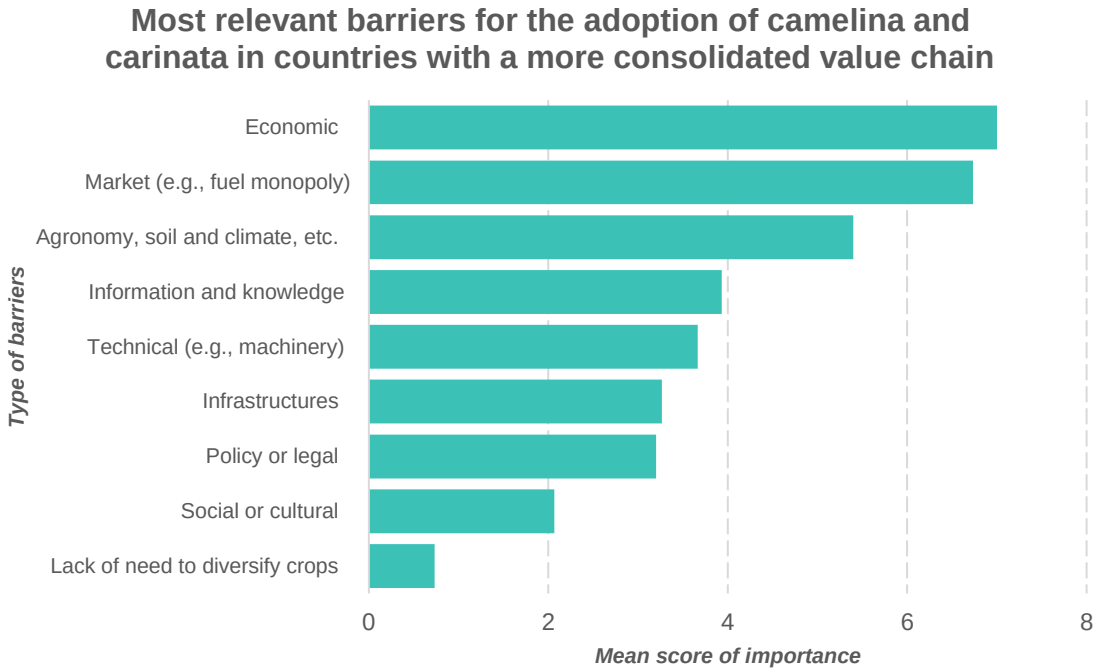

Figure 1:Top-rated barriers for the adoption of camelina and carinata in countries with a more consolidated value chain (France, Spain, Italy, Germany and Poland). Mean score of importance is calculated on a scale from 0 (not important) to 8 (very important).

Figure 2 shows the prioritisation of barriers according to the results of the PILs conducted in countries a with a less consolidated value chain (Bulgaria, Greece, Morocco, Serbia and Tunisia). According to the stakeholders from those countries, market obstacles were considered as the most relevant barrier for the adoption of camelina and carinata, followed by economic, agronomic and the lack of information/knowledge. In these countries, social and cultural barriers were also highlighted as significant, ranking just after the lack of information/knowledge. This difference might be attributed to the varying socio-economic and cultural contexts, where traditional farming practices, resistance to change, and limited exposure to innovative crops like camelina and carinata occupy a more prominent role in shaping stakeholders' perceptions. In countries with a consolidated value chain, farmers and stakeholders are generally more exposed to innovative crops, reducing the relevance of social and cultural barriers.

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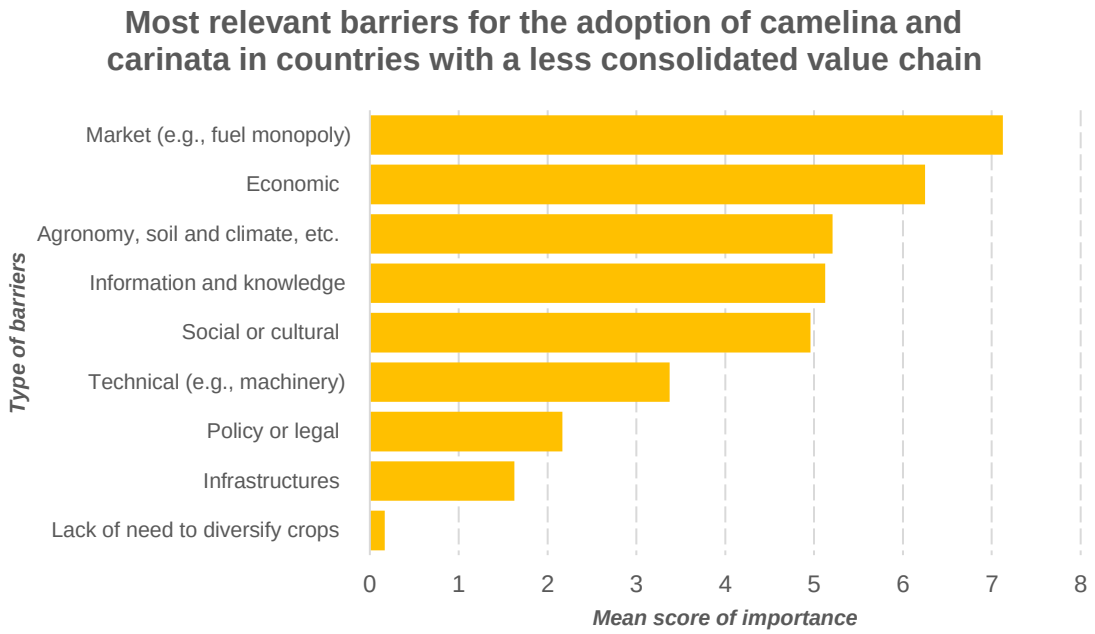

Figure 2: Top-rated barriers for the adoption of camelina and carinata in countries with a less consolidated value chain (Bulgaria, Greece, Morocco, Serbia and Tunisia). Mean score of importance is calculated on a scale from 0 (not important) to 8 (very important).

Differences in prioritisation between countries with more and less consolidated value chains reflect varying levels of maturity in the value chain and stakeholder familiarity with the crops. Consolidated value chains emphasise optimisation and specific technical or economic challenges, while less developed value chains focus on foundational barriers like market creation, cultural acceptance, and awareness.

For instance, market barriers are prioritised in countries with less consolidated value chains because stakeholders face significant challenges in identifying buyers, securing stable demand, or entering competitive markets. These regions often lack opportunities to support the commercialisation of innovative crops. In countries with established value chains, market emerged as a key barrier as well even if it might be less critical because established distribution networks, buyers, and markets for camelina and carinata already exist. According to this argument, in less consolidated value chains, unclear or unfavourable policies might still pose challenges, but they still ranked lower than more stringent barriers like market access or economic feasibility.

Consistently with the identified barriers, stakeholders participating in the PILs were also asked to prioritise the main reasons why policies are needed to support the adoption of camelina and carinata. The main results of this analysis are described in the following chart (Figure 3), based on priorities identified by stakeholders in countries with more or less consolidated value chains.

As a general trend, in all 10 countries the most pressing challenges are related to information, awareness, and infrastructure. Policies targeting these aspects are essential to enable the adoption of camelina and carinata. Also, the lack of awareness emerged as a critical issue indicating the need for targeted awareness-raising programs and measures to enhance competitiveness to ensure sustainable growth.

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Lack of information is a key point in all the contexts investigated, emphasising the need for policies aimed at improving information dissemination and knowledge sharing throughout the value chain.

Technology and infrastructure needs are particularly relevant, highlighting the need for policies to promote access to and development of technologies tailored to camelina and carinata specific features as well as investments in logistical and structural improvements.

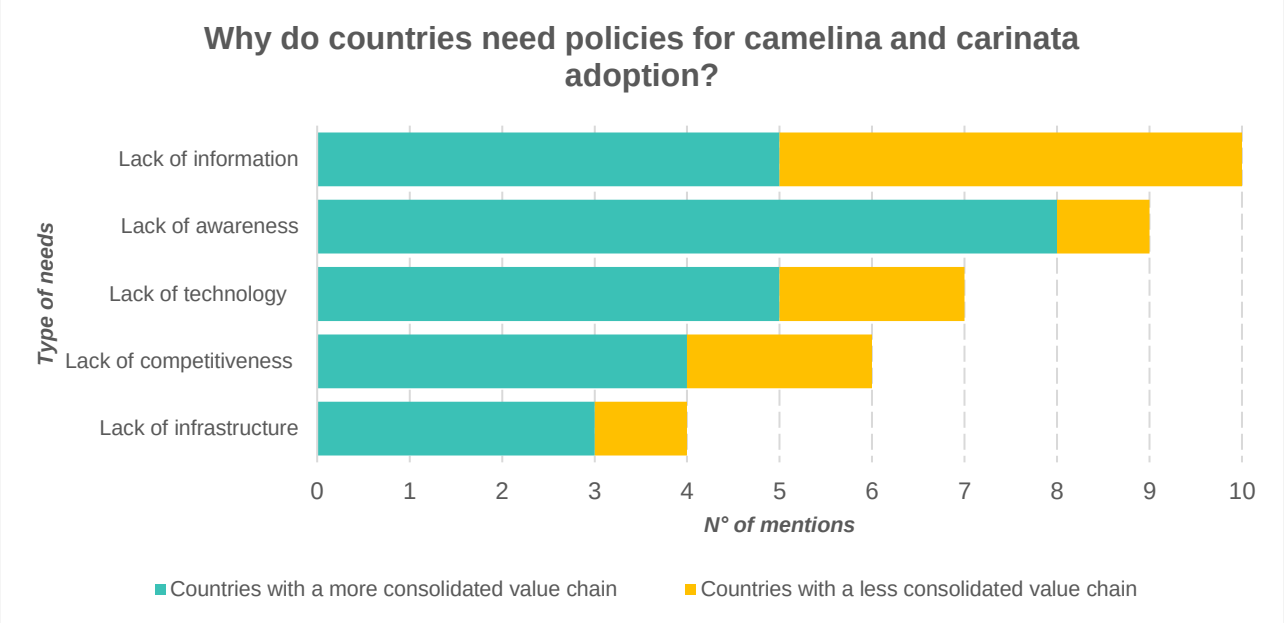

Figure 3 – Policy needs for camelina and carinata adoption.

The main challenges and opportunities emerged in the PILs are also analysed more in details in the following paragraphs according to the clustering developed through the adapted STEEP framework among cultural, technical, economic, environmental, governance, and structural barriers and opportunities.

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5.1 Cultural Challenges and Opportunities

Cultural resistance to adopting innovative crops like camelina and carinata remains a key challenge in consolidated European countries. In Italy, for example, the agricultural sector has a deep-rooted tradition of cultivating oil seed crops like soybeans and rapeseed, which offer established market routes. This entrenched behaviour makes it difficult for farmers to embrace novel feedstocks. Similarly, in Spain, despite the agri-environment-climate commitments (AECC) under the CAP's second pillar, many farmers perceive the administrative and logistical burden as daunting, thereby resisting changes that would necessitate unfamiliar farming practices.

Nonetheless, opportunities exist to overcome these cultural barriers through education and localised initiatives. France's GAEC framework demonstrates how cultural inertia can be tackled by aligning innovative cropping systems with mandatory requirements for subsidies. Farmers can fulfil fallow land requirements while benefiting economically from planting camelina and carinata. Germany's Protein Crop Strategy highlights another effective approach: promoting stakeholder cooperation to facilitate knowledge transfer. Lessons from less consolidated markets like Morocco, where cooperatives promote crop diversification and localised knowledge-sharing, could further enhance these efforts in Europe. By integrating traditional practices with modern incentives, countries can bridge cultural gaps, fostering widespread adoption of innovative feedstocks.

5.2 Technical Challenges and Opportunities

High initial costs and the complexity of adopting new technologies create significant technical barriers in countries like Germany and Italy. In Germany, the cultivation of camelina faces challenges due to its sensitivity to herbicides and reliance on fertilisers to achieve optimal yields. Similarly, Italian farmers struggle with integrating these crops into existing systems, given the high costs of specialised machinery and a lack of technical knowledge. Spain's issues with administrative monitoring checks further complicate the technical feasibility of implementing cover or intercrops, particularly under AECC payment schemes.

Despite these challenges, consolidated countries are uniquely positioned to leverage EU-wide policies to overcome technical barriers. The CAP's second pillar provides avenues for financial support to improve technical capacities, such as funding for advanced irrigation systems or precision farming tools. France's adaptation of camelina to specific agroecological zones underscores how targeted research can address region-specific technical challenges. Similarly, Germany's focus on multi-annual payments under CAP reduces financial strain on farmers, enabling long-term investments in technical upgrades. Insights from Tunisia, where technical challenges are being mitigated through Ministry-led initiatives, suggest that consolidated European nations can further benefit from centralised technical support to enhance the integration of these innovative systems.

5.3 Economic Challenges and Opportunities

Economic constraints, particularly related to market uncertainties and high production costs, remain pervasive in Europe's consolidated agricultural economies. In Spain, the dominance of fuel monopolies hampers the biofuel market, limiting opportunities for camelina and carinata. Similarly, Poland's reliance on rapeseed has led to market saturation and declining profitability, discouraging diversification. Italy and France face comparable issues, where established oilseed markets make it difficult for alternative crops to compete without targeted financial incentives.

However, these economic challenges also reveal significant opportunities. The CAP's eco-scheme goals provide financial incentives that can offset the costs of adopting new cropping systems, as

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seen in France's alignment of GAEC 6 and 7 with camelina cultivation. Italy's exploration of circular bioeconomy applications for camelina oil showcases the potential for integrating these crops into high-value markets, such as bioplastics and sustainable aviation fuels (SAF). Germany's focus on premium organic markets for camelina further demonstrates how niche markets can boost profitability. Drawing from Morocco's cooperative-based models, European nations could establish localised value chains to stabilise prices and improve market access, ensuring that innovative crops become financially viable for farmers.

5.4 Environmental Challenges and Opportunities

Environmental issues such as soil degradation, reliance on chemical inputs, and climate change impacts are significant across Europe. In Poland, for instance, declining soil quality and high fertiliser reliance have long-term implications for sustainability. Similarly, Tunisia and Spain face water scarcity and land fragmentation, which are exacerbated by unpredictable weather patterns. Germany's climate, while generally suitable for camelina, still presents risks of late frosts and droughts that threaten crop viability.

These environmental challenges are not insurmountable and can be turned into opportunities through policy alignment and innovative practices. The CAP's eco-schemes encourage sustainable land management, offering financial incentives for practices that enhance soil health and biodiversity. For example, camelina's deep rooting system can improve soil structure and water retention, making it an ideal candidate for conservation agriculture in countries like Poland and Spain. France's success in integrating these crops into agro-ecological systems demonstrates the potential for addressing soil degradation while fulfilling CAP compliance requirements. Leveraging lessons from Tunisia's efforts to stabilise seed supplies and support crop diversification, European nations could adopt similar strategies to mitigate climate-related risks and enhance resilience.

5.5 Governance Challenges and Opportunities

Governance gaps, particularly related to inconsistent policies and administrative burdens, remain critical barriers in Europe's consolidated agricultural economies. In Spain, the complexity of AECC payment schemes deters farmer participation, while in Germany, CAP subsidies disproportionately favor large-scale farms, marginalising smaller stakeholders. Italy faces challenges in reconciling regional disparities within its national CAP strategic plan, leading to uneven policy implementation. Furthermore, it was emphasised in several countries that a potential non clear inclusion of camelina and carinata in the list in Annex IX Part A of the RED, which defines the intermediate crops authorised for SAF production, would pose a challenge to their diffusion. Therefore, it is important that the upcoming European Commission guidance supports camelina and carinata inclusion in this list.

Addressing these governance challenges requires streamlined policies and better alignment between national and EU objective. France's example of integrating GAEC compliance with CAP incentives demonstrates how governance can drive adoption by simplifying administrative requirements. Germany's emphasis on agri-environment-climate measures (ACEMs) highlights the importance of providing targeted subsidies to support smaller farms and innovative practices. Lessons from Bulgaria and Tunisia, where centralised policies aim to enhance crop diversification and reduce market monopolies, underscore the need for governance structures that are both inclusive and adaptable. Consolidated European nations can further refine their governance

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frameworks to ensure equitable access to resources, fostering broader adoption of sustainable practices.

5.6 Structural Challenges and Opportunities

Structural issues, including monopolistic markets and inadequate infrastructure, pose significant challenges in Europe's consolidated agricultural systems. In Italy and Poland, established oilseed markets dominate, leaving little room for alternative crops to gain traction. Similarly, France and Germany face logistical challenges related to storage and processing capacities, which hinder the scalability of camelina and carinata. Spain's biofuel sector, dominated by a few large players, further illustrates the structural barriers to market entry.

Opportunities to address these structural challenges lie in building robust value chains and improving infrastructure. France's use of GAEC standards to incentivise diversification highlights the potential for structural reforms to promote alternative cropping systems. Germany's interest in marginal land utilisation demonstrates how innovative crops can complement existing systems without competing for prime agricultural land. Poland's exploration of conservation agriculture practices, coupled with targeted investments in processing facilities, can further enhance the scalability of these crops. Drawing from Morocco's cooperative-led approach, European nations could foster collaboration between small and large-scale enterprises, creating synergies that stabilise markets and enhance resilience.

6. Policy recommendations

Starting from the policy recommendations developed in Deliverable 6.6 'Policy Brief version 1' (summarized in Table 7), a cross-analysis was conducted with the results from the PILs from the 10 EU countries. The objective was to highlight how the identified challenges and opportunities can be addressed through the implementation of the proposed policies or through additional recommendations based on PILs results.

D6.6 Policy recommendations	
Rec. 1	Encourage Member States to make areas cultivated with carinata and camelina eligible for first-pillar CAP payments. Apply performance-based CAP-subsidies to account for multiple complex environmental benefits provided from crops such as camelina and carinata also in the second CAP-pillar. Possibly differentiate payments in the second pillar regionally and in time according to expected contributions to climate- and ecosystem services.
Rec. 2	Increase public R&D efforts to support necessary innovations in seeds production, pre-treatment of seeds, harvesting and processing methods and auxiliary materials and pesticides specialised for catch/cover cropping, as well as intercropping & catch/cover cropping. Increase CAP-payments (both pillars) for innovative feedstocks with clear climate and environmental advantages to account for lack of scale effects.
Rec. 3	RED support is critical for intermediate crops. This can be achieved by including them into Annex IX Part A, if their cultivation is not associated with additional land use and by providing clear guidance that allows for the scaling-up in the production of camelina and carinata eligible for Annex IX support. This long-term support should be coupled with increased public R&D efforts to promote innovations for future material uses.
Rec. 4	Increase efforts for information sharing related to innovative feedstocks.
Rec. 5	Raise public awareness and recognition for environmentally friendly low-input farming practices, and the sustainable use of products and byproducts according to a cascading process flow. Use product labels to inform consumers about bio-based content of (innovative) products.
Rec. 6	Reduce difficulties related to acquiring licenses for seeds and pesticides. Possibly engage farming organisations and intermediaries such as public farm advisory services.
Rec. 7	Use multi-annual payments to support innovative cropping systems with camelina and carinata to account for necessary trial and error processes, high upfront costs, and cost-perception biases

Table 7: Policy recommendations developed in D6.6 'Policy Brief version 1'.

To effectively address the cultural challenges associated with adopting innovative crops like camelina and carinata, a comprehensive, multifaceted approach is essential. Policies should prioritise enhancing information sharing and knowledge transfer (Rec. 4), bridging the gap between traditional farming practices and modern technologies. Regionalised initiatives can offer valuable insights into the economic and environmental benefits of these crops, making the transition more accessible to farmers. Concurrently, raising public awareness (Rec. 5) through targeted educational

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campaigns and product labelling can reshape public perceptions, emphasising the sustainability of camelina and carinata.

To overcome technical barriers, it is crucial to increase public R&D efforts (Rec. 2) aimed at developing region-specific solutions that enable the effective cultivation of these crops in diverse soil and climate conditions. Providing long-term support through multi-annual payments (Rec. 7) will help farmers to invest in specialised machinery required for the successful integration of camelina and carinata in crop rotations. Simplifying the authorisation process for seeds and pesticides (Rec. 6) will also enable farmers to access a broader range of tools, facilitating a smoother transition to innovative cultivation systems.

Economic challenges, such as high production costs and market uncertainties, can be alleviated through targeted policy interventions. The combined application of Rec. 1 and Rec. 2 will lower production costs, offer financial stability, and promote diversification from saturated markets like rapeseed in Poland and Italy. Additionally, raising public awareness of bio-based products (Rec. 5) will stimulate demand in high-value markets, such as bioplastics and sustainable aviation fuels (SAF), further enhancing economic viability.

By addressing cultural, technical, and economic challenges, environmental concerns can also be mitigated. The integrated implementation of policies that promote the widespread adoption of camelina and carinata (Rec. 1, Rec. 2 and Rec. 4) will leverage the unique growth characteristics of these crops to tackle environmental issues such as soil degradation, water scarcity, and climate change impacts.

Some governance challenges can be addressed through the implementation of Rec. 3, which proposes the inclusion of the two oilseed crops, in Annex IX Part A of RED, and their eligibility under the upcoming guidance currently under preparation. In this way, farmers' adoption of camelina and carinata could be facilitated, as it will offer an alternative approach to meet the eco-conditionality requirements of the CAP (GAEC 7) and differentiate farm incomes. PILs results also highlighted the need for policy intervention to encourage the introduction of these two crops. The alignment of subsidies under the first and second pillars of the CAP (Rec. 1) provides a valuable tool to recognize financial incentives and promote their adoption. On the other hand, needs not addressed in the policy recommendations included in D6.6 emerged during the PILs. Indeed, the need for action to reduce the complexity of CAP measures (Spain) and the disparity of subsidies between large and small farms (Germany) were also highlighted: these aspects might be further explored in the final version of the policy brief.

Lastly, structural issues, including monopolistic markets and inadequate infrastructure, must be addressed to encourage the development of this sector. Stronger focus on R&D in biobased value chains (Rec. 2Rec. 7) will empower stakeholders to invest in infrastructural innovation needed to scale production. Encouraging collaboration between small and large-scale enterprises (Rec. 4) will foster synergies, reduce market entry barriers, and ensure equitable access to resources, further strengthening the agricultural landscape.

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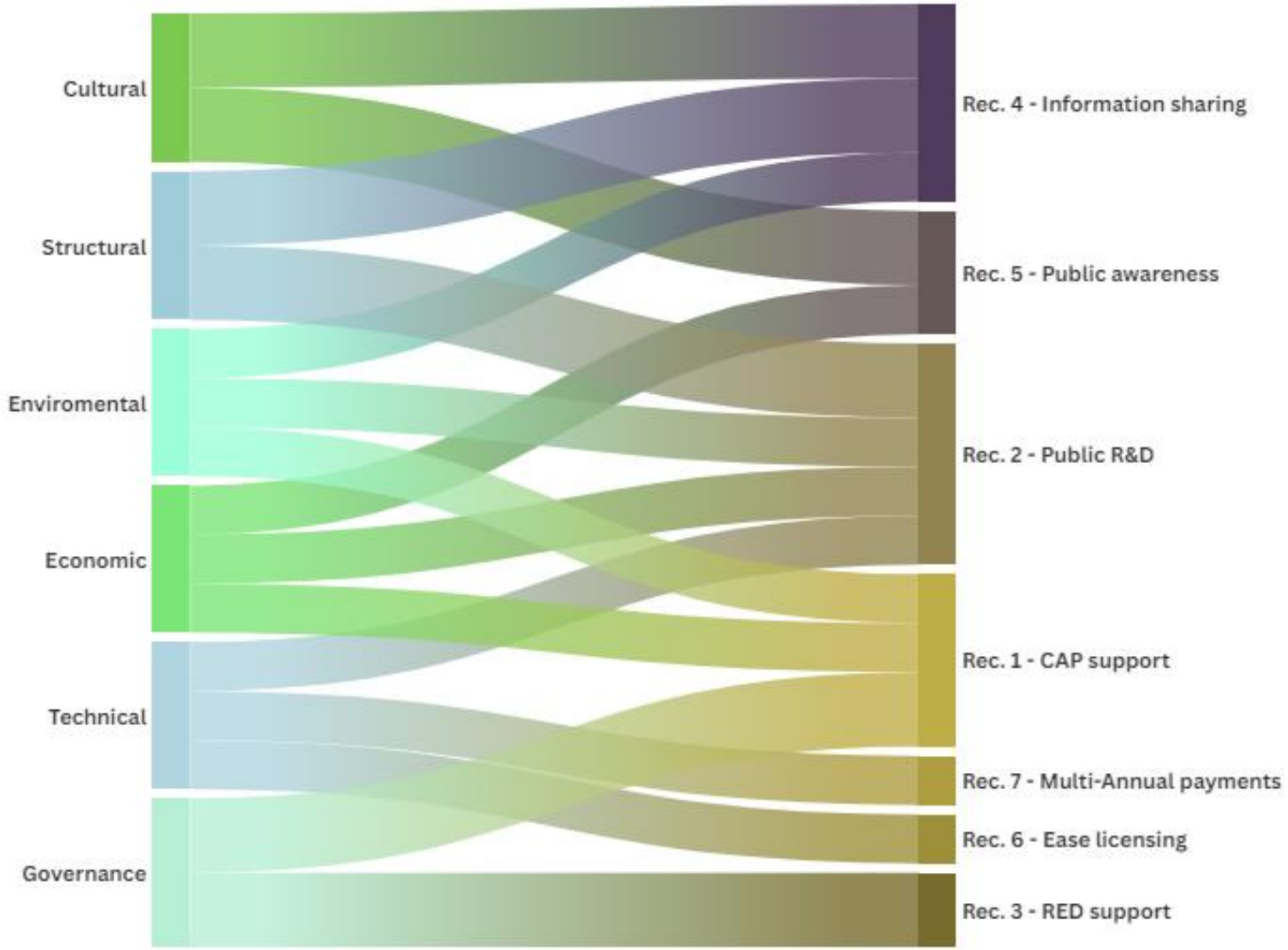

Figure 4: Policy recommendations (reported in Table 7) to address challenges and opportunities.

7. Conclusions

The organisation of Policy Innovation Labs made it possible to bring together various stakeholders from different countries and contexts to identify needs and gaps within current policy landscape addressing oilseed bio-based value chains. This bottom-up co-design approach ensured the inclusion of complementary expertise and perspectives among stakeholders in a robust framework for integrating knowledge into policy-making processes.

The implementation of the PILs in all the CARINA target countries (Italy, France, Spain, Bulgaria, Germany, Serbia, Poland, Tunisia, Greece and Morocco) allowed to consider various perspectives on contexts with different stages of value chain consolidation for camelina and carinata, unveiling pathways for establishing and/or upscaling the two cropping systems.

Through these labs, it was possible to describe for each country the policy context for oilseed crops and to collect and prioritise the main barriers and opportunities for the adoption of camelina and carinata. At the European level, common trends were observed, though variations occurred in the prioritisation of barriers depending on the degree of value chain consolidation, as well as structural disparities between different contexts and countries.

These differences have highlighted the importance of developing coherent but tailored policies at the European level, to support the adoption of camelina and carinata, ensuring a coordinated approach and shared agenda. It is crucial that these policies are well suited to be tailored to the specificities of different contexts, addressing local structural characteristics and priorities to maximise their effectiveness.

Furthermore, the participation of experts during PILs enabled the gathering of country-specific insights and to validate the main findings from the first version of the CARINA deliverable D6.6 – Policy Brief, which delved into the policy frameworks necessary for the advancement of sustainable agriculture through the promotion of camelina and carinata crops. Then, according to the main insights from the PILs, a description on how the identified challenges and opportunities can be effectively addressed through the implementation of the proposed policies was provided. The results also revealed an important policy gap to be filled, strictly related to a lack of policy recommendations connected to governmental challenges. This analysis will inform more refined policy recommendations in the final version of the Policy Brief (planned for the end of the project).

To conclude, by addressing these interconnected challenges and leveraging targeted opportunities, European countries with more consolidated value chains for camelina and carinata can lead the way in adopting innovative cropping systems that balance economic, environmental, and social objectives. Engaging local communities and farmers through targeted training and awareness programs will be key to overcoming cultural resistance and ensuring the successful adoption of innovative agricultural practices.

However, the integration of lessons learned from both consolidated and less consolidated value chains, underscores the importance of collaborative efforts and adaptive policies to foster sustainable agricultural practices across Europe.

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8. References

Bateman, I. J., & Balmford, B. (2018). Public funding for public goods: A post-Brexit perspective on principles for agricultural policy. *Land Use Policy*, *79*, 293–300. https://doi.org/https://doi.org/10.1016/j.landusepol.2018.08.022

Chibowski, P., Izdebski, W., Laskowska, E., Makarchuk, O., Skudlarski, J., Zaika, S., & Zając, S. (2016). Stan i perspektywy produkcji roślin oleistych w Polsce i na Ukrainie w kontekście rozwoju sektora biopaliw transportowych. *Problems of World Agriculture / Problemy Rolnictwa Światowego*, *1827-2016–147763*, 11. https://doi.org/https://doi.org/10.22004/ag.econ.235445

Dace, E., Cascavilla, A., Bianchi, M., Chioatto, E., Zecca, E., Ladu, L., & Yilan, G. (2024). Barriers to transitioning to a circular bio-based economy: Findings from an industrial perspective. *Sustainable Production and Consumption*, *48*, 407–418. https://doi.org/https://doi.org/10.1016/j.spc.2024.05.029

European Commission. (2008). *COUNCIL DIRECTIVE of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (91/676/EEC) Regulation (EC) No 1137/2008 of the European Parliament and of the Council*.

European Commission. (2009). *DIRECTIVE 2009/128/EC OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 21 October 2009 establishing a framework for Community action to achieve the sustainable use of pesticides*.

European Commission. (2018). *DIRECTIVE (EU) 2018/2001 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 11 December 2018 on the promotion of the use of energy from renewable sources (recast) (Text with EEA relevance)*.

European Commission. (2022). *ANNEXES to the COMMISSION IMPLEMENTING REGULATION (EU) on rules to verify sustainability and greenhouse gas emissions saving criteria and low indirect land-use change-risk criteria*.

European Commission. (2023). *DIRECTIVE (EU) 2023/959 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading system*.

European Commission. (2024a). *COMMISSION DELEGATED DIRECTIVE (EU) of 14.3.2024 amending Annex IX to Directive (EU) 2018/2001 of the European Parliament and of the Council as regards adding feedstock for the production of biofuels and biogas*. http://data.europa.eu/eli/dir/2018/2001/oj.

European Commission. (2024b). *REGULATION (EU) 2024/3012 OF THE EUROPEAN PARLIAMENT AND OF THE COUNCIL of 27 November 2024 establishing a Union certification framework for permanent carbon removals, carbon farming and carbon storage in products*. http://data.europa.eu/eli/reg/2024/3012/oj

European Commission. (2024c). *The future of European competitiveness: Part A.* https://commission.europa.eu/document/download/97e481fd-2dc3-412d-be4c-f152a8232961_en

Funded by the European Union

European Network For Rural Development. (2015). *RDP analysis: Support to environment & climate change M10.1 Agri-environment-climate commitments*.

European Network for Rural Development. (2016). *Workshop on Agri-environment-climate Measures (AECM): Challenges of controllability and verifiability*.

Gradziuk, P., Jończyk, K., Gradziuk, B., Wojciechowska, A., Trocewicz, A., & Wysokiński, M. (2021). An economic assessment of the impact on agriculture of the proposed changes in EU biofuel policy mechanisms. *Energies*, *14*(21). https://doi.org/10.3390/en14216982

Kiss, F., Đurišić-Mladenović, N., Tomić, M., & Marjanović-Jeromela, A. (2024). Biodiesel Production Potential from Oilseed Crops in Serbia. In *Contemporary Agriculture* (Vol. 73, Issues 1–2). Walter de Gruyter GmbH. https://doi.org/10.2478/contagri-2024-0011

Lee, C., & Ma, L. (2020). The Role of Policy Labs in Policy Experiment and Knowledge Transfer: A Comparison across the UK, Denmark, and Singapore. *Journal of Comparative Policy Analysis: Research and Practice*, *22*(4), 281–297. https://doi.org/10.1080/13876988.2019.1668657

Neuendorf, K. A. (2017). *The Content Analysis Guidebook* (Second Edition). SAGE Publications, Inc. https://doi.org/10.4135/9781071873045

Ouanji, F., Khachani, M., Boualag, M., Kacimi, M., & Ziyad, M. (2016). Large-scale biodiesel production from Moroccan used frying oil. *International Journal of Hydrogen Energy*, *41*(45), 21022–21029. https://doi.org/10.1016/J.IJHYDENE.2016.05.236

Paskhalidis, C., Petropoulos, D., Sotiropoulos, S., & Papakonstantinou, L. (2018). THE EUROPEAN UNION'S COMMON AGRICULTURAL POLICY AND DEVELOPMENT OF AGRO-FOOD SECTOR IN GREECE. *RUDN Journal of Agronomy and Animal Industries*, *13*(4), 373–382. https://doi.org/10.22363/2312-797X-2018-13-4-373-382

Popovic, R., Jeremić, M., & Matkovski, B. (2016). Oil Crops Market in Serbia. *Rat. Povr.*, *53*. https://doi.org/10.5937/ratpov53-9828

Vlachos, C. E., Mariolis, N. A., & Skaracis, G. N. (2014). A comparative greenhouse gas emission analysis of oilseed crops for biodiesel production in Greece. *The Journal of Agricultural Science*, *152*(2), 263–273. https://doi.org/DOI: 10.1017/S0021859613000075

Wellstead, A. M. (2020). Policy Innovation Labs. In A. Farazmand (Ed.), *Global Encyclopedia of Public Administration, Public Policy, and Governance* (pp. 1–5). Springer International Publishing. https://doi.org/10.1007/978-3-319-31816-5_4000-1

World Bank. (n.d.). Unleashing the Potential of Agriculture to Boost Growth in Interior Regions. In *The Unfinished Revolution: Bringing Opportunity, Good jobs and Greater Wealth to all Tunisians*.

Zanetti, F., Alberghini, B., Marjanović Jeromela, A., Grahovac, N., Rajković, D., Kiprovski, B., & Monti, A. (2021). Camelina, an ancient oilseed crop actively contributing to the rural renaissance in Europe. A review. *Agronomy for Sustainable Development*, *41*(1), 2. https://doi.org/10.1007/s13593-020-00663-y

Funded by the European Union

Websites:

AgFlow. (2023). Greece: More Interest in Sunflowers Than Rapeseeds. https://www.agflow.com/agricultural-markets-news/greece-more-interest-in-sunflowers-than-rapeseeds/. Visited 03/01/2025

Al Mouahidi, K. (2024). Morocco launches “Green Generation 2020-2030”, a new farming development strategy. https://medafricatimes.com/19464-morocco-launches-green-generation-2020-2030-a-new-farming-development-strategy.html. Visited 03/01/2025

Atalayar. (2024). Morocco launches plan to double vegetable oil production. https://www.atalayar.com/en/articulo/economy-and-business/morocco-launches-plan-to-double-vegetable-oil-production/20240318061000197754.html. Visited 03/01/2025

Reidy S. (2023) Bulgaria’s oilseed production holds steady. https://www.world-grain.com/articles/18744-bulgarias-oilseed-production-holds-steady#:~:text=Sunflower%20production%20is%20estimated%20at,total%20EU%20imports%2C%20FAS%20said. Visited 03/01/2025

Ministerio de Agricultura, Pesca Y Alimentaciòn de España. (2024). Avance de solicitudes únicas presentadas y superficies declaradas en la campaña 2024. https://www.fega.gob.es/es/noticias/node-15843. Visited 03/01/2025

Sapp M. (2020) Morocco Looks at Energy Transition with Opportunities for Biomass but Not Crop-Based Biofuels. Available at https://advancedbiofuelsusa.info/morocco-looks-at-energy-transition-with-opportunities-for-biomass-but-not-crop-based-biofuels. Visited 03/01/2025

Annexes

ANNEX A: Policy Innovation Lab structure and topics

1. Live interactive session: (45 minutes)

Main theme to discuss:

- **Introduction**
  Round of the table to introduce the participants each other
- **State of the value chain**
  Potential input question: Which is the state of the oilseed crops value chain in the country?
- **Barriers**
  Potential input question: Which are the barriers for the oilseed crops sector?
- **Policy gaps**
  Potential input question: Why do we need policies to promote oilseed crops?
- **Policy instruments**
  Potential input question: Are you aware of any policy instruments addressing oilseed crops use or cultivation in your country?
- **Future markets**
  Potential input question: Which will be the future markets for oilseed crops?

2. Presentation session: (10 minutes)
Present the main challenges and opportunities of Camelina and B. carinata compared to the more diffused oilseed crop in your country based on your experience in CARINA project

3. Feedback Qualtrics session: (10 minutes)
Qualtrics available in all the local language containing the following questions:
1. Which group do you most identify with? (multiple choice question):

- *Federation/Cooperative/Advisory*
- *Bioproduct producer*
- *Academia, research, R&D&I*
- *Seed Producer*
- *Public body (ministry, department..)*
- *Association, NGO*

2. Did you know about these crops? (multiple choice question):

- *Yes, I knew both crops*
- *I only knew about Camelina*
- *I only knew about B. carinata*
- *I did not know either of them*

3. What statements do you associate with Camelina cultivation? (multiple choices question – more than one option can be selected):

- *It is a resilient crop*
- *Low input required*
- *Easy to cultivate*
- *It is a productive crop*
- *It is an economically profitable crop*
- *It is an environmentally sustainable crop*
- *Other*
- *None of the above*

4. What statements do you associate with the cultivation of B. carinata? (multiple choices question – more than one option could have been selected):

- *It is a resilient crop*
- *Low input required*
- *Easy to cultivate*
- *It is a productive crop*
- *It is an economically profitable crop*
- *It is an environmentally sustainable crop*
- *Others*
- *None of the above*

5. What markets do you know for these crops? (multiple choices question – more than one option can be selected):

- *Biodiesel*
- *Animal feed (cake)*
- *Edible oil (for human consumption)*
- *Alternative bioproducts*
- *I did not know any of these uses*
- *Others*

6. Prioritise those barriers that you consider most relevant for the implementation of Camelina and B. carinata (rank to most relevant to least relevant):

- *Market (e.g., fuel monopoly)*
- *Economic*
- *Agronomy, soil and climate, etc.*
- *Social or cultural*
- *Information and knowledge*
- *Technical (e.g., machinery)*
- *Policy or legal*
- *Infrastructures*
- *Lack of need to diversify crops*
- *Others*

7. What do you think the implementation of Camelina and B.carinata will be like in 2050? (single choices question):

- *Residual: only a small part of the productive sector grows them (even as a diversification strategy)*
- *In development: more people interested in growing them, and more market opportunities.*
- *Mature: well known by the primary production sector and by the industry.*
- *Strategic: integrated in the bio-products value chain*

8. In order to move from a residual to a strategic implementation: what measures should be taken to boost the commercialisation of these crops? (open question)

9. Why do we need policies for Camelina and B. carinata adoption in your country? (multiple choice)

- *Lack of competitiveness*
- *Lack of information*
- *Lack of awareness*
- *Lack of technology*
- *Lack of infrastructure*
- *Regulatory and legislative challenges*
- *Other*