



Developing skills for introducing circular business models and digital technologies in olive oil sector

D2.3 National Report on current and future skill levels for transition of the olive oil sector to circular economy

GREECE

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Project management



Identification of olive sector



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National Report on current and future skills levels for transition of the olive oil sector to circular economy - Greece

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1. Executive Summary

Although the Greek olive sector has been gradually incorporating elements of circular economy, the process is still in the early stages of development. Skills such as, knowledge of sustainable farming practices and of water and soil protection, organic farming and pest control, waste valorization and understanding of food policies and regulations are starting to gain traction within the sector, due to the pressure for sustainability performance, the environmental regulation and policies, the financial changes and the development of new technologies. There are still skill gaps throughout the value chain of the sector that have to be addressed, such as financial constraints, limited knowledge of circular economy principles, lack of regulatory incentives, deficiency of technical skills for sustainable production and limited entrepreneurial spirit throughout the sector. By overcoming challenges like initial investment costs and the sector's fragmentation, by providing education and technical support, and by increasing government incentives and consumer awareness for sustainable products, circular economy principles could become more integrated into the olive sector, contributing to greater sustainability of the sector and economic resilience.

2. Introduction

2.1. Purpose and Objectives

This report presents the research on the current and future skills levels and the emerging professions for transition of the olive oil sector to circular economy in Greece. The report is a part of Work Package 2 ("Identification of olive sector circular needs and emerging skills and/or professions for transition of the olive oil sector to a circular economy in the 5 countries,,) of the CIRCOLIVE project ("Developing skills for introducing circular business models and digital technologies in the olive oil sector,,) and represents deliverable D2.3. ("National Report on current and future skill levels for transition of the olive oil sector to circular economy- Greece,,).

The aim of this report is to investigate and analyze current skill levels, factors shaping the demand for skills, skill gaps and future skill needs and occupations related to circular economy in olive growing sector. The review of the available literature and the analysis of the collected data determined current and future skills levels and emerging professions in Greece, which will be used as basis for further project activities and the creation of a curriculum for vocational education and training on circular business skills in the olive growing sector in Greece.

2.2. Key Findings

Greece is one of the world's leading producers of olive oil, which is a product that plays a crucial role in both the country's economy and culture. By embracing circular economy principles, the Greek olive sector can become more resilient, sustainable, and profitable. Transitioning to a circular economy model can address environmental challenges, improve resource efficiency, and create new business opportunities. Towards this direction it is important for the sector to



develop and cultivate a broad set of skills across technical, managerial, agricultural, and entrepreneurial expertise and to establish professions aligned with circular economy principles. To manage this transition collaboration among stakeholders, investment in innovation, supportive policies and effective transfer of knowledge are required to ensure the successful adoption of circular economy.

3. Methodology

The chapter "Methodology" describes the methods of data collection and their analysis. The aim of the chapter is to inform the reader about the methodology used and the possibility of repeating the study using the same methodology.

3.1. Data collection methods

The data was collected from two data sources: primary and secondary data sources.

Primary data collection involves the process of preparing tools for data collection and collecting data from a planned sample of respondents. Three data collection instruments were prepared for the purposes of this study: a questionnaire and two interview reminders. The questionnaire was designed with the aim of collecting quantitative data on a sample of professionals in the olive oil sector. The questionnaire (ANNEX 1 (D2.3): Online survey targeting MSMEs in the olive oil sector about current and future skills needs for transition of the olive oil sector to circular economy) contained multiple-choice questions, closed questions, open questions and questions in the form of a Likert scale. The questions related to current skill levels, factors shaping the demand for skills, skill gaps and future skill needs and occupations related to the circular economy in olive growing sector. ESCO occupation groups and skills were used, to the extent possible to identify the most demanded skills (Table 1, Table 2).

Table 1. Occupations from ESCO used in the questionnaire (ANNEX 1 (D2.3))

Occupations in the survey	ESCO occupations	ESCO occupation code
Agronomist	Agronomist	2132.2
Agricultural production manager	Agricultural and forestry production manager	1311
Agricultural labourer	Agricultural, forestry and fishery labourer	921
Environmental engineer	Environmental engineer	2143.1
Oil mill operator	Oil mill operator	7514.2
Food technologist	Food technologist	2145.1.4
Quality control and safety officer	Industrial quality control manager	1321.2.2
	Health safety and environmental manager	1213.7
Packaging production manager	Packaging production manager	2141.9
Logistics and supply chain manager	Supply chain manager	1324.8
	Logistics engineer	2149.2.6
Researcher and scientist	Research engineer	2149.2.8



in circular economy	Soil scientist	2133.11
Sustainability manager	Sustainability manager	1213.8
Alternative fuels engineer	Alternative fuels engineer	2149.9.1
Waste treatment engineer	Waste treatment engineer	2143.1.4
Recycling specialist	Recycling specialist	2143.1.3
Food technician	Food technician	3119.5
Product development engineering drafter	Product development engineering drafter	3118.3.12
Environmental programme coordinator	Environmental programme coordinator	2133.6

Table 2. Skills and knowledge from ESCO used in the questionnaire (ANNEX 1 (D2.3))

Skills in the survey	ESCO skills and knowledge	Concept URI
Knowledge of sustainable farming practices	Follow environmentally-sustainable work practices	http://data.europa.eu/esco/skill/a992f345-7c06-4982-8fc9-5fab55e316af
Knowledge of water and soil protection	Advise on soil and water protection	http://data.europa.eu/esco/skill/3e25fd3e-2bcd-4320-9587-0aadf7fb93b1
Organic farming and pest control techniques	Organic farming	http://data.europa.eu/esco/skill/186da517-9a3e-41cd-9158-4001e3694459
	Perform pest control	http://data.europa.eu/esco/skill/08881cb7-5331-4b11-9442-4d7c9fce749e
Understanding of food policies and regulations	Food policy	http://data.europa.eu/esco/skill/e591f458-93c4-4cc7-a441-2340545c33f3
	Control food safety regulations	http://data.europa.eu/esco/skill/4d7410df-51a9-42bc-83ec-363c201ee631
Waste and by-product management	Waste management	http://data.europa.eu/esco/skill/40f65a56-ccb-4601-9f32-1cc6cdd24f28
	By-products	http://data.europa.eu/esco/skill/f2412a5c-8072-4cd7-8fa1-806864f91276
Energy efficiency in production	Energy efficiency	http://data.europa.eu/esco/skill/83fc0b2b-6cd2-46af-b1ff-d3fc83604c26
Supply chain management	Supply chain management	http://data.europa.eu/esco/skill/f929c89e-c363-4132-a918-e021d57b307c
Digital skills (e.g. data management, precision agriculture)	Product data management	http://data.europa.eu/esco/skill/e2d0daae-2aa1-40cc-99e2-b340b02f97d3
	Agriculture not further defined	http://data.europa.eu/esco/isced-f/0810
Produce sustainable products	Produce sustainable products	http://data.europa.eu/esco/skill/97725325-5287-4ebb-9f83-1ba2c38f465c
Develop and	Develop waste	http://data.europa.eu/esco/skill/114a79ef-



coordinate waste management processes	management processes	1e62-475b-a862-954f5b4cca20
Develop recycling programs	Develop recycling programs	http://data.europa.eu/esco/skill/862920c8-f2d0-4058-8fb8-9f06fbfc2446
Renewable energy integration	Renewable energy	http://data.europa.eu/esco/skill/f8413360-6114-40de-a276-c59b764b9913
Product data management and digitalization	Product data management	http://data.europa.eu/esco/skill/e2d0daae-2aa1-40cc-99e2-b340b02f97d3
Ensure compliance with environmental legislation	Ensure compliance with environmental legislation	http://data.europa.eu/esco/skill/089ee650-297e-4716-87d1-440743b70a0d
Asses the life cycle of resources	Asses the life cycle of resources	http://data.europa.eu/esco/skill/4e87c852-602a-4a0e-b8d8-20709ce14ac5
Develop new food products	Develop new food products	http://data.europa.eu/esco/skill/090ae6b3-12ab-4c72-b98a-17b790cf416e
Plan digital marketing/digital skills	Plan digital marketing	http://data.europa.eu/esco/skill/736ef286-fbd3-4e5c-a4b4-d1e2008c9898
Implement marketing strategies	Implement marketing strategies	http://data.europa.eu/esco/skill/13e2378e-0d10-450d-843a-b3592575826e
Green marketing	Marketing principles	http://data.europa.eu/esco/skill/de03f4fd-c147-4477-a048-7109e5ba2d6f
Thinking creatively and innovatively	Thinking creatively and innovatively	http://data.europa.eu/esco/skill/e84d080a-ff6d-41a7-b7b9-133e97c7bf00
Entrepreneurial mindset	Show entrepreneurial spirit	http://data.europa.eu/esco/skill/bdcf429c-5ccf-4c3d-bb61-4c987573a35e
Deep tech knowledge	Principles of artificial intelligence	http://data.europa.eu/esco/skill/e465a154-93f7-4973-9ce1-31659fe16dd2
	Principles of artificial intelligence	http://data.europa.eu/esco/skill/f049d050-12da-4e40-813a-2b5eb6df6b51

Data was collected from 20 respondents, as it was planned (Table 3). The questionnaires were collected online via Google forms.

Table 3. Description of the sample of respondents who participated in the online questionnaire (N=20)



Variable	N	Percentage (%)
Gender		
Male	18	90
Female	2	10
Age		
Up to 36	0	
37 - 56	9	45
57 and more	11	55
Education		
High school and lower	3	15
Bachelor degree	7	35
Master degree	8	40
PhD	2	10
Enterprise size		
Micro (<10 employees)	18	90
Small (<50 employees)	1	5
Medium sized (<250 employees)	1	5

Two interview reminders were also prepared for the qualitative data collection. One interview reminder was prepared for experts in the agri-food sector (ANNEX 2 (D2.3): Structured interview with circular business agro-food experts/professionals about current and future skills needs for transition of the olive oil sector to circular economy). The other one was for providers of education in Greece (ANNEX 3 (D2.3): Structured interview with VET providers about current and future skills needs for transition of the olive oil sector to circular economy). The reminders contained open ended questions with a selection of possible answers to guide the conversation and conduct the interview as efficiently as possible. The planned sample size was 5 respondents for experts in the agri-food sector and 5 respondents for providers of education. Interviews were conducted face-to-face with respondents and through an online meeting. The interviews were recorded and a transcript of the conversation was made. Each respondent has voluntarily and expressly consented to the collection and further processing of personal data and has voluntarily agreed to answer questions for the purpose of research within the CIRCOLIVE project. Each respondent has confirmed this with their signature in the documents: a) Statement related to giving consent for the processing of personal data and b) Information form for participation in research – personal informed consent.

Secondary data are ready-collected data that come from various sources, e.g: available studies, skills needs analysis, forecasts, etc. When using this data, the source is always cited in the report and the list of references used can be found in chapter 9 of this Report.

3.2. Data analysis methods

After the data collection was completed, the data analysis was carried out. Quantitative data



collected through questionnaires were analyzed using descriptive analysis and response frequencies. The data are presented in the form of tables, graphically through graphs and descriptively. The data collected through the interviews were processed through a content analysis.

4. Current Skill Levels regarding Circular Economy in the Olive Oil Sector

Circular economy in the olive sector in Greece is still in the early stages of development, but it is gaining attention as the need for sustainability is increasing globally. Greece is one of the world's leading producers of olive oil, and the implementation of circular economy principles in the agricultural sector is of immense significance (Kounani et al. 2023a). These principles aim to reduce waste, to extend the lifecycle of products, and to maximize the resource efficiency (Murray et al., 2017). Thus, Greece's new CAP Strategic Plan aims at a more resilient, green and digital agriculture, in line with the priorities of the European Green Deal, supporting a more efficient management of the natural resources and reduction of the agriculture's environmental footprint (Greece's CAP Strategic Plan 2023-2027).

Awareness about circular economy is growing among olive oil producers in Greece, but it still remains inconsistent across the industry sector (Kounani et al. 2024). Greek olive oil mills are generally enterprises of small to medium size (Foteinopoulos & Darakas, 2018) and most of them do not bottle or market olive oil. Although larger olive oil mills and producers are more likely to adopt circular practices, smaller and traditional producers, still have limited exposure to the circular economy principles, and often focus on more immediate economic concerns rather than long-term sustainability.

As the olive sector generates significant waste, including pomace, wastewater, and other by-products there are efforts creating value from olive waste and by-products via circular bio-economy approaches (Kounani et al. 2023a; Martínez et al., 2024). However there are certain difficulties in treating olive mill waste mainly due to its high organic load, the seasonal operation of olive mills (typically from November to February), its high territorial scattering and the high costs for installing a waste treatment facility especially for small- and medium-sized producers (Ergüder et al. 2000; Vlysidis et al., 2017). Nonetheless, it is crucial to find solutions for olive waste and by-products treatment in order to avoid negative environmental impacts combined with an effort to locally preserve scarce natural resources (energy, water, soil, raw material). The skills that are related to recycling and reusing these materials are gradually evolving, with some producers investing in processes such as biogas production, composting, or usage of the pomace for energy generation and pomace oil production (Kounani et al. 2024).

There's also a growing effort driven by circular economy to use water more effectively and to reduce energy consumption during olive oil production (Dutournié et al., 2019; Kounani et al., 2023a). However, there are many producers owning smaller farms and mills that still lack the technical expertise to implement these measures effectively and continue to use traditional methods.

Nowadays in Greece according to the questionnaires answered in this investigation many of the enterprises (at a percentage of 50%) occupy agronomists and agricultural production managers and also in some agricultural consultants, civil engineers, oil mill operators and food technologists (Figure 1).

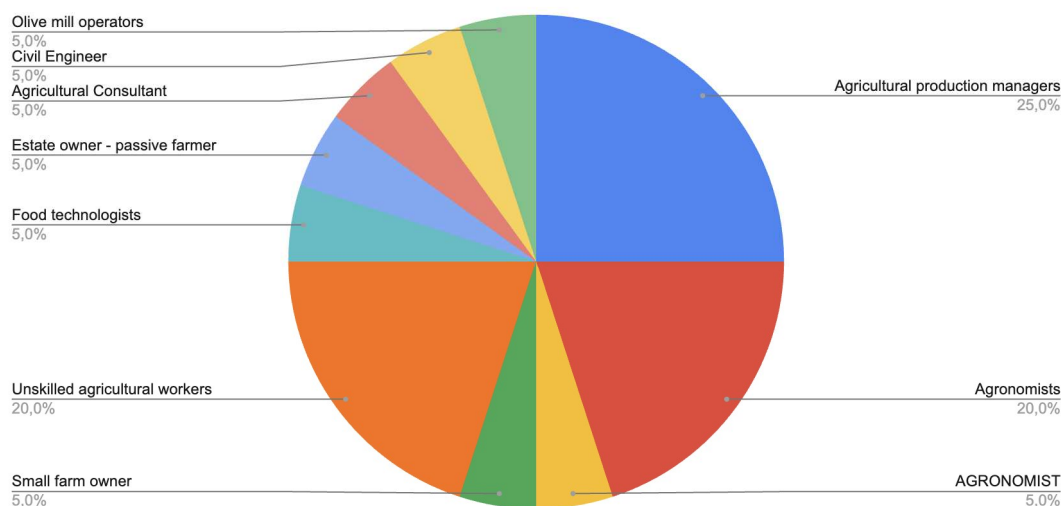


Figure 1. Occupations/professions employed in the olive oil sector according to the respondents

Furthermore 60% of the respondents are aware of and in some cases implement practices such as, water reduction and by-product valorization methods, 8% of them use eco-friendly packaging materials, 5% use renewable energy sources, while the rest know or even implement either sustainable transportation techniques and logistics solutions or water recycling methods and its efficient usage in olive oil production. Many of them (around 40%) also believe that their skills and their knowledge about circular economy are adequate or even good (15%), whereas 35% of them consider it limited (Figure 2). Moreover, most of the circular business agro food experts/professionals interviewed, with good or even excellent skills and knowledge on circular economy, stated that they are currently using in their enterprises water reduction and by-product valorization methods, eco-friendly packaging materials and carbon footprint reduction practices.

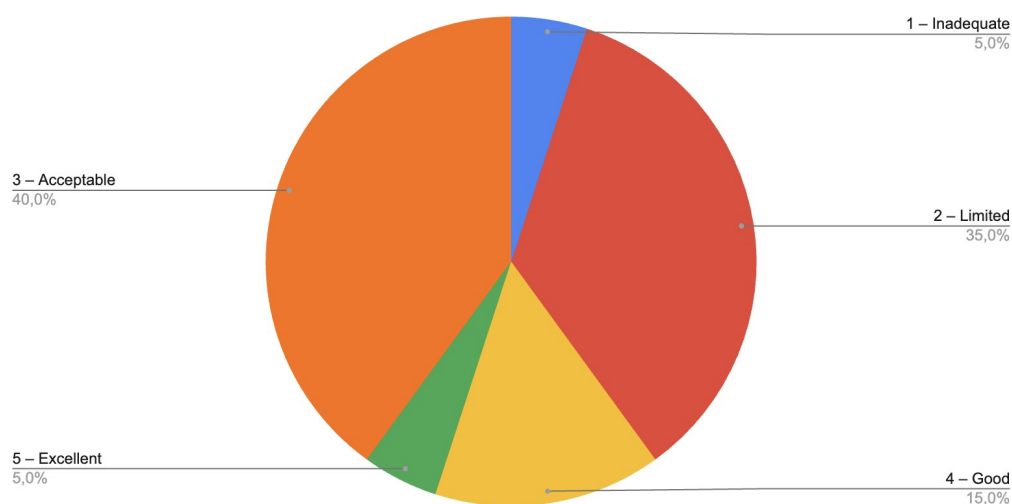


Figure 2. Level of skills and knowledge of the respondents related to the circular economy

Concerning the skills that are required for the implementation of circular economy in the olive oil sector, knowledge of sustainable farming practices and of water and soil protection was considered by most of the respondents as the most significant, followed by organic farming and pest control techniques, understanding of food policies and regulations and waste and by-product management (Figure 3). In accordance to these results all the VET providers and most of

the agro-food experts interviewed, agreed that knowledge of sustainable farming practices, water and soil protection and also waste and by-product management are very important for the adoption of circular economy principles.

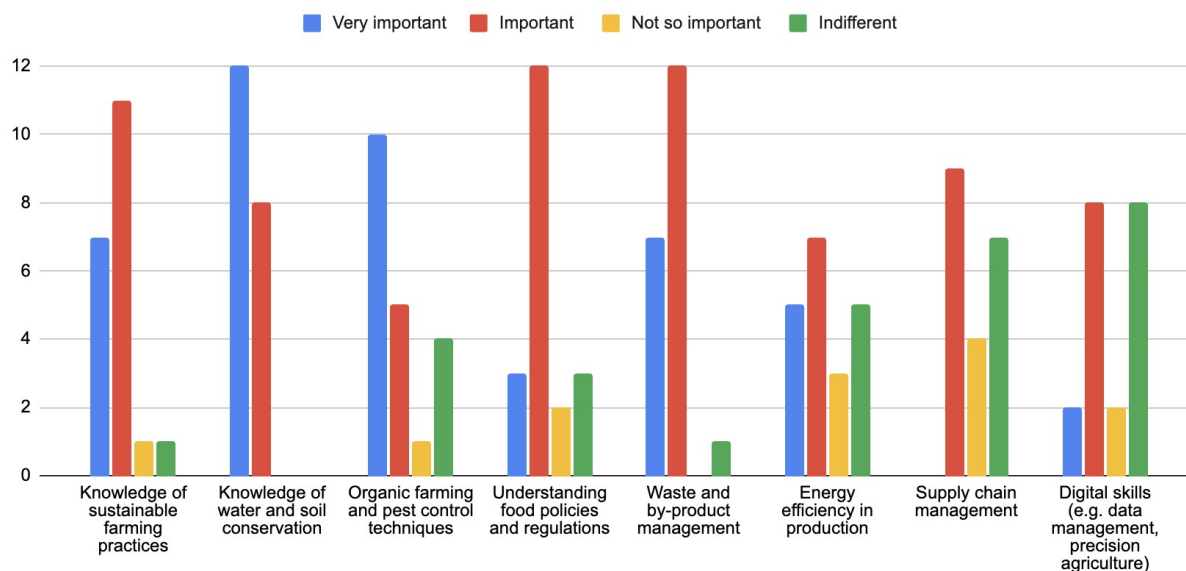


Figure 3. Skills that are most important in the olive oil sector regarding circular economy according to the respondents (N=20).

Regarding training and knowledge dissemination of circular economy principles in Greece, it is limited although increasing. There are a few national and EU-funded initiatives (e.g. CAP Strategic Plan, LIFE programs etc.) aiming to enhance skills that concern sustainable production practices, but often aim at farmers and enterprises occupied in broader agriculture, not specifically the olive oil sector. There are also a few Greek universities and research centers that offer courses related to circular economy practices in agriculture, including olive oil production. Although Greece has universities (e.g. Agricultural University of Athens, Technical University of Greece) and research institutions that are involved in circular economy practices, including the reuse of by-products from olive oil production, the transition of the olive sector into circular economy is still in development, as there is a need for more skilled professionals to disseminate the knowledge and apply the new technologies in the field. Specifically, from the answers given by the VET provider interviewees emerged that the non-profit organization “New Agriculture – New Generation” is currently providing training programs for adults on sustainable olive farming and olive oil production under the title "Open Olive Academy".

5. Current Skill Gaps regarding Circular Economy in the Olive Oil Sector

Although it is undisputable for the olive oil sector to integrate into circular economy, there are only a small percentage of olive mills in Greece that actually follow such principles. Olive mill owners' attitudes towards circular economy have played and continue to play a decisive role in the degree of circularity of each olive mill and the industry as a whole (Kounani et al. 2024).



Treatment of the waste produced through the olive sector can be based on circular and bioeconomy principles, such as cascading (a consecutive production process in which waste is used for high-added value products or ingredients before the remaining biomass being used for lower added-value products), upcycling (converting waste into a higher added-value product), recycling, or recovering for bioenergy use. Nevertheless, most of the waste in Greece is currently used for low or medium-value products (details in D2.1 & D2.2) and only a very small percentage of the Greek olive oil mills follow a standard in environmental management (ISO14001) (Kounani et al. 2024). The olive industry still relies heavily on traditional farming practices and faces difficulties in fully integrating modern technologies. One of the greatest problems in valorizing waste from the olive oil sector in Greece is the seasonal operation of olive mills and their territorial scattering. However, cooperatives or partnerships between the stakeholders of the sector could be ideal structures regarding the critical waste quantities needed for a profitable collection and valorization, including investments in technologies (Donner et al. 2022).

Two significant challenges for the adoption of circular economy in the enterprises involved in the olive oil sector are both the strong managerial implication (internal factor) and the financial and technical support from experts, policy and decision-makers (external factor). There is unfortunately limited specialized knowledge among many olive oil producers in Greece, especially in relation to advanced technologies for waste recycling and resource recovery. According to a study conducted by Donner et al. (2022) the existence of skilled human resources was essential for the adoption of circular economy approaches in two Greek cooperatives. In the first case transformation was conducted by a young proactive management, while in the second one the collaboration with sustainability consultants was one of the key factors for a successful circular economy approach. Another possible solution to fill the knowledge gaps in adopting circular economy principles could be the formation of shareholding enterprises which form strong ties with olive farmers. Farmers in these cases comply with the companies' quality requirements, and the companies provide input used for production and advisory service (Donner et al. 2022).

Large investments are often also required in order to implement technologies for the treatment of waste and by-products. Even though subsidies are needed for the incorporation of strategies based on circular economy the enterprises do not have any specific support measures. Thus, although the significance of waste management activities is recognized, it is not supported in practice (Radić et al., 2021).

There's also need for more market incentives or policies that could encourage circular economy practices within the sector in Greece. Key partnerships are a crucial element for the implementation of circular business models in the olive oil sector. Forming of a cooperative may serve for collective marketing, as olive oil produced by numerous small farms can be collectively branded under the cooperative mark (Donner et al. 2022). Partnerships can also be formed as a business cluster or a gathering of enterprises from the same region. Nevertheless, as previously analyzed in details in D2.1 and D2.2 (CIRCOLIVE project, 2024) olive farming in Greece is highly fragmented with a large number of small farms and dominated by smallholders.

Furthermore a significant portion of Greek olive oil producers, especially smallholder farmers, have limited digital skills. Many of them still use traditional farming and processing methods, and thus, they often consider digital transformation of their operations to be complex or unnecessary. This reluctance or lack of awareness prevents the adoption of new technologies



that could enhance their enterprises' efficiency, sustainability, and profitability. It is often also accompanied by lack of the suitable digital infrastructure that can ensure quality control or track traceability throughout the production process.

According to the field research of the CIRCOLIVE project (Questionnaires) there are many factors that form a demand for new skills involved in the olive oil sector and the most influencing of them are: (a) the pressure to improve sustainability performance (such as need for cost reduction or supply chain issues) (according to 75% of the respondents), (b) environmental regulation and policies (55% of the respondents), (c) financial changes (such as global markets and trade policies) (40% of the respondents), (d) adoption of circular economy models (35%) and (e) development of new technologies (such as ultrafiltration filters) and innovation (35%) (Figure 4). VET providers interviewed also agreed that these factors make the development of new skills necessary. Furthermore, it was mentioned during these interviews that practices which include management of wastewater and recovery of many useful components (such as phenolic compounds) can be crucial for the olive oil sector. Additionally, according to the agro food experts' interviews, environmental regulation and policies (at the percentage of 80%) and adoption of circular economy models, development of new technologies and innovation, resource scarcity and global market demands and trade dynamics (all at the percentage of 60%) play significant role in shaping the need for new skills in the olive oil sector.

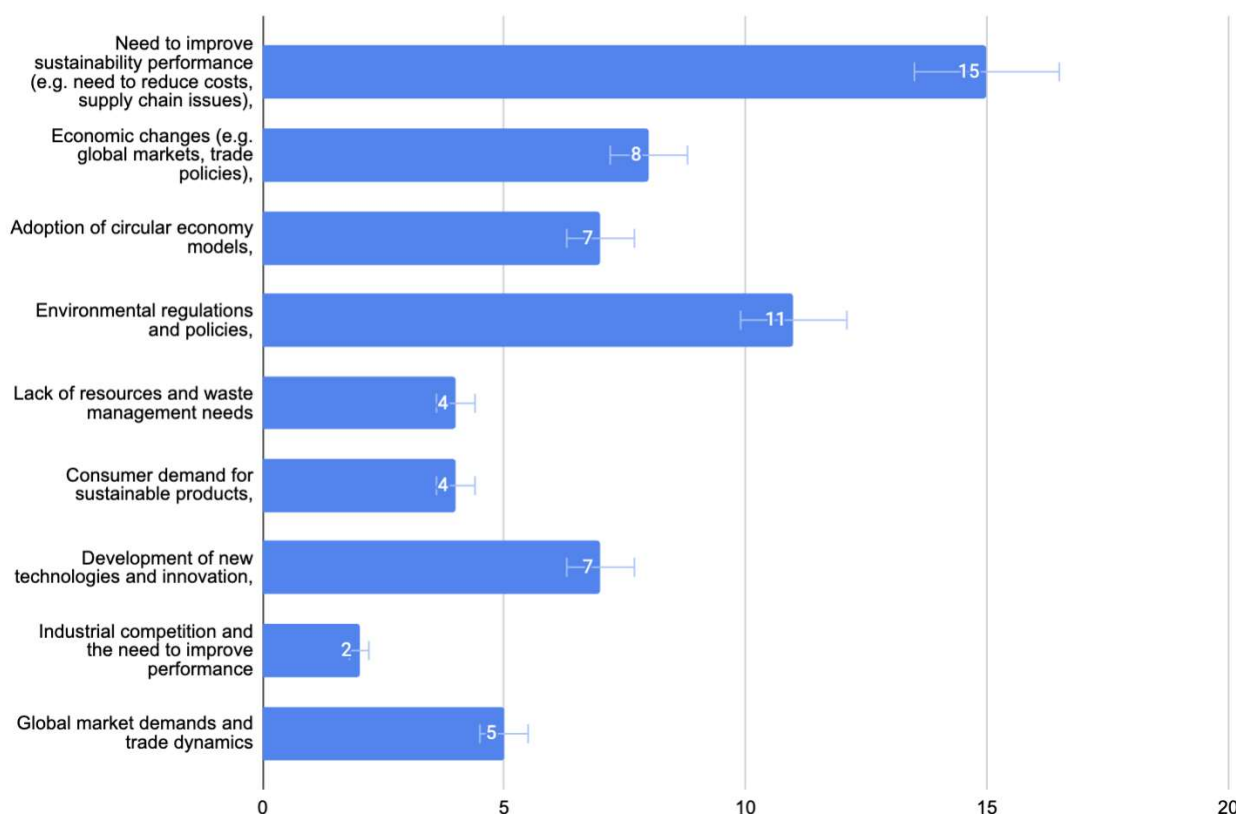


Figure 4. Factors that most influence the demand for new skills according to the respondents (axis x shows the number of answers, N=20)

When questionnaires' respondents were asked about the skill gaps that limit their transition to a circular economy model, 80% of them answered that financial constraints prevent them from doing so 53% that limited knowledge of circular economy principles is a problem for them and



that lack of regulatory incentives constitutes a barrier (Figure 5). In a similar manner agro food experts agreed that there are financial constraints and lack of knowledge on circular economy that block the adoption of CE principles, but also pointed the lack of technical skills for sustainable production methods and the limited entrepreneurial spirit throughout the Greek olive oil sector to hinder the transition of the sector to a circular economy model.

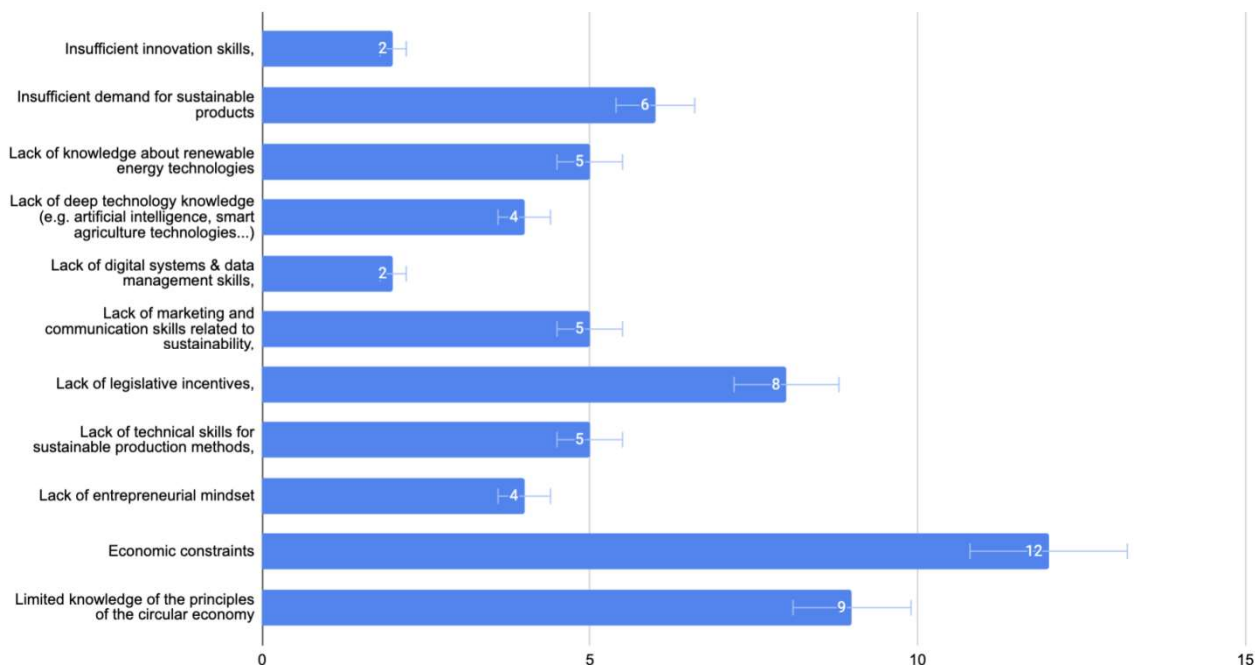


Figure 5. Skill gaps that limit the effort to transition to circular economy according to the respondents (axis s shows the number of answers, N=20)

Finally, according to the answers given to the questionnaires some of the professions involved in the olive sector such as, sustainability managers, waste treatment engineers, recycling specialists and environmental engineers require skills in circular economy. Also, both the respondents of the questionnaires and the agro-food experts interviewed agreed that occupations such as agricultural production managers, agronomists, supply chain managers and researchers/scientists in circular economy should also be equipped with circular economy skills.

6. Future Skill Needs and Emerging Professions for Transition of Olive Oil Sector to Circular Economy

The transition of Greece's olive oil sector to a circular economy model requires skills and emerging professions to promote sustainability, resource efficiency, and waste reduction. To facilitate this shift, the sector will need a workforce equipped with a variety of technical, managerial, and entrepreneurial skills.

Among the emerging professions that would be needed for the implementation of circular economy principles in the olive oil sector Sustainability Consultants and/or Circular Economy Managers with knowledge of sustainability principles, life cycle analysis, waste management, resource efficiency, and sustainable agricultural practices could serve by helping olive oil producers to design and implement circular practices, from farming and processing to packaging



and disposal, customized to their needs. Moreover Waste Valorization Engineers who expertise in waste management and upcycling would help the stakeholders involved in the sector to adopt techniques for reusing or valorizing waste to high added value products.

Additionally, emerging professions such as Data Analysts and Precision Farming Experts, specialized in precision agriculture tools, data analytics, and smart farming systems that enable efficient use of resources like water, energy, and fertilizers could help stakeholders of the sector develop and implement digital solutions that provide real-time data on various aspects of the olive oil production process. Thus, better decision-making, optimization of resource use, and tracking of environmental impacts can be achieved contributing to a more sustainable, circular business model.

Furthermore, experts such as Marketing Professionals for eco-friendly products expertised in sustainable packaging and design of eco-friendly materials will be needed, as the demand for eco-friendly products increases, for designing packaging that is fully recyclable, biodegradable, or reusable. Additionally, professions such as Renewable Energy Specialists, with knowledge in renewable energy systems, energy audits, and energy management, and Supply chain Specialists for green logistics who expertise in circular supply chain management, logistics and sourcing sustainable materials, could help olive oil producers redesign their supply chains to prioritize sustainability, waste reduction, and closed-loop systems. They will ensure that through the entire supply chain—from the procurement of olive trees to the final packaging - circular economy practices are implemented.

Olive farmers and olive oil mill owners that answered the questionnaires in our investigation stated that by-product and waste management (at the rate of 85%), production of sustainable products (75%), development and coordination of recycling programs (65%) and renewable energy integration (at the percentage of 50%) are the most critical skills for ensuring their enterprises' future success in adopting circular economy principles (Figure 6). During the interviews similar answers were given regarding the skills required for the transition into circular economy, with agro-food experts further noting the importance of the assessment of the life cycle of the available resources.

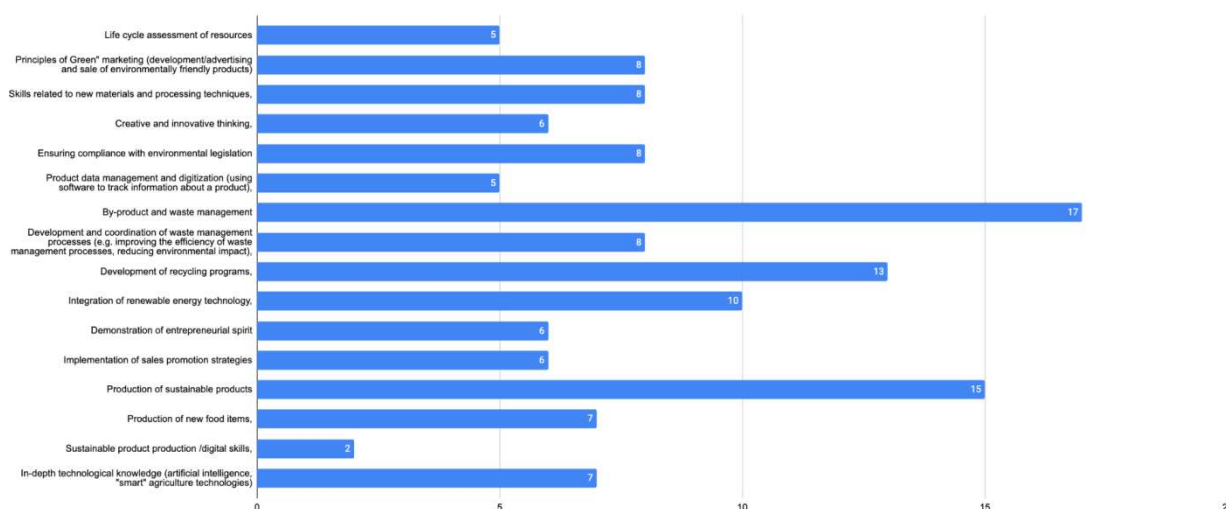


Figure 6. Skills that are important to the stakeholders of the sector to successfully adopt circular economy practices in the future (axis s shows the number of answers, N=20)



The respondents of the questionnaires and the agro-food experts also believe that professions such as circular economy managers (at a percentage of 55%) waste valorization engineers (e.g. for biofuel production from waste) (55%), data analysts for sustainable agriculture (30%) and marketing professionals for eco-friendly products (30%) will become important in the future for the transition of the olive oil sector into circular economy (Figure 7). And these professions will require the development of future skills such as knowledge of waste and by-product valorization (at a rate of 80%), circular product design and eco-packaging (40%). The VET providers interviewed further consider that environmental impact auditors will be needed for a better implementation of circular economy in the olive oil sector. Also, according to their answers, expertise in sustainable resource management is a skill that will be critical for all these emerging professions (Figure 8).

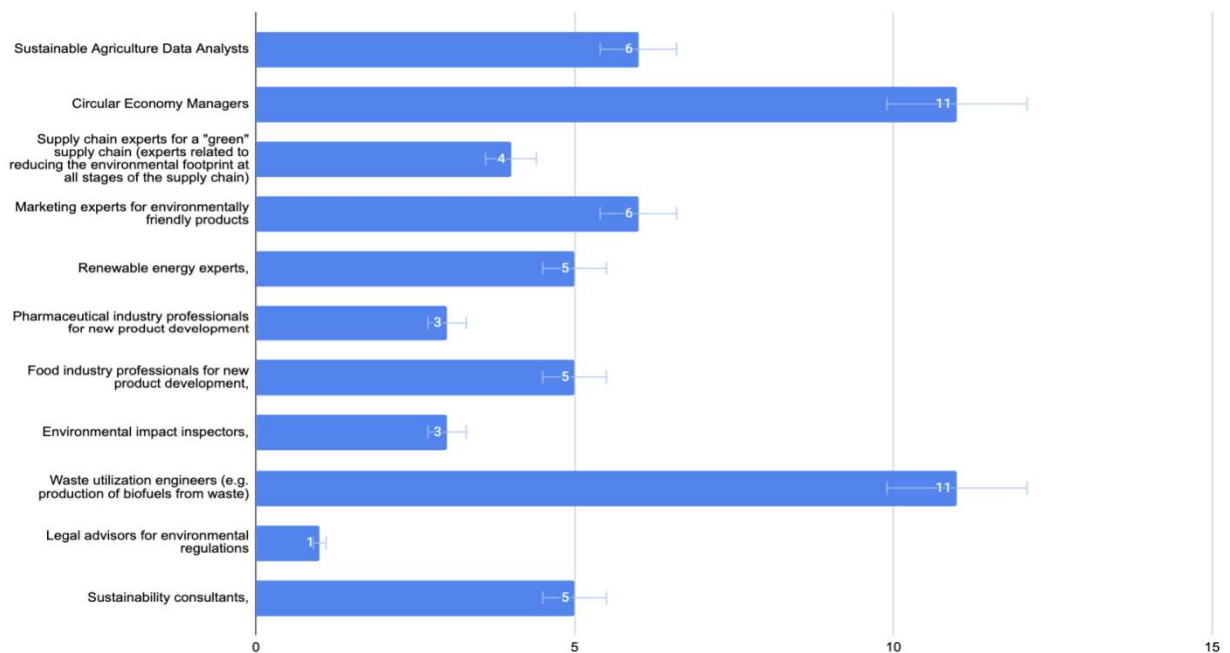


Figure 7. Emerging professions that will become important in the future for the transition of olive oil sector to circular economy (axis s shows the number of answers, N=20)

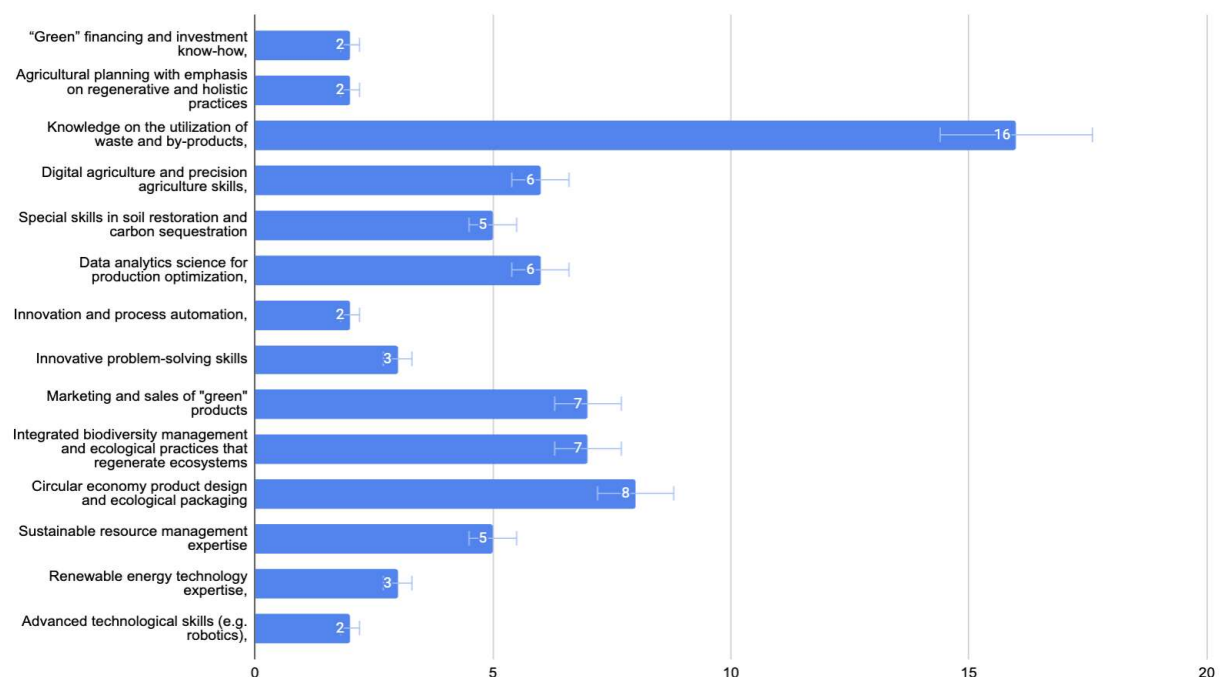




Figure 8. Skills related to circular economy in the olive sector that will be important for the emerging professions in the future (axis s shows the number of answers, N=20)

Regarding the possibility for the Greek educational institutions to provide courses on circular economy principles all the VET providers answered positively. Specifically, concerning ELGO-Dimitra it was reported that it can implement training programs aiming to stakeholders of the olive sector with experience in olive oil production processes. The organization “New Agriculture – New Generation” could probably provide live demonstrations in a field or a mill and/or online seminars in the form of asynchronous videos, aimed at stakeholders of the sector, who would be receptive to change and collaborate with industry professionals and who also understand the importance of sustainable development. Finally, Agricultural University of Athens could conduct programs with courses on circular economy practices, in the form of mixed training (face-to-face and asynchronous) that could be attended by whoever believes in the philosophy of circular economy. Furthermore, the Center of Education and Lifelong Learning of Agricultural University of Athens should offer relative, short-term programs that would be not particularly specialized and thus, better understandable by participants with no studies on agriculture.

7. Conclusions

While there is growing awareness concerning circular economy in the olive oil sector in Greece, the level of green skills applied throughout the sector vary widely depending on the size and innovation capacity of the individual stakeholders. Larger, more advanced enterprises are more probable to adopt circular economy practices, but a broader, industry-wide transition will require investment in education, training, and infrastructure development. Although there are currently several olive oil mills or cooperatives across the country that follow environmentally friendly practices and refer to themselves as biological olive oil mills, most of these practices refer to the cultivation process rather than the olive oil production process (Kounani et al. 2023b).

Generally, there is a strong belief that skills such as, knowledge of sustainable farming practices and of water and soil protection, organic farming and pest control techniques, understanding of food policies and regulations and waste and by-product management are required for the implementation of circular economy in the Greek olive oil sector. Furthermore, according to the stakeholders of the sector, professions involved in the olive sector such as, sustainability managers, waste treatment engineers, recycling specialists, environmental engineers, agricultural production managers, agronomists, supply chain managers and researchers/scientists should be equipped with circular economy skills.

Although treating olive oil sector’s effluents is challenging, most of the waste in Greece is currently converted to low or medium-value products and the sector still relies heavily on traditional farming practices and faces difficulties in adopting modern technologies. Nevertheless, there are stakeholders of the Greek olive oil sector, according to our field research, who are aware of and in some cases implement practices in the context of circular economy such as, water reduction and by-product valorization methods, usage of eco-friendly packaging materials, usage of renewable energy sources, sustainable transportation techniques and logistics solutions and water recycling and its efficient usage in olive oil production.



There is an evolving demand for new skills in the olive oil sector in Greece, which is formed by factors such as the pressure to improve sustainability performance, environmental regulation the need to improve sustainability performance, environmental regulation and policies, financial changes, adoption of circular economy models and development of new technologies.

Among the skill gaps that are currently limiting the Greek olive oil sector's transition to a circular economy model Greece are financial constraints, limited knowledge of circular economy principles, lack of regulatory incentives, lack of technical skills for sustainable production methods and the limited entrepreneurial spirit throughout the sector. Even though external financial support is required for investing in new technologies and the relative infrastructure to support them, the enterprises of the sector do not have often any specific support measures. Additionally, market incentives or policies that could encourage more sustainable practices within the sector in Greece are not strong enough to provide incentives for the implementation of new technologies. There is apparently need for reinforcement of awareness and transfer of knowledge from the research level to the field to challenge the stakeholders of the sector for further applying circular economy principles.

Education on circular economy in the olive oil sector in Greece has the potential to revolutionize the sector by aligning it with modern sustainability goals, boosting profitability, and protecting the environment. Although universities and research institutions in Greece, such as the Agricultural University of Athens and the Technical University of Crete, are actively engaged in research on waste valorization and sustainable practices in olive oil production, there are limited relative courses available to the stakeholders of the sector. Nevertheless, the possibility and the capability for the Greek educational institutions to provide courses on circular economy principles exists, according to our field research.

8. Recommendations

The transition of Greece's olive oil sector to a circular economy model is essential for sustainability, economic resilience, and global competitiveness. This shift requires targeted skill development and the establishment of professions aligned with circular economy principles. Specifically, there is need for emerging professions, such as Sustainability Consultants and Circular Economy Managers with knowledge of sustainability principles, Waste Valorization Engineers who expertise in waste management and upcycling, Data Analysts and Precision Farming Experts, specialized in precision agriculture tools, data analytics, and smart farming systems, Marketing Professionals for eco-friendly products expertised in sustainable packaging and design of eco-friendly materials, Renewable Energy Specialists, with knowledge in renewable energy systems, energy audits, and energy management, and Supply chain Specialists for green logistics, to ensure that through the entire supply chain-from the procurement of olive trees to the final packaging- circular economy practices are implemented. And these professions will require the development of future skills such as knowledge of waste and by-product valorization, circular product design and eco-packaging, environmental impact management, and specialization in sustainable resource management, according to our field research.

Transitioning the Greek olive oil sector into a circular economy model requires a multifaceted approach that combines technological innovation, policy and financial support, consumer awareness, and collaborative efforts among stakeholders.



For the purpose of implementation of circular economy in the Greek olive oil sector there are several strategies that have to be adopted. Specifically, establishing partnerships among farmers, cooperatives, and researchers is crucial. Such collaborations can lead to shared resources, shared value creation based on olive oil waste and by-products and enhanced knowledge of circular practices in the sector. Awareness among producers, distributors, and consumers about the benefits of circular practices needs to be raised, while they have to be educated to lead their behavior towards more sustainable paths. Consumer informing on circular economy is still low in Greece, indicating the necessity for communicating marketing plans that will point out benefits of circular economy products, including olive oil, and will provide information about the crucial importance of reducing environmental problems caused by the olive oil industry. Stakeholders of the sector have to be equipped with knowledge of modern technologies for waste treatment and recycling. Despite the mainstream policy for more sustainable production, there is often still lack of financial support that will assist olive oil stakeholders in incorporating alternative valorization strategies and in connecting with research projects or businesses dedicated to manufacturing high value products out of olive oil waste and to supporting circular economy initiatives.

While circular economy has recently started to be implemented across the Greek olive sector, there are promising signs of progress, particularly in regions and enterprises that have the potential to invest in sustainable innovation. By growing awareness, providing legal, technical and financial support, and the suitable infrastructure, circular economy could become a cornerstone of the Greek olive industry leading to sustainable growth.

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10. Appendices

10.1. Survey Questionnaires and Interviews

10.1.1. Annex 1 (D2.3) – Online Survey targeting MSMEs in the Olive Oil Sector about Current and Future Skills Needs for Transition of the Olive Oil Sector to Circular Economy

ANNEX 1 (D2.3): Online Survey targeting MSMEs in the Olive Oil Sector about Current and Future Skills Needs for transition of the Olive Oil Sector to Circular Economy

This survey is launched as the second consultation activity of the project *“Developing skills for introducing circular business models and digital technologies in olive oil sector (CIRCOLIVE)”*, a three-year project co-funded by the European Union under the Erasmus+ Programme.

The project aims to support the EU transition to the Circular Economy by improving/enhancing the circular business skills in the olive oil sector in Spain, Italy, Greece, Portugal and Croatia, in order to promote the



adoption of circular entrepreneurial models for waste and by-product valorization of the whole olive value chain.

The answers to this survey will help us in the identification of skills for developing VET curricula on circular business models and digital technologies in olive oil sector.

In this survey definition of *Circular Economy* presents methods and possibilities of using olive by-products and waste in the olive oil sector. *ESCO* (European Skills, Competences, Qualifications and Occupations), the European multilingual classification of Skills, Competences, Qualifications and Occupations, was used to identify and select existing occupations and skills relevant to circular economy in the olive oil sector.

The survey takes **about 10 minutes**. Responses will be treated **anonymously** and the results will be used for **CIRCOLIVE project purposes only**.

Your answer is valuable to us and we thank you in advance for your time and effort.

Part 1: General Information

- 1) Respondent's gender
 - a) Male
 - b) Female
 - c) I prefer not to answer

- 2) Respondent's age _____ years old

- 3) Enterprise size:
 - a) Micro (<10 employees)
 - b) Small (<50 employees)
 - c) Medium sized (<250 employees)
 - d) Large size (>250 employees)

- 4) Respondent's education
 - a) High school and lower
 - b) Bachelor degree
 - c) Licenciatura degree
 - d) Master degree
 - e) PhD
 - f) Other _____

- 5) Which segment of the olive oil sector does your enterprise operate in?
 - Olive growing
 - Olive oil production
 - Olive growing and olive oil production



- Other (Please specify): _____

6) Which of the following best describes your **current occupation/profession*** in the olive oil sector? (Select the most relevant)

*selected occupations from ESCO relevant to olive oil sector. ESCO - the European multilingual classification of Skills, Competences, Qualifications and Occupations

- Agronomists
- Agricultural production managers
- Agricultural labourers
- Environmental engineers
- Oil mill operators
- Food technologists
- Quality control and safety officers
- Packaging production managers
- Sales and marketing managers
- Logistics and supply chain managers
- Researchers and scientists
- Other (Please specify): _____

Part 2: Current Skill Levels

7) Which of the following **circular economy practices** are you currently implementing or aware of in your enterprise? (Select all that apply)

- Waste reduction and by-product valorization (e.g., olive pomace composting)
- Water recycling and efficient usage in olive oil production
- Renewable energy use
- Eco-friendly packaging materials
- Sustainable transportation and logistics solutions
- Carbon footprint reduction
- None of the above

8) How do you **rate skills and knowledge** about circular economy (methods and possibilities of using olive by-products and waste in olive sector) in your enterprise?

- a) 1 - Poor
- b) 2 - Limited
- c) 3 - Acceptable
- d) 4 - Good
- e) 5 - Excellent

9) According to your opinion, which of the following **skills*** are most significant in the olive oil sector regarding circular economy? (Rank in order of importance, 1 not important at all to 5 being the most important)



* selected skills from ESCO adapted to olive oil sector. ESCO - the European multilingual classification of Skills, Competences, Qualifications and Occupations

- Knowledge of sustainable farming practices
- Knowledge of water and soil protection
- Organic farming and pest control techniques
- Understanding of food policies and regulations
- Waste and by-product management
- Energy efficiency in production
- Supply chain management
- Digital skills (e.g. data management, precision agriculture)

Part 3: Factors Shaping Skills Demand

10) In your opinion, which of the following **factors** are most influencing **the demand for new skills** in your enterprise? (Select all that apply):

- Pressure to improve sustainability performance (e.g., need for cost reduction, supply chain issues)
- Economic changes (e.g., global markets, trade policies)
- Adoption of circular economy models
- Environmental regulations and policies
- Consumer demand for sustainable products
- Industry competition and performance improvement pressures
- Development of new technologies and innovation
- Resource scarcity and waste management needs
- Global market demands and trade dynamics

Part 4: Skill Gaps

11) Are there any noticeable **skills gaps** in your enterprise that limit your ability to transition to a circular economy? (Select all that apply)

- Lack of technical skills for sustainable production methods
- Financial constraints
- Lack of regulatory incentives
- Limited knowledge of circular economy principles
- Lack of digital and data management skills
- Insufficient innovation skills
- Insufficient market demand for sustainable products
- Limited understanding of renewable energy technologies
- Shortage of marketing and communication skills related to sustainability
- Lack of entrepreneurial mindset
- Lack of deep tech knowledge (e.g. artificial intelligence, smart farming technologies...)



12) Do you think that the following **occupations, identified by ESCO, need circular economy skills** in the olive oil sector? (Yes/No/I don't know)

- Sustainability manager
- Alternative fuels engineer
- Waste treatment engineer
- Recycling specialist
- Environmental engineer
- Food technologist
- Food technician
- Product development engineering drafter
- Environmental programme coordinator

13) In the olive oil sector, do you think that following **occupations*** would also **need circular economy skills**? (Yes/No/I don't know)

*selected occupations from ESCO relevant to olive oil sector. ESCO - the European multilingual classification of Skills, Competences, Qualifications and Occupations

- Agronomists
- Agricultural production managers
- Agricultural labourers
- Oil mill operators
- Quality control and safety officers
- Packaging production managers
- Sales and marketing managers
- Logistics and supply chain managers
- Researchers and scientists

14) If you think that any other occupation in olive oil sector not listed above would also need circular economy skills, please list them below: _____

Part 5: Future Skill Needs and Occupations

15) Which of the following **skills*** are most critical for your company's **future** success in adopting circular economy practices? (Select all that apply):

*skills from ESCO adapted to olive oil sector. ESCO - the European multilingual classification of Skills, Competences, Qualifications and Occupations

- By-product and waste management
- Produce sustainable products
- Develop and coordinate waste management processes
- Develop recycling programs
- Renewable energy integration
- Product data management and digitalization
- Ensure compliance with environmental legislation



- Assess the life cycle of resources
- Develop new food products
- Plan digital marketing /digital skills
- Implement marketing strategies
- Green marketing
- Thinking creatively and innovatively
- Entrepreneurial mindset
- Deep tech knowledge (e.g. artificial intelligence, smart farming technologies...)

16) In your opinion, what **emerging occupations** do you expect will become important in the **future** in the olive oil sector **for transition to circular economy**? (Please, select 3)

- Circular economy managers
- Sustainability consultants
- Renewable energy specialists
- Waste valorization engineers (e.g., biofuel production from waste)
- Environmental impact auditors
- Data analysts for sustainable agriculture
- Marketing professionals for eco-friendly products
- Supply chain specialists for green logistics
- Legal advisors on environmental regulations
- Professionals in the food and pharmaceutical industry for the development of new products

17) In your opinion, which **future skills**, regarding circular economy, will be critical for these emerging **occupations** in the olive oil sector? (Please, select 3)

- Knowledge of waste and by-product valorization
- Expertise in sustainable resource management
- Digital and precision agriculture skills
- Circular product design and eco-packaging
- Data science and analytics for optimizing production
- Renewable energy technology expertise
- Process innovation and automation
- Marketing and sales of green products
- Green finance and investment expertise
- Leadership in sustainability strategy
- Specific skills in soil regeneration and carbon sequestration
- Integrated biodiversity management and ecological practices that regenerate ecosystems
- Agricultural planning with a focus on regenerative and holistic practices
- Deep tech skills (e.g. robotics, blockchain...)
- Innovative problem-solving skills

18) Dear respondent,

Thank you for your time and contribution to CIRCOLIVE project



19) I consent to have the information stated above used by the CIRCOLIVE project partners solely for meeting the purposes of this survey.

Yes – No

20) In case you want receive information about the project and activities, please enter your e-mail _____

10.1.2. Annex 2 (D2.3) – Structured Interview with Circular Business Agro-food Experts/professionals about Current and Future Skills Needs for transition of the Olive Oil Sector to Circular Economy

Instructions for Structured interview

General information:

- useful tool of quantitative research and social surveys
- standardized interview schedule
- each interviewee gets the same questions, in the same way and order
- minimizes variation between interviews

Conducting structured interviews:

- Introduce the research

(identify yourself, general information about CIRCOLIVE project, purposes of research and procedure of interview)

- Ethical issues

(GDPR, recording interview) – need to be signed

ANNEX 2 (D2.3): Structured Interview with Circular Business Agro-food Experts/professionals about Current and Future Skills Needs for transition of the Olive Oil Sector to Circular Economy

In this interview definition of *Circular Economy* presents methods and possibilities of using olive by-products and waste in olive sector. *ESCO* (European Skills, Competences, Qualifications and Occupations), the European multilingual classification of Skills, Competences, Qualifications and Occupations, was used to identify and select existing occupations and skills relevant to circular economy in the olive oil sector.

Part 1. General Information

Date:

Location:

Interviewees' years:

Interviewees' educational level:

Enterprise name:

Enterprise email address (in case you want receive further information about the Circolive project):

Enterprise size:

- Micro (< 10 employees)
- Small (< 50 employees)
- Medium sized (< 250 employees)



- Large size (> 250 employees)

Which segment of the olive oil sector does your enterprise operate in?

- Olive growing
- Olive oil production
- Olive growing and olive oil production
- Other (Please specify): _____

1. What is your **occupation/profession** in the olive oil sector?

- For e.g. agronomist, agricultural production manager, agricultural labourer, environmental engineer, oil mill operator, food technologist, quality control and safety officer, etc.

Part 2. Current Skill Levels

2. Which **circular economy practices** are you currently implementing, or aware of in your enterprise?

- For e.g. waste reduction and by-product valorization, water recycling and efficient usage in olive oil production, renewable energy use, eco-friendly packaging materials, sustainable transportation and logistics solutions, carbon footprint reduction

3. How would you **rate skills and knowledge** about circular economy in your enterprise?

- 1 - Poor
- 2 - Limited
- 3 - Acceptable
- 4 - Good
- 5 - Excellent

4. According to your opinion, which **skills** are most significant in the olive oil sector regarding circular economy?

- For e.g. knowledge of sustainable farming practices, knowledge of water and soil protection, organic farming and pest control techniques, understanding of food policies and regulations, waste and by-product management, energy efficiency in production, supply chain management, digital skills

Part 3. Factors Shaping Skills Demand

5. In your opinion, which **factors** are influencing **the demand for new skills** in your enterprise the most?

- For e.g. pressure to improve sustainability performance, economic changes, adoption of circular economy models, environmental regulations and policies, consumer demand for sustainable products, industry competition and performance improvement pressures, development of new technologies and innovation, resource scarcity and waste management needs, global market demands and trade dynamics



Part 4. Skill Gaps

6. Are there any noticeable **skills gaps** in your enterprise that limit your ability to transition to a circular economy?
 - For e.g. lack of technical skills for sustainable production methods, financial constraints, lack of regulatory incentives, limited knowledge of circular economy principles, lack of digital and data management skills, insufficient innovation skills, insufficient market demand for sustainable products, limited understanding of renewable energy technologies, shortage of marketing and communication skills related to sustainability, lack of entrepreneurial mindset, lack of deep tech knowledge (e.g. artificial intelligence, smart farming technologies...)
7. In the olive oil sector, which **occupations** do you think would need circular economy skills?
 - o For e.g. agronomists, agricultural production managers, agricultural labourers, oil mill operators, quality control and safety officers, packaging production managers, sales and marketing managers, logistics and supply chain managers, researchers and scientists in circular economy

Part 5. Future Skill Needs and Occupation

8. In your opinion, which **skills** are most critical for your company's **future** success in adopting circular economy practices?
 - For e.g. by-product and waste management, produce sustainable products, develop and coordinate waste management processes, develop recycling programs, renewable energy integration, product data management and digitalization, ensure compliance with environmental legislation, assess the life cycle of resources, entrepreneurial mindset, deep tech knowledge
9. What **emerging occupations** do you expect will become important in the **future** in the olive oil sector **for transition to circular economy**?
 - For e.g. circular economy managers, sustainability consultants, renewable energy specialists, waste valorization engineers, environmental impact auditors, data analysts for sustainable agriculture, marketing professionals for eco-friendly products, supply chain specialists for green logistics, legal advisors on environmental regulations, professionals in the food/pharmaceutical industry for the development of new products
10. In your opinion, which **future skills**, regarding circular economy, will be critical for these emerging **occupations** in the olive oil sector?
 - For e.g. knowledge of waste and by-product valorization, expertise in sustainable resource management, digital and precision agriculture skills, circular product design and eco-packaging, data science and analytics for optimizing production, renewable energy technology expertise, process innovation and automation, marketing and sales of green products, green finance and investment expertise, leadership in sustainability strategy, deep tech skills, innovative problem-solving skills

10.1.3. Annex 3 (D2.3) – Structured Interview with VET Providers about Current and Future Skills



Needs for transition of the Olive Oil Sector to Circular Economy

Instructions for Structured interview

General information:

- useful tool of quantitative research and social surveys
- standardized interview schedule
- each interviewee gets the same questions, in the same way and order
- minimizes variation between interviews

Conducting structured interviews:

- Introduce the research - (identify yourself, general information about CIRCOLIVE project, purposes of research and procedure of interview)
- Ethical issues - (GDPR, recording interview) – need to be signed

ANNEX 3 (D2.3): Structured Interview with VET Providers about Current and Future Skills Needs for transition of the Olive Oil Sector to Circular Economy

In this interview definition of *Circular Economy* presents methods and possibilities of using olive by-products and waste in olive sector. *ESCO* (European Skills, Competences, Qualifications and Occupations), the European multilingual classification of Skills, Competences, Qualifications and Occupations, was used to identify and select existing occupations and skills relevant to circular economy in the olive oil sector.

Part 1. General Information

Date:

Location:

VET name:

VET email address (in case you want receive further information about the CIRCOLIVE project):

Interviewees' years:

Interviewees' educational level:

Type of Education/VET Institution:

1. University
2. Polytechnic
3. Institute
4. Public Open University
5. VET provider
6. Private VET provider
7. Other (specify): _____

Interviewees' role:

1. Executive
2. Manager
3. Lecturer
4. VET specialist
5. Other _____

Main information about educational/VET provider

- Length of business
- Number and type of employees by role (teaching, training, administrative...)



- Area of expertise/subject provided (agronomy, forestry, economy, other)
- Other information

Part 2. Current Skill Levels

11. According to your opinion, which **skills** are most significant in the olive oil sector regarding circular economy?
- For e.g. knowledge of sustainable farming practices, knowledge of water and soil protection, organic farming and pest control techniques, understanding of food policies and regulations, waste and by-product management, energy efficiency in production, supply chain management, digital skills

Part 3. Factors Shaping Skills Demand

12. In your opinion, which **factors** are influencing **the demand for new skills** in the olive oil sector?
- For e.g. pressure to improve sustainability performance, economic changes, adoption of circular economy models, environmental regulations and policies, consumer demand for sustainable products, industry competition and performance improvement pressures, development of new technologies and innovation, resource scarcity and waste management needs, global market demands and trade dynamics

Part 4. Skill Gaps

13. In the olive oil sector, which **occupations** do you think **would need** circular economy skills?
- For e.g. agronomists, agricultural production managers, agricultural labourers, oil mill operators, quality control and safety officers, packaging production managers, sales and marketing managers, logistics and supply chain managers, researchers and scientists

Part 5. Future Skill Needs and Occupation

14. In your opinion, which **skills** are generally most critical for **future** success in adopting circular economy practices in the olive oil sector?
- For e.g. by-product and waste management, produce sustainable products, develop and coordinate waste management processes, develop recycling programs, renewable energy integration, product data management and digitalization, ensure compliance with environmental legislation, assess the life cycle of resources, entrepreneurial mindset, deep tech knowledge
15. What **emerging occupations** do you expect will become important in the **future** in the olive oil sector **for transition to circular economy**?
- For e.g. circular economy managers, sustainability consultants, renewable energy specialists, waste valorization engineers, environmental impact auditors, data analysts for



sustainable agriculture, marketing professionals for eco-friendly products, supply chain specialists for green logistics, legal advisors on environmental regulations, professionals in the food/pharmaceutical industry for the development of new products

16. In your opinion, which **future skills**, regarding circular economy, will be critical for these **emerging occupations** in the olive oil sector?
- For e.g. knowledge of waste and by-product valorization, expertise in sustainable resource management, digital and precision agriculture skills, circular product design and eco-packaging, data science and analytics for optimizing production, renewable energy technology expertise, process innovation and automation, marketing and sales of green products, green finance and investment expertise, leadership in sustainability strategy, deep tech skills, innovative problem-solving skills

Part 6. Education

17. Does your institution currently provide courses on circular economy practices in the olive oil sector?
- If YES, in what format? If NO, go to question 8.
18. In your opinion, do you think your institution could implement courses on circular economy practices in the olive oil sector?
- If YES, in what format?
19. In your opinion, which competences should the participant/student have before attending a course about circular economy?



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