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# Empowering smallholder olive growers in northwest Tunisia through an agroecological business model

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Olive cultivation struggles with climate change, resource degradation, and price volatility. Agroecology is considered as the mainstream model for transforming agriculture toward sustainable agri-food systems within the given economic and political context. This study aims to conduct an agroecological assessment of the current business model of the olive growers and to develop an upgraded integrating the agroecological practices in northwest Tunisia. A participative approach based on workshops with stakeholders in the olive oil value chain (OOVC) was conducted. In addition, a Business Model Canvas (BMC), followed by the application of the Business Agroecology Criteria Tool (B-ACT) was used. The results show that six principles (co-creation of knowledge, social value and diets, fairness, connectivity, land and natural resource governance, and participation) are integrated within the existing BMC, but hold significant promise for enhancement within an upgraded BMC focuses on economic diversification, niche market penetration, and heritage preservation. The establishment of an Olive Growers' Association is geared toward empowering olive growers, fostering collaboration and access to resources, knowledge exchange, collective decision-making, and co-learning in sustainable food systems. Moreover, integrating olive oil processing, conditioning, and marketing into the Olive Growers' association ensures quality control, streamlines operations, and enhances value across the olive growers' BMC.

## KEYWORDS

olive growers, agroecological business model, agroecological practices, sustainability, Tunisia

## 1 Introduction

Olive oil is of significant economic importance in the Mediterranean basin, where various varieties are grown and studied for their drought tolerance, genetic diversity and consumption patterns (Zafeiriou et al., 2012; Rico et al., 2023). The olive-growing sector is considered strategic for Tunisia. For the 2021/2022 campaign, Tunisia is ranked as the world's third largest producer with 240 000 tons and second largest exporter with 208 000

tons of olive oil (COI, 2023). The olive-growing sector contributes to the achievement of national objectives in terms of economic growth, food security, job creation and increased export earnings 2 081, 5,424 MTND (1 USD = 31,040; TND, 2023; ONAGRI, 2023). Olive growing follows a monoculture agricultural model, with massive use of inputs and natural resources. However, this model faces several difficulties that limit its environmental, economic and social impact, such as the choice of associations used, poor technical control of both the olive grove and associated crops, poor control of livestock and its negative effect on olive trees (Ben Abdallah et al., 2022).

Agroecology offers a theoretical framework with remarkable/considerable potential for designing farming and food systems that are productive, efficient, resilient, better connected and self-sufficient (Altieri and Nicholls, 2012). The olive oil value chain (OOVC) demonstrates considerable potential for agroecological improvement, notably by enhancing soil fertility, promoting biodiversity, exploiting synergies through by-products and promoting economic diversification (Dhehibi et al., 2024).

Few initiatives have effectively developed, implemented, and evaluated the integration of agroecological practices in the olive value chain in northwestern Tunisia. This research gap offers an opportunity to investigate how agroecological principles can improve the sustainability of olive cultivation, a key component of the regional economy and an important cultural symbol in the area (Dhehibi et al., 2024).

Our research aims to conduct an agroecological assessment of the current business model of the olive growers and to develop an upgraded integrating the agroecological practices in northwest Tunisia. The objective of the agroecological business model is to encourage olive farmers to produce branded olive oil, enhancing their income, livelihoods, and establishing a value system that highlights geographical origin.

The CGIAR initiative “Transformational Agroecology in Food, Land and Water Systems” explores opportunities for co-development and improvement of business models in olive oil value chains by integrating agroecological principles.

## 2 The agroecology: a transformative approach to sustainable development

Agroecology is the integrative study of the ecology of the entire food system, encompassing biophysical, economic and social dimensions. Indeed, its distinctive feature is that it is an “integrative” science, meaning one that seeks relationships in order to promote a better understanding of agricultural reality and its context (Francis et al., 2003).

It is a science that integrates theory and practice; according to Edwards and Farrington (1993), it is a relatively new discipline that integrates the techniques and paradigms of ecology with the practices of agricultural sciences for the study of agroecosystems. As an applied science, agroecology focuses on both theoretical principles and their practical applications to inform the design and implementation of concrete solutions (Caporali, 2007).

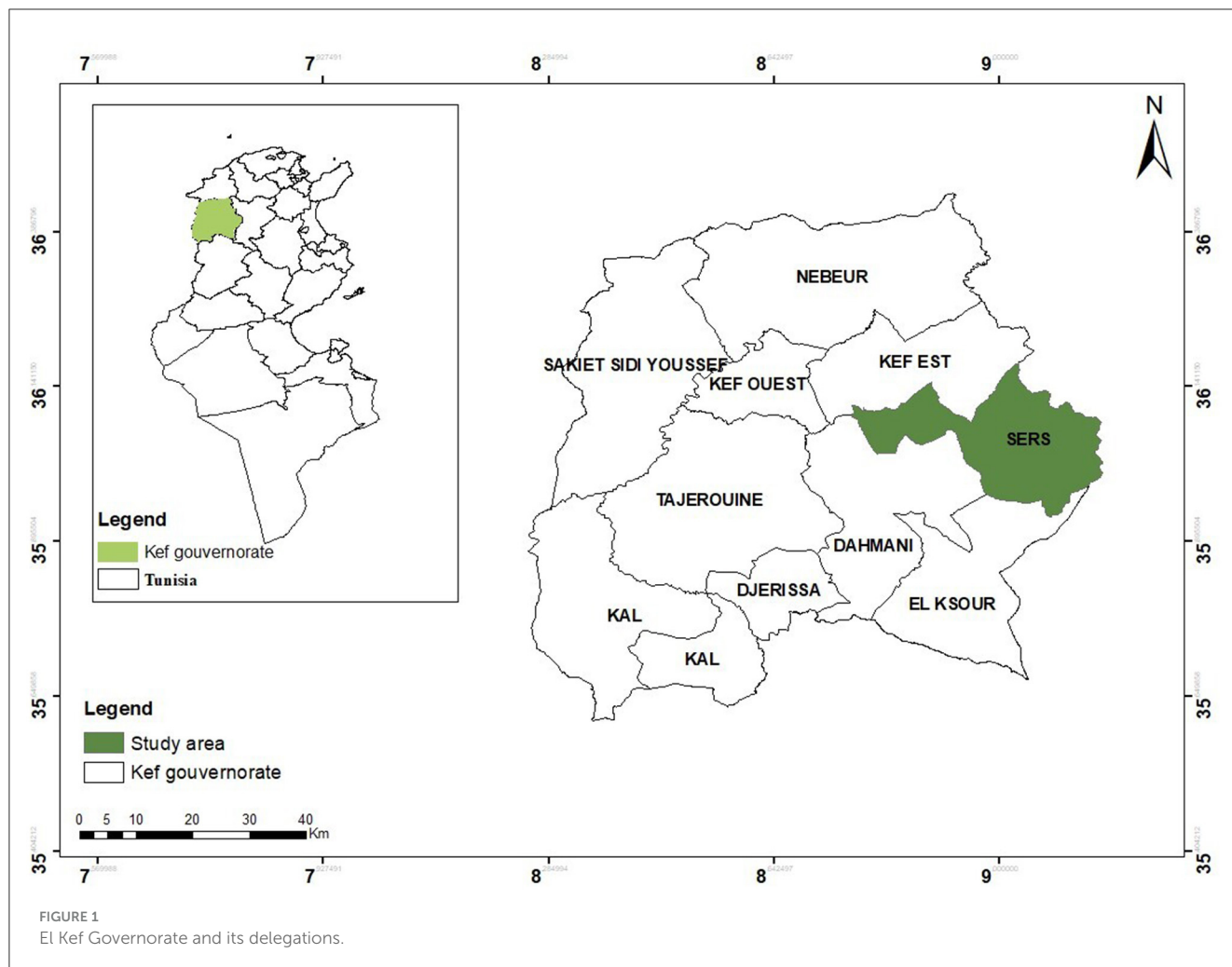
By bringing the contribution of inputs or genetic advances, the scientific and technical knowledge aimed at intensifying production

has actually led to the rationalization and simplification of biological complexity. The definition of agroecology then changed as a result of the global and political understanding of sustainable development, which sought a new equilibrium between agricultural output and resource reproduction (Wezel et al., 2015). According to the triptych economics, environment, and society, the production and protection features of the agroecosystem were incorporated into the larger global dimensions of development. Agroecology, as a field of study, a method of agriculture, or a social and political movement, addresses social, economic, and development issues in addition to agronomic and environmental issues nowadays (Wezel et al., 2009). Agroecology now encompasses industry, national and international politics, in addition to farmers and scientists. Consequently, the meaning of agroecology may differ based on the player in question and the scope of the concept (Bellon and Ollivier, 2018).

Agroecological principles have recently evolved to include social and cultural aspects of food systems, in addition to agricultural practices at the field, farm, and landscape scales (Wezel et al., 2020). The agroecological transition is based on 13 principles defined for all food systems. Among them, a subset can be specifically applied to livestock: integrated animal health management, valorization of natural resources and by-products to reduce necessary inputs, optimization of the metabolic functioning of systems and reduction of pollution, management of resource diversity to strengthen resilience, and adaptation of practices to preserve biodiversity and associated ecosystem services (Ducos et al., 2023). These principles are essential both for the transition of agricultural systems toward global food and nutrition security, and for strengthening resilience in the face of climate change (Wezel et al., 2020).

Agroecology is seen as a key approach to achieving sustainable development goals in the olive sector. By adopting agroecological practices, farmers can contribute to the preservation of ecosystems, food security, the reduction of rural poverty and resilience in the face of climate change. Sustainability issues are leading to a rethinking of agricultural and food production models. Agroecosystems must not only provide production functions, but also various services (preservation of water resources, pollination, pest control) and social issues such as employment and equity (Dale and Polasky, 2007). These issues must take account not only of biotechnology, but also of the social component of agriculture. Agroecology provides a source of innovation for the sustainable reconstruction and management of agroecosystems, reflecting the intersection of agriculture, environment and social sciences (Gliessman et al., 2007; Tomich et al., 2011).

Agroecology can provide a viable solution for improving the olive oil value chain in Tunisia by addressing various facets identified in academic research. Adopting agroecological methods has the potential to improve water-use efficiency in olive farming, improve olive oil quality by influencing factors such as ripening, harvesting techniques and processing methods, as well as preserving traditional water-harvesting practices such as *jessour* that play an essential role in olive cultivation in arid areas (Piras et al., 2021). In addition, the application of agroecology can facilitate the exploration of microbial diversity linked to olive groves, potentially paving the way for the creation of natural



enemies to combat pests that pose a threat to olive trees (Gharsallah et al., 2023). Agroecology can improve the sustainability of Tunisian olive oil production by promoting modern management practices, improving efficiency and ensuring economic viability (Mokrani et al., 2022).

### 3 Methodology

#### 3.1 Study site

Our work is focused in the Elles region of the Sers delegation in the Kef governorate in the semi-arid zone of north-west Tunisia (Figure 1). The governorate was chosen because of the importance of its production system based on olive growing and large crops associated with extensive sheep farming. More than 43% of El Kef's population is rural and involved in agricultural activities, with at least 40% of the active population fully employed in the agricultural sector.

Olive growing in El Sers is the main activity of the majority of farmers, most of them private, small and family-owned. Nearly 92% of the area dedicated to arboriculture is occupied by olive trees, covering approximately 6,305 ha (12% of the governorate's olive-growing area), with an average density of 300 plants per hectare.

It produces 11% of the governorate's oil olives and 17% of its table olives (CRDA KEF, 2020; ODNO, 2020).

El Sers region is home to several oil mills, essential hubs of the olive oil production chain. These mills serve as pivotal centers where harvested olives undergo meticulous processing to extract olive oil. There are 3 traditional mills with a storage capacity of 20 tons and a modern mill with a storage capacity of 70 tons. These mills play a crucial role in the local economy, preserving the region's rich olive heritage while contributing significantly to the Tunisian olive industry.

#### 3.2 Study design

This research compares conventional business models with agroecological models, using agroecological living laboratories (ALLs), an innovative approach that engages all key actors in the innovation process.

Additionally, this study employed a participatory co-design method through focus groups with stakeholders in the olive oil value chain in the Elles region. The initial step involved identifying and prioritizing value chains with agroecological potential through discussions with farmers and local authorities. After selecting a

**TABLE 1** Description of multi-stakeholder workshops organized in the study area.

Workshop	Participants number	Objective
November 1, 2 and 3, 2022	20 participants/day	Selection of value chains specific to the selected study areas (olive trees, cereals, sheep breeding, beekeeping, etc.), in collaboration with local stakeholders, on the basis of a set of criteria (yield, cultural suitability, gross margin, marketing, local know-how, natural resources, etc.).
December 15, 2022 Kef	33 participants	Identification and mapping of the main CVs in the Kef region
October 10, 2023 Kef	28 participants	Identify current business models in CVHO through participatory analysis to understand how the model works, indicators of inclusion and value propositions. All this through a Canvas built with discussion groups

Source: Author's elaboration from analysis of field data (2023).

value chain, we characterized it by consulting local farmers and key stakeholders. Workshops were then organized to educate stakeholders on agroecology principles, emphasizing biodiversity, natural resource conservation, and production system resilience (Table 1).

We analyzed farmers current business models using a toolkit that integrates the Business Model Canvas (BMC), the B-ACT tool, and a SWOT analysis, collectively referred to as the Holistic Business Model Assessment Toolkit by the CGIAR AE Initiative. The Business Model Canvas facilitates characterization, while the B-ACT evaluates the agroecological performance of the business model. Together with the SWOT analysis, these tools identify existing constraints, challenges, and opportunities.

The next phase includes organizing workshops to address identified challenges and capitalize on opportunities, beginning at the operational level and advancing to organizational and regional levels, all within an agroecological business model framework.

Two workshops, held on December 8 and 15, 2022, in Siliana and El Kef, focused on identifying, prioritizing, and mapping key actors in the selected value chains. The focus groups revealed that the primary value chains chosen were cereals, olive oil, sheep meat, honey, and fig trees. Participants used economic, social, and environmental criteria to narrow the selection to three value chains: olive oil and sheep meat in Kef, and olive oil and honey in Siliana. Stakeholders decided to prioritize the olive oil value chain due to its significant economic, social, and environmental potential, as well as its alignment with agroecological principles. These deliberations included stakeholders from all segments of the olive oil value chain, such as service providers, olive growers, industrial processors, and key public institutions and agencies supporting value chain development, including the Ministry of Agriculture, the Kef Regional Commission for Agricultural Development (CRDA), the Olive Institute (IO), the Livestock and Pasture Office (OEP), the Sylvopastoral Development Office of the North West (ODESYPTANO), the North West Cluster, the Agricultural Investment Promotion Agency (APIA), and microfinance institutions. Once the olive oil value chain (OOVC)

was identified, a series of two workshops were organized with the aim of analyzing the current OOVC business model in each region using a CANEVAS model.

A collaborative workshop convened in June 2023 engaged all stakeholders to co-design an agroecological innovation package for Elles community. Outcomes highlighted critical agricultural challenges, including the closure of the agricultural extension unit, a notable decline in olive yields, aging olive trees, and issues with erosion and water management, encompassing both availability and maintenance concerns. From the co-design process, two primary agroecological innovations emerged at the farm level: composting and intercropping, specifically with olive trees.

Various constraints were identified by olive growers hindering the adoption of these innovations, such as a shortage of labor for compost production and general olive tree farming, insufficient knowledge and expertise on compost production, pruning, and irrigation techniques, inadequate machinery for composting, and a lack of organized collaboration among farmers.

The workshop's findings suggested a series of innovation-related actions linked to composting, including applying compost in demonstration plots to assess its impact on the region's olive groves, organizing training sessions on various agricultural practices, processing olive by-products on-site to create compost, formulating specifications mandating and overseeing agroecological practices, like using compost for olive trees, and establishing a local farmers' association (GDA and SMSA) to facilitate innovation introduction.

### 3.3 Analytical tools

B-ACT Agroecological Assessment Tool and Business model framework are used in this study.

#### 3.3.1 Business model

A business model is a framework that outlines how a company creates, delivers, and captures value (Osterwalder and Pigneur, 2010). It describes the fundamental aspects of how a business operates and generates revenue. Business models can vary widely depending on the industry, market, and specific goals of the company. They are also identified as a reflection on the implemented strategy, enabling the evaluation of outcomes and benefits (Murray and Scuotto, 2015).

The business model diagnostic allowed the identification of the main challenges and bottlenecks faced by the community of olive farmers in Elles, with regards to their business performance and to the integration of agroecological principles. We used the results of the diagnostic to inform and guide a workshop with all the relevant stakeholders, with the objective of co-designing a new business model that addresses the some of the challenges and harnesses the regional strengths and opportunities.

#### 3.3.2 B-ACT agroecological assessment tool

Business Agroecology Criteria Tool (B-ACT) is a tool to evaluate and identify inspiring and promising agroecological businesses that contribute to sustainable food systems. The extent



to which a company “inspires” is reflected in its alignment with the 13 principles of agroecology (HLPE, 2019), while “promising” is reflected in its business model, its value-generating activities and its scalability. This tool guides through a series of questions to determine the extent to which each of the 13 agroecological principles (HLPE, 2019) is reflected in the company’s direct and indirect activities. The list of principles compiled by the High-Level Panel on Food Security and Nutrition, established by Nicholls et al. (2016), CIDSE (2018) and FAO (2018). Each principle is linked to one of the three organizing principles of sustainable food systems: improving resource efficiency, building resilience, or ensuring social equity (HLPE, 2019).

Running the B-ACT involves a systematic evaluation of agricultural practices against a set of agroecological principles. This comprehensive tool assesses the integration of agroecological elements within a business model. It begins with gathering data on the agricultural activities and then proceeds to measure their alignment with the defined agroecological principles. The tool considers various aspects such as resource use efficiency, ecological balance, biodiversity conservation, and socio-economic impacts. By applying this tool, businesses gain insights into their current practices’ adherence to agroecological principles and can identify areas for improvement or enhancement. This approach aids in fostering sustainable agricultural practices, promoting resilience, and enhancing the overall ecological and socio-economic performance of the business.

## 4 Results and discussion

### 4.1 Agroecological olive oil value chain identification

Stakeholders prioritized the olive oil value chain due to its substantial economic, social, and environmental benefits, along with its alignment with agroecological principles. This process included stakeholders from all segments of the olive oil value chain, such as service providers, olive growers, industrial processors, and essential public institutions (such as Ministry of Agriculture, CRDA of El Kef, IO, OEP, North-West Sylvopastoral Development Office- ODESYPANO, the North-West Pole, and APIA), and microfinance institutions. Following the identification of the Olive Oil Value chain (OOVC), a workshop was held to analyze the current business model in the Elles region using a CANEVAS model. In October 2023, a collaborative workshop brought together all stakeholders to co-design an agroecological innovation package for the Elles community. The discussions revealed significant agricultural challenges, including the closure of the agricultural extension unit, declining olive yields, aging olive trees, and issues related to water erosion and management. From this co-design process, two primary agroecological innovations emerged at the farm level: composting and intercropping, particularly with olive trees. Olive farmers noted several barriers to adopting these innovations, such as labor shortages for compost production and olive cultivation, insufficient knowledge on compost production, pruning, and irrigation techniques,

inadequate machinery, and a lack of organized collaboration among farmers. The workshop recommended several actions related to composting innovation, including applying compost in demonstration plots to evaluate its effects on local olive groves, organizing training sessions on various agricultural practices, transforming olive by-products on-site to produce compost, establishing specifications to enforce agroecological practices like compost use for olive trees, and creating a local farmers association (GDA and SMSA) to support the implementation of these innovations.

### 4.2 Current business model for olive growers group

The BMC provides a comprehensive overview of the olive oil industry in Elles (Table 2), highlighting the importance of key partnerships for success in this sector.). Key partnerships play a vital role in the success of the olive oil BMC. Several partners support the growers such as inputs providers (Mabrouka Company, supply agricultural machinery and high-quality plants, CRDA, IO, National Olive Oil Office-ONH, Northwest Cluster of Olive Oil, Enda Tamweel (a microfinance company) and the APIA. These partnerships ensure that olive growers in Elles have access to essential inputs, financial resources, and technical support, contributing to the overall success of the olive oil value chain. The olive oil value chain in Elles encompasses various key activities, from olive cultivation to sales, with growers focusing on manual, pesticide-free farming methods. They prioritize traditional practices such as using non-mechanized harvesting and traditional oil mills to preserve oil quality. Collaboration among growers, sharing of knowledge, and interaction with research institutions further strengthen production. The key resources that support the olive oil business in Elles include the bioclimatic advantages of the mountainous region, indigenous olive varieties, ancient irrigation systems, and skilled labor. Strong family support and collaboration with agricultural research institutions are also crucial. The value proposition centers on the production of high-quality, often organic olive oil, reflecting the unique characteristics of the region and traditional methods.

Customer relationships are strengthened through the annual “El Hilga” festival and direct sales to loyal customers. Elles olive oil commands a premium price, due to its high quality, with sales occurring through local markets, oil mills, and word-of-mouth recommendations. Despite the relatively small-scale production, the community enjoys diverse customer segments, including grocers, restaurants, and occasional exporters. The cost structure includes expenses like labor, irrigation, and harvesting, with the most significant costs related to labor for manual harvesting (Table 2).

Revenue streams primarily come from olive oil sales, with a premium price compared to neighboring regions. Opportunities for revenue growth include product labeling, agroecological innovations, and establishing a controlled designation of origin (CDO) for Elles olive oil. These efforts aim to improve product value and income generation for the growers.

TABLE 2 Existent Business model of the olive growers group.

Key partnerships	Key activities	Value proposition	Customer Relationships	Customers segments
<b>Public:</b> <ul style="list-style-type: none"> <li>CRDA Kef</li> <li>Olive Institute</li> <li>The National Oil Office</li> <li>APIA</li> </ul> <b>Private:</b> <ul style="list-style-type: none"> <li>Northwest Cluster of olive oil</li> <li>Inputs providers: agricultural machinery</li> <li>Mabrouka Company: high quality standards plants and services.</li> <li>Enda Tamweel: credits</li> </ul>	<ul style="list-style-type: none"> <li><b>Producing the olives:</b> preparation of soil, pruning of trees, irrigating the parcel, fertilizing with organic matter and manual harvesting</li> <li><b>Processing:</b> oil mill with traditional system</li> <li><b>Trading:</b> direct sale for the local customers</li> </ul>	<ul style="list-style-type: none"> <li>High quality olive oil.</li> <li>Ten local varieties are only cultivated in this area, specific aroma for the olive oil in Elles.</li> <li>Presence of ancestral irrigation system of fresh water: stability of production</li> <li>Traditional oil mill (cold press): good quality of the olive oil</li> </ul>	<ul style="list-style-type: none"> <li>Relationships between olive growers and customers are based on trust and loyalty.</li> <li>Olive growers prefer to sell his olive oil in cash.</li> <li>Transactions are totally commercial and non-contractual.</li> </ul>	<ul style="list-style-type: none"> <li>Local or regional consumers: in bulk in different packaging</li> <li>Traditional oil mill</li> <li>Visitors to El Hilga festival</li> <li>Restaurants, grocery store and in rare cases the exporters.</li> </ul>
	<b>Key resources</b> <ul style="list-style-type: none"> <li>Special bioclimate, Mountainous zone</li> <li>Traditions specific to the region</li> <li>Fertile soil, Olive dating from Roman times</li> <li>Variety specific to the area</li> <li>Skilled labor and family labor</li> <li>Financial family support, Solidarity</li> <li>Water resources, Good Infrastructure</li> <li>Proximity of agricultural services</li> </ul>		<b>Channels</b> <ul style="list-style-type: none"> <li>Short marketing channels; Direct sales to consumers (festival El hilga).</li> <li>Loyal buyers, neighbors, oil mills and extended family members</li> <li>Word-Of-Mouth via agents in the region</li> <li>Local intermediaries or exporters can buy the olive oil of Elles in bulk to resell it packaged in other markets.</li> </ul>	
<b>Cost structure</b>			<b>Income</b>	
Activities related to olive oil	Cost medium/ha/\$	%	<ul style="list-style-type: none"> <li>The price is always set according to the price of bulk olive oil.</li> <li>Sale to consumers: 1 L = \$5.48 (still \$0.64 higher than other regions).</li> <li>The average gross income of an olive grower per hectare of olive trees is between \$1,233.87 and \$2,056.45.</li> </ul>	
Cost of plowing	96.77	8.45%		
Size cost	161.29	13.9%		
Preparing the land for irrigation	96.77	8.45%		
Irrigation	16.29	13.9%		
Plant rejuvenation	19.35	1.7%		
Carrying bags	16.12	1.4%		
Labor cost for olive harvest	483.87	41.8%		
Treatment for olive oil production of 2.5 tons per hectare	120.96	10.5%		
Total	1,156.45	100%		

Source: Author's elaboration from analysis of field data (2024).

### 4.3 Upgrading business model

The upgrading business plan for the Elles olive oil value chain is a collaborative initiative aimed at producing a high-quality, agroecologically cultivated olive oil product. Its overarching objective is to unify local olive growers, promote sustainable agricultural practices, and enhance marketability through improved processing, packaging, and marketing strategies.

The plan's specific objectives are multifaceted: first, to create a Mutual Agricultural Services Company of Olive Growers (SMSA) to foster collaboration. Second, to implement agroecological practices such as composting and intercropping to ensure sustainable farming. Third, to pursue Controlled Designation of Origin (CDO) status for Elles' olive oil, protecting its unique characteristics. Fourth, to integrate olive oil processing and modern

packaging within the association. Lastly, to establish a sales boutique, elevating the marketing and distribution of the product.

Key activities include:

- Creation of the SMSA:** this will unite olive growers based on leadership, farm capacity, and potential to adopt agroecological methods, with support from ICARDA, research institutions, and development agencies.
- Adoption of Agroecological Practices:** spanning 2 years, this activity will focus on training growers in composting and intercropping, facilitated by the Olive Institute and other partners, with necessary equipment provided to ensure sustainability.
- Establishment of a Controlled Designation of Origin (CDO):** the CDO will highlight the unique agroecological methods

used in Elles, with support from standardization bodies and government agencies.

- iv. **Integration of Olive Oil Processing:** this activity will involve renovating facilities, acquiring advanced processing equipment, and training growers to ensure the production of high-quality olive oil.
- v. **Modern Packaging for Olive Oil:** the association will invest in packaging equipment and collaborate with design experts to create visually appealing, high-quality packaging.
- vi. **Marketing and Sales Development:** the final activity includes establishing a sales boutique and engaging in promotional activities to boost sales and market presence.

The Upgrading Plan involves a spectrum of key actors, each contributing to various dimensions of the initiative. At the core are the Olive Growers Group, managing small-scale plots and employing modern farming techniques, while facing specific challenges in pruning practices and actively involving women in the harvest. Supporting this group are multiple entities: CRDA El Kef, providing training and administrative support; the IO, focusing on research and agroecological practices; the ONH, aiding in productivity enhancement, quality promotion, and export facilitation; the Northwest Cluster of Olive Oil, aiding in recycling, quality management, financial access, and marketing; APIA, advocating private investment in agriculture; INRAT and ICARDA, contributing to agronomic research; CEPEX, supporting export processes; DGPA and OEP, focusing on sustainable plant and livestock development; INNORPI, ensuring standardization and certification; SMSA Zitouna, having established a CDO with its expertise in CTV, facilitating extension programs; PACKTEC, providing packaging support; and various banks, including BNA, BS, Ezzitouna Bank, and BFPME, offering financing options. Finally, Enda Tamweel provides financial inclusion for vulnerable populations. Together, these actors bolster and fortify the operations of Elles olive growers across the entire value chain.

The plan aims to initially sell 8,000 bottles of packaged olive oil, with a target of reaching 40,000 bottles within 5 years, enhancing both the local economy and the visibility of Elles olive oil in national markets.

#### 4.4 Agroecological assessment of the olive grower's group

The current economic model has several weaknesses, including the lack of technical skills among olive growers, gaps in compost production, pruning, and irrigation, as well as low productivity of the olive tree. Additionally, the absence of collective action, such as a farmers' association to promote olive oil, and conflicts over water management among olive growers complicate the situation. The lack of a designated origin and individual marketing strategies also limit the competitiveness of olive oil, both in the national and international markets. Lack of knowledge about good agricultural practices and processing techniques harms the quality of the product, reducing its added value. Furthermore, the absence of

appropriate training and technical support creates a gap between market needs and production capabilities.

A collaborative, strategic approach is crucial to address these challenges. This includes raising awareness among olive farmers about their profession's difficulties, engaging them in relevant decision-making, and promoting innovative farming practices. Agroecology offers a promising path for revitalizing the olive sector, enabling farmers to enhance sustainability and bolster their farms' resilience against climate and economic threats.

The agroecological assessment of the olive growers' group in Elles highlights a comprehensive approach to sustainable olive farming, focusing on recycling, input reduction, soil health, animal health, biodiversity, synergy, economic diversification, co-creation of knowledge, social values, fairness, connectivity, land governance, and participation. Recycling is a key practice, with olive growers utilizing pruning waste as a source of fodder and biochar, while also incorporating organic fertilizers and olive oil wastewater to enhance soil fertility. In terms of input reduction, growers minimize the use of synthetic fertilizers, pesticides, and water, adopting precision agriculture techniques and nitrogen-fixing plants to boost yields sustainably. The growers prioritize soil health by integrating organic matter, reducing tillage, and using cover crops, all of which improve soil structure and nutrient content. Olive by-products, such as leaves and branches, are crucial for animal health, serving as forage for livestock.

They also pursue economic diversification through niche marketing of high-quality olive oil with regional branding, aiming to capitalize on the unique characteristics of their product. Olive waste is repurposed into by-products, providing alternative income sources. Co-creation of knowledge is evident as traditional farming knowledge is shared, though the lack of agricultural extension services is a concern. Growers aim to establish an association to facilitate innovation and knowledge exchange. The social values of the community are deeply intertwined with olive oil production, with an emphasis on collective efforts to promote their unique local heritage and improve cooperation among stakeholders. Fairness in labor practices relies heavily on family labor, and while there is limited access to social security, strong community networks provide support during crises.

Olive growers seek to establish a farmers' association to advocate for labor rights and empower the community. Connectivity is strengthened through direct local sales and participation in events like the Olive Oil Festival, where growers showcase their products. The growers are proactive in land and natural resource governance, addressing challenges such as erosion and water scarcity. They engage in national strategies for biodiversity conservation and climate resilience. Finally, in terms of participation, although olive growers are represented by the national Farmer's Union, they are often excluded from decision-making. They aim to amplify their voice through an olive oil association, contributing to regional development.

The assessment using B-ACT on olive producers revealed high overall agroecological performance among the farmers. Specifically, it showed a substantial alignment, meeting 92.9% of the agroecological criteria related to improving resource efficiency (covering principles 1 and 2). However, the evaluation indicated that the adherence to principles focused on strengthening resilience

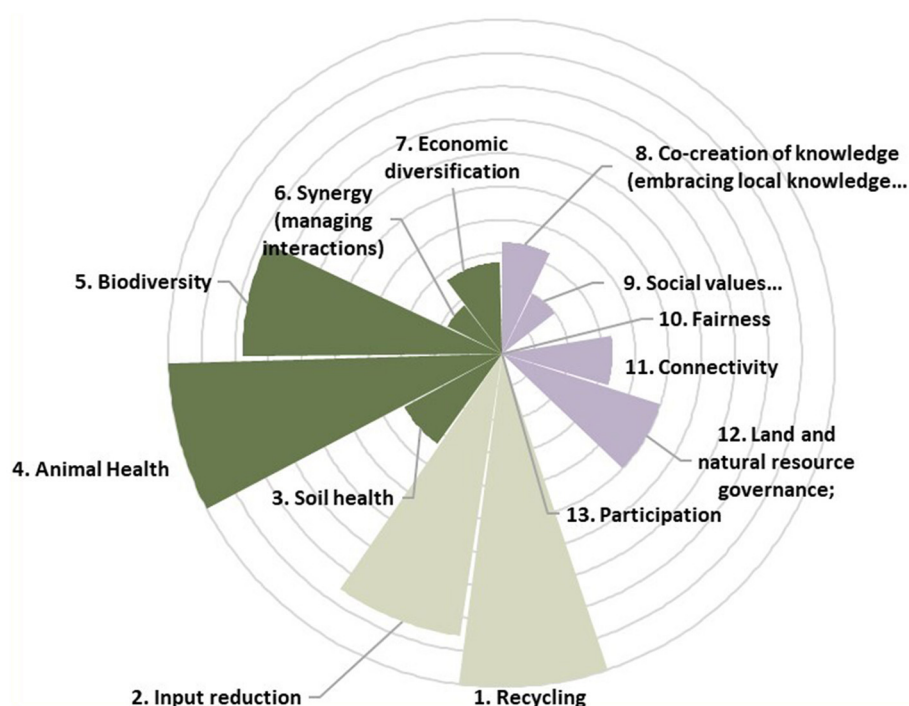


FIGURE 2  
Business model's current alignment with HLPE (2019) agroecological principles.

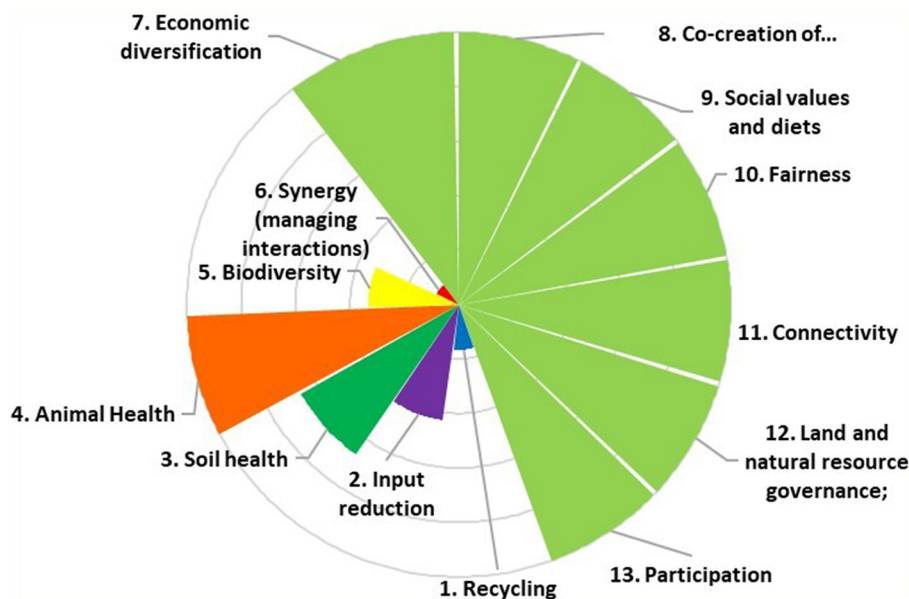


FIGURE 3  
Business model's potential alignment with HLPE (2019) agroecological principles.

(encompassing principles 3 to 7) and securing social equity (including principles 8 to 13) was comparatively lower, meeting 51.3% and 22.8% of the respective criteria. Additionally, the diagnosis identified key target groups, including farmer households and their immediate environment on a small scale, national entrepreneurs involved in processing, trading, and retailing of

agricultural products also on a small scale, and consumers on a medium scale. The level to which individual criteria were fulfilled and their potential impact is visually presented in the accompanying radar diagrams (Figures 2, 3)

The analysis of the current business model for the stakeholders involved in Elles olive oil production revealed both weaknesses



TABLE 3 Opportunities and suggestions for the current business model of olive growers' group.

Level	Weaknesses	Opportunities	Suggestions
Olive growers	Soil erosion	Preventing soil erosion	Intercropping with olive trees
	Low olive tree yields	Improving olive tree yields	Training days (pruning, irrigation, compost production and use, etc.,
	Soil degradation	Improve soil fertility	Application of the compost in demonstration plots
	Low valorization of the olive by-products	Synergy crop-livestock	Processing of olive by-products and on-site compost production
	Olive growers lack organized associations.	Olive growers motivated to create an olive oil association.	Creating an SMSA for Elles olive growers
	Low olive oil quality in the current business model (compared to the quality potential)	Great potential of improvement of olive oil quality	OI support to improve the olive oil quality.
	Low added value created compared to the quality potential of Elles olive oil	Value added creation (packaging, CDO, etc.)	Create a new product packaged and labeled.
	Low valorization of Elles olive oil	High potential of Elles community in olive oil system Conservation and enhancement of Elles' heritage, greater economic and social development of the region, attracting young people and limiting migration	Establish a CDO Olive oil specifications in line with agroecological requirements
	Spot market (direct sale)	Joint sale of a new packaged and controlled olive oil product	Establishing a contemporary sales boutique within the association
Extension services	Lack of agricultural extension, Lack of know-how and knowledge necessary for the production and use of compost, pruning techniques, irrigation	Initiative agroecology project Common vision among all stakeholders to valorize Elles olive oil	<ul style="list-style-type: none"> <li>- Improvement of agricultural extension in the region.</li> <li>- Living lab creation based on olive growers' association.</li> <li>- Better involvement of public institutions (CTV and CRDA) through activities and partnerships with the research institutions involved (IO, INRAT)</li> </ul>
Olive oil mill (processing)	The processing in the olive oil mills does not guarantee the requested quality of olive oil in case of the creation of controlled designation of origin (CDO)	Integration of the process level by the olive growers into the association	Purchase of machine for processing olives into oil Olive institute support

Source: Author's elaboration from analysis of field data (2024).

and significant opportunities for growth and improvement. Understanding these points provides a foundation for enhancing the model's effectiveness (Table 3).

## 4.5 Upgraded business model for olive growers association integrating agroecological principles

The upgraded BMC for the olive grower's association in Elles is designed to enhance their collective performance, particularly in producing and marketing virgin and extra virgin olive oil (Table 4). It integrates agroecological practices, emphasizing sustainability and environmental care, while incorporating governance, social benefits, and economic value. Key public partners such as the CRDA, ONH, and CEPEX provide training, administrative, and financial support, while private entities offer machinery, financial services, and high-quality inputs. Development partners like ICARDA and the Northwest Cluster of Olive Oil assist in production quality and market access.

At the farm level, key activities include soil preparation, pruning, irrigation, organic fertilization, and harvesting.

Agroecological methods such as intercropping and composting are also integrated. At the association level, activities span olive collection, processing, packaging, sales, administrative tasks, and machinery upkeep. Resources essential to the model include regional olive varieties, local knowledge, infrastructure, historical irrigation systems, and centenarian olive trees. Support from organizations like ICARDA and INRAT, along with specialized machinery, further strengthens the association's operations.

The value proposition emphasizes sustainable olive production, improved yields, and higher income for farmers. By adopting agroecological methods, farmers can enhance soil fertility and erosion control while benefiting from specialized training, credit access, and solidarity within the association. The model also promotes social unity and creates a controlled designation of origin (CDO) for Elles olive oil, increasing product value. Customers are offered high-quality, traceable olive oil, while new market channels, including a local sales boutique and international exports, are pursued with the help of trade fairs.

The cost structure allocates funds to different aspects of the model, such as SMSA creation, agroecological practices, olive oil processing, and marketing (Table 4). Revenue is generated from olive and olive oil sales, with a premium placed on products adhering to agroecological practices. The model also

TABLE 4 Upgraded Business model of the olive growers association.

Key partners	Key resources	Value proposition	Relations	Customers
<b>Public partners</b> <ul style="list-style-type: none"> <li>• OI</li> <li>• INRAT</li> <li>• CRDA</li> <li>• ONH</li> <li>• CRDA</li> <li>• DGPA</li> <li>• APIA</li> <li>• INNORPI</li> <li>• CEPEX</li> <li>• PACKTEC</li> </ul> <b>Private partners</b> <ul style="list-style-type: none"> <li>• Bank</li> <li>• Mabrouka company,</li> <li>• Input providers</li> <li>• Enda Tamweel</li> </ul> <b>Development partners</b> <ul style="list-style-type: none"> <li>• ICARDA</li> <li>• Olive Oil Cluster of North Ouest</li> </ul>	<b>At farm level and community</b> <ul style="list-style-type: none"> <li>• Olive groves in Elles community with typical varieties of the region</li> <li>• Know-how of olive growers (inputs reduction, No use of pesticides)</li> <li>• Biodiversity of Elles region</li> <li>• Ancestral irrigated system</li> <li>• Ecotourism</li> <li>• Infrastructure: transport, Road, Storage</li> <li>• Olive: centenarian, dating from Roman times</li> </ul> <b>At association level</b> <ul style="list-style-type: none"> <li>• Support from the OI, INRAT, ICARDA, CRDA etc.</li> <li>• Expert to facilitate the creation of the SMSA</li> <li>• Expert of AOC</li> <li>• Trainings for olive growers' association</li> <li>• Oil extraction machine</li> <li>• Compost equipment</li> <li>• Harvesting machine</li> <li>• Expert designer</li> <li>• Storage tanks</li> <li>• Labors (employees)</li> <li>• Olive oil Filling machines Bottling</li> </ul>	<b>To olive growers, members of the association</b> <ul style="list-style-type: none"> <li>• Access to SMSA advice and services</li> <li>• Improve the sustainability of the olive farming system</li> <li>• Improved productivity, Improved income</li> <li>• Value added created at the different steps of the olive oil production system</li> <li>• Premium quality of the olive oil</li> <li>• Improved social cohesion within association</li> <li>• Access to credit</li> <li>• Niche market</li> <li>• Economic diversification</li> <li>• Job creation</li> </ul> <b>To Elles community</b> <ul style="list-style-type: none"> <li>• Controlled designation of origin</li> <li>• Community engagement</li> </ul> <b>To customers</b> <ul style="list-style-type: none"> <li>• Regular supply</li> <li>• Transparency and traceability</li> <li>• Sales offers</li> </ul>	<b>At olives production level</b> <ul style="list-style-type: none"> <li>• Contract between the SMSA and the olives growers</li> </ul> <b>At olive growers' association</b> <ul style="list-style-type: none"> <li>• Improve olive growers' engagement into the association</li> <li>• Planning and distribution of responsibilities between association members</li> <li>• Sharing advice and knowledge for all adherents,</li> <li>• Improving social cohesion through a fair access to association services</li> </ul> <b>At marketing level</b> <ul style="list-style-type: none"> <li>• Contract between the SMSA and customers (supply, quality, price, others)</li> </ul>	<ul style="list-style-type: none"> <li>• Modern sales boutique</li> <li>• Specialized traders like supermarkets</li> <li>• Exporters</li> <li>• Discerning consumers seeking premium products adhering to agroecological standards and reflecting the essence of the local territory.</li> <li>• Fairs</li> <li>• Festivals</li> </ul>
Keys activities		Channels	Governance and people	Environmental and social benefits
<b>At farm level</b> <ul style="list-style-type: none"> <li>• All the agricultural activities related to the preparation of soil, pruning of trees, irrigating the parcel, fertilizing with organic matter and harvesting the olive trees.</li> <li>• Additional agroecological practices will be incorporated into the olive production system especially the intercropping, compost and rejuvenation pruning.</li> </ul> <b>At the association level</b> <ul style="list-style-type: none"> <li>• Olive collection</li> <li>• Transport</li> <li>• Storage</li> <li>• Processing the olives</li> <li>• Conservation and conditioning of the olive oil</li> <li>• Research of the new olive oil market.</li> <li>• Administrative tasks management</li> <li>• Selling store management</li> <li>• Machine maintenance</li> <li>• Technical assistance to the members</li> <li>• Capacity building of their members.</li> </ul>		<ul style="list-style-type: none"> <li>• Creation of a modern sales boutique into the association</li> <li>• Selling in international markets via the exporters to promote Elles olive oil with CDO.</li> <li>• Olive Growers Association can actively engage in fairs with the backing of ONH and CEPEX to explore new markets for their products.</li> <li>• Ensuring the transportation of the collected olives to the association.</li> </ul>	<ul style="list-style-type: none"> <li>• Active engagement of the community members</li> <li>• Preserve natural and cultural heritage</li> <li>• Improve olive grower's participation in decision making</li> <li>• Building knowledge through collective action</li> <li>• Land and natural resource governance</li> <li>• Improve inclusion and equality.</li> </ul>	<ul style="list-style-type: none"> <li>• Improve biodiversity</li> <li>• Improve soil health</li> <li>• Climate change mitigation through agroecological practices</li> <li>• Community cohesion</li> <li>• Community empowerment</li> <li>• Dignified livelihoods</li> <li>• Job creation</li> </ul>
Cost streams			Revenue streams	
<p>The cost of the upgraded plan of the business model is estimated to 139,225 \$ including:</p> <ul style="list-style-type: none"> <li>• 2% for the creation of the SMSA,</li> <li>• 14.3% for the adoption of the agroecological practices,</li> <li>• 2% for the creation of Controlled Designation of Origin,</li> <li>• 48.6% for the integration of the olive oil processing,</li> <li>• 23.7% for the integration of the olive oil conditioning,</li> <li>• 9.3% for the integration of the olive oil marketing.</li> </ul>			<ul style="list-style-type: none"> <li>• The olive growers association derives its revenue from the sale of olives, as well as packaged virgin and extra virgin olive oil, in accordance with both national and international market trends.</li> <li>• A quality premium is applied to the selling price of olives, rewarding olive growers who embrace agroecological practices.</li> <li>• Existing opportunities to bolster its revenue by providing various services to its members and the community, such as oil storage, extraction, training, etc.</li> <li>• The sale of a one-liter bottle of controlled olive oil at nearly \$10.</li> </ul>	

Source: Author's elaboration from analysis of field data (2024).

diversifies revenue by offering services like storage and extraction (Table 4). Governance emphasizes democratic principles, active participation, and fair involvement, with a focus on empowering women. The environmental and social benefits are significant, with improvements in soil fertility, biodiversity preservation, erosion control, and community empowerment. The association fosters social cohesion, creates dignified livelihoods, and promotes autonomy through training, job creation, and access to resources and credit.

The contributions of the upgraded business model to promote the agroecological principles are presented in Appendix 1. These contributions are in line with the literature review. The upgraded business model for olive production in the Elles region aligns with agroecological principles, contributing to sustainability through practices such as recycling, input reduction, and biodiversity enhancement. Olive cultivation generates substantial waste, including wood, branches, leaves, and by-products like olive pomace and mill wastewater. Traditionally, these wastes posed significant environmental challenges and incurred high disposal costs. However, recent research has developed biotechnological solutions to valorize these by-products through thermochemical and biochemical processes, producing biofuels, biofertilizers, and other valuable products (Galanakis and Giourka, 2017; Negro et al., 2017).

The BMC also focuses on reducing agricultural inputs by preserving the natural ecosystem. Historically, olive groves were grown on mountain terraces with minimal mechanization and low agrochemical input, harmonizing agriculture with the local environment (Loumou and Giourga, 2003; Morgado et al., 2020). Intercropping, which is gaining popularity for its climate resilience, improves resource efficiency and enhances crop quality and ecosystem services (Hoffland et al., 2020; Glaze-Corcoran et al., 2020; McAlvay et al., 2022). Olive by-products also contribute to reducing feed costs and environmental burdens in livestock farming by replacing conventional grain-based feeds. This aligns with bioeconomy principles, enabling sustainable use of nutraceutical ingredients while mitigating climate change (Molina-Alcaide and Yáñez-Ruiz, 2008; Berbel and Posadillo, 2018).

Biodiversity, a key agroecological component, is optimized through traditional practices that conserve indigenous olive varieties, which are often disease-resistant and drought-tolerant, thriving in marginal conditions. Such biodiversity is crucial for resilient ecosystems (Altieri et al., 2015). In the Elles region, high-quality olive varieties like Chetoui and Chemlali, coupled with diversified agroforestry, enhance ecosystem resilience to climate change (Weber et al., 2020; Martins et al., 2023).

Agroecology promotes sustainable practices that integrate ecological, economic, and environmental factors (Mondal and Palit, 2021). Olive growers in Elles are exploring circular economy models by converting olive by-products into additional revenue streams, improving their farm management skills through collaborations with NGOs and social enterprises (Isaac et al., 2007; Chen et al., 2015; Calvano and Tamborrino, 2022).

Farmers are also considering forming a cooperative association to promote innovation and sustainability. By participating in local

government sustainability initiatives and embracing biodiversity conservation (Souissi et al., 2024), Elles olive growers are responding to consumer demand for environmentally responsible products (Iakovidis et al., 2022; Radić et al., 2023). The proposed farmers association could also enhance collective bargaining power, advocate for land rights, and develop product differentiation strategies, including modern packaging for niche markets (Ribeiro and Santos, 2004; Holt-Giménez et al., 2010; Souissi et al., 2024). This model, supported by agroecological principles, boosts biodiversity, improves soil health, and promotes social equity, environmental sustainability and economic resilience (Matzembacher and Meira, 2019; Shankland, 2022; Wittman and James, 2022; Rykovska, 2023).

A workshop brought together key stakeholders from the olive oil value chain (development and research institutions, private actors, and financial organizations) to validate the olive grower's business model in Elles community and explore investment opportunities, particularly in processing (olive oil mills). The business model received strong interest, with representatives from the Kef region expressing their willingness to adopt it and promote the Controlled Designation of Origin (CDO) for Elles olive oil nationally and internationally. In this regard, the leader of the olive grower's association emphasized "*The olive oil business model presents a real and significant opportunity for Elles community. It empowers small olive growers through the integration of agroecological practices and promotes high-quality Elles olive oil under the Controlled Designation of Origin.*" Development institutions in Kef region recognized its value for fostering sustainable production and adding value for smallholders, while financial institutions showed readiness to support the initiative through tailored financial mechanisms.

Scaling up the adoption of the agroecological olive growers' business model beyond northwest Tunisia requires innovative financial mechanisms that align public policy, private sector investment, and farmers' capacities to support sustainable practices. These mechanisms include state subsidies redirected from chemical inputs to organic methods, tax incentives, microfinance loans, and cooperative financing. By integrating these mechanisms, Elles can advance its agroecological transition, ensuring inclusivity, scalability, and resilience in the agricultural sector.

## 5 Conclusion and political implications

Olive production is a major agricultural, environmental, and economic driver for Mediterranean countries. Olive trees are cultivated across diverse landscapes and agroecological zones, where varying levels of management intensity are applied (Dimon et al., 2023). However, biodiversity in agroecosystems undergoing intensification tends to diminish (Biaggini et al., 2007). When properly managed, enhanced agroecosystem biodiversity can provide numerous benefits, such as supporting soil fertility, crop protection, and productivity (Altieri, 1999). The component of agro-biodiversity that delivers these beneficial services, depending on the stakeholders' objectives and priorities, is considered "functional" (Moonen and Barberi, 2008; Barberi, 2013).

Elles olive oil in the community of El Sers, in the northwest of Tunisia, marks a significant advance in the understanding of the business model in force. Using an inclusive and participatory methodology involving stakeholders, this assessment provided a comprehensive understanding of the complex mechanisms of the olive oil business model in the community of Elles, leading to an upgraded business model. This model presents a solid foundation rooted in conventional practices and environmental awareness. This means a collective commitment to sustainability and community engagement, while also highlighting opportunities for improvement, including in the adoption of agroecological practices and principles and market expansion through controlled designation of origin.

The upgraded business model has deepened the vision and missions of the group of olive growers, highlighting their commitment to an agroecological approach in harmony with the principles of sustainable agriculture. This business model represents a transformative vision responding to the constraints of the current model, emphasizing collaborative efforts, agroecological practices and strategic partnerships. It focuses on economic diversification, penetration of niche markets and preservation of assets, even if it requires substantial investment with promising returns (Vega, 2016). Indeed, several key initiatives are proposed to strengthen olive oil production in the region, including the creation of the Olive Growers Association. This collective effort aims to unify and empower olive growers, foster collaboration, knowledge exchange and collective decision-making. Additionally, adopting agroecological practices, such as composting and intercropping, aims to optimize yields, improve soil health and promote long-term sustainability (Colombo et al., 2020). The creation of a controlled designation of origin serves to authenticate and elevate the quality of the region's olive oil, establishing its unique identity and distinguishing it in the market (Clodoveo et al., 2021). Additionally, the integration of olive oil processing, packaging and marketing within the olive growers association ensures quality control, streamlines operations and improves value across the board business model of olive growers.

This upgraded business model presents a comprehensive roadmap for the Elles olive oil sector, integrating sustainability, economic growth and community engagement through a holistic approach. Importantly, this transformation plan is a collaborative initiative involving diverse stakeholders, echoing a unified vision to evolve Elles olive oil toward an agroecological business model.

## Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

## Ethics statement

The studies complied with local laws and institutional guidelines. Ethical approval and written informed consent were not necessary for human participants, as consent was obtained verbally during the workshops.

## Author contributions

RM: Conceptualization, Formal analysis, Investigation, Methodology, Software, Validation, Visualization, Writing – original draft, Writing – review & editing. MD: Conceptualization, Methodology, Project administration, Supervision, Validation, Visualization, Writing – review & editing. AS: Project administration, Supervision, Visualization, Writing – review & editing. BD: Conceptualization, Funding acquisition, Methodology, Project administration, Supervision, Validation, Visualization, Writing – review & editing. MO: Conceptualization, Methodology, Validation, Writing – review & editing. AC: Supervision, Validation, Visualization, Writing – review & editing. AF: Project administration, Supervision, Validation, Writing – review & editing. HO: Validation, Visualization, Writing – review & editing. AO: Supervision, Validation, Visualization, Writing – review & editing. MF: Validation, Visualization, Writing – review & editing. AL: Validation, Visualization, Writing – review & editing.

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## Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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## Supplementary material

The Supplementary Material for this article can be found online at: <https://www.frontiersin.org/articles/10.3389/fsufs.2025.1587318/full#supplementary-material>



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