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Review

Underutilized Vegetable Crops in the Mediterranean Region: A Literature Review of Their Requirements and the Ecosystem Services Provided

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Abstract: By 2050, the increasing demand for food will put additional pressure on natural resources. Underutilized crops, such as wild vegetables, are an essential component of the Mediterranean diet and are widely correlated with the traditional cuisine of Mediterranean countries. They could be widely associated with resistance to abiotic stress and enhanced genetic diversity, and could provide various ecosystem services. Their cultivation could support the Sustainable Development Goals (SDGs) established by the UN and the current EU policies related to environmentally friendly agriculture. Based on an extensive literature review, the aim of this paper is to summarize the environmental and ecological requirements of specific Mediterranean underutilized vegetables, the provisioning and regulating ecosystem services that could be derived from their cultivation, and their potential use. It is concluded that thorough planning of underutilized crop cultivation could enhance the provisioning and regulating ecosystem services that positively affect Mediterranean agriculture. However, further research should be carried out regarding their environmental and economic impact in order to assess the environmental and socio-economic effects of underutilized crops cultivation. This could lead to designing future policies that support underutilized crop cultivation and consumption.

Keywords: biodiversity; climate change; endemic species; Mediterranean diet; neglected crops; sustainable agriculture

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1. Introduction

According to FAO [1], the need for intensive food production from the agricultural sector will require more resources to meet the needs of the growing world population by 2050. At the same time, targets have been set for more resilient agroecosystems that sustainably provide food and nutrients [1]. Agroecosystems are often considered as sources of provisioning and regulating ecosystem services (Table 1). These may include the provision of food or biomass for energy, bioremediation through the root system, erosion and pest control, and greenhouse gas emissions mitigation [2,3]. The Common International Classification of Ecosystem Services (CICES), developed from the environmental accounting work undertaken by the European Environment Agency, is the main framework that encodes the major ecosystem services (Table 1).

In 2016, the Member States of the UN adopted the Sustainable Development Goals (SDGs), integrating social, economic, and environmental dimensions in achieving sustainability (Table 2). The SDGs include 17 goals, 169 targets, and 200 benchmarks for achieving its sustainability goals, with a time horizon of 2030. A set of SDGs and targets are directly linked to sustainable agricultural production. The SDGs recognize the critical role of sustainable ecosystem management [4]. Although ecosystem services are not explicitly mentioned in the SDGs, it is crucial to highlight and strengthen them to make optimal management decisions in agricultural production [4–6]. This policy is also outlined in European Union policies such as the Farm to Fork Strategy New Green Deal. However, further research should be carried out to translate national and international objectives into local policies that demonstrate the interaction between agricultural production and how ecological and socio-economic systems are affected by climate change, especially in vulnerable regions.

The Mediterranean basin is a crucial plant biodiversity hotspot, containing 22,500 plant species of which 11,700 are endemic (about 10% of the world's total plant species) [7]. Moreover, the Mediterranean region is a climate change hotspot, with a further increase in the average temperature (of 0.9–5.6 °C compared to the last two decades of the 20th century, depending on greenhouse gas emission scenarios) and a decrease in annual precipitation (by 4–22%, depending on greenhouse gas emission scenarios), leading to vulnerabilities and variability in the region's agri-food sector [8,9]. It is worth mentioning that the current food supply chain (production, transport, processing, manufacturing, packaging, storage, retail, consumption, losses, and waste) could be responsible for 21–37% of the total annual greenhouse gas emissions [10].

Agricultural production across the Mediterranean region mainly consists of small-scale cultivations. Local food products compose the core of the Mediterranean diet. At the same time, the agroecosystems of the region provide other ecosystem services such as carbon storage, pollination, habitat provisioning, the promotion of cultural heritage, and agro-tourism [11]. However, intensive agricultural practices that aim to maximize food supply could cause pressure on agroecosystems, affecting the ecosystem services provided, such as biodiversity and soil carbon sequestration [3].

Agricultural products, a vital component of a healthy diet, are also vulnerable to climate change. Many practices can be optimized to promote adaptation across the agri-food sector. Options on the food supply side include diversifying crops and selecting plant species with greater tolerance to changing climate conditions [10]. Demand-side adaptation includes practices such as adopting sustainable dietary patterns [10]. Food preference has short- and long-term effects on human health and longevity as well as on the public health system [12]. Among the diet plans worldwide, the Mediterranean diet has been well-recognized as a healthy diet that promotes well-being and longevity [13–15].

Underutilized crops such as wild vegetables are an essential ingredient of the Mediterranean diet and are highly correlated with the traditional cuisine of Mediterranean countries [16,17]. Recently, studies have been conducted that provide useful information about the valuable phytochemicals concentrations in underutilized vegetables of the Mediterranean region [18,19]. Consequently, the enhancement of their cultivation could substitute other major vegetables without affecting nutrient and phytochemical supplies through the agri-food sector. Endemic underutilized vegetables could be more resistant to abiotic and biotic stresses such as drought, high temperatures, pests, and diseases while remaining productive [20]. Underutilized vegetables could enhance genetic diversity, which is a critical supporting ecosystem service [21]. In total, they could potentially enhance a country's food security, its available nutritional quality, and the stability of its agricultural income [22]. However, there are several socio-economic, environmental, and policy challenges arising from underutilized vegetable crops cultivation (Table 2).

Table 1. Potential provisioning and regulating ecosystem services of underutilized crops according to Common International Classification of Ecosystem Services (CICES) V 5.1.

Section	Group	Class	Code
Provisioning	Cultivated terrestrial plants for nutrition, materials or energy	Cultivated terrestrial plants grown for nutritional purposes	1.1.1.1
	Cultivated terrestrial plants for nutrition, materials or energy	Fibres and other materials from cultivated plants	1.1.1.2
	Cultivated terrestrial plants for nutrition, materials or energy	Cultivated plants as source of energy	1.1.1.3
	Wild animals (terrestrial and aquatic) for nutrition, materials or energy	Wild plants used for nutrition	1.1.5.1
	Wild animals (terrestrial and aquatic) for nutrition, materials or energy	Fibres and other materials from wild plants	1.1.5.2
	Wild animals (terrestrial and aquatic) for nutrition, materials or energy	Wild plants as source of energy	1.1.5.3
	Genetic material from plants, algae or fungi	Seeds, spores and other plant materials collected for maintaining or establishing a population	1.2.1.1
Regulation & Maintenance	Mediation of wastes or toxic substances of anthropogenic origin by living processes	Bio-remediation by micro-organisms, algae, plants, and animals	2.1.1.1
	Regulation of baseline flows and extreme events	Erosion control	2.2.1.1
	Pest and disease control	Pest control	2.2.3.1
	Pest and disease control	Disease control	
	Atmospheric composition and conditions	Regulation of chemical composition of atmosphere and oceans (greenhouse gas emissions)	2.2.6.1

Table 2. Major Sustainable Development Goals (SDGs) and specific targets related to underutilized crops cultivation.

Goal		Target	
SDG2	Zero Hunger	2.3	Achievement of twofold agricultural productivity and small-scale food producers incomes, including through secure and equal access to land, other productive resources and inputs, knowledge, financial services, markets and opportunities for value addition and non-farm employment
SDG2	Zero Hunger	2.4	Achieve sustainable food production systems and develop resilient agricultural practices that support productivity and production, assist in maintaining ecosystems, enhance climate change adaptation, extreme weather, drought, flooding and other disasters and improve land and soil quality
SDG2	Zero Hunger	2.5	Maintain genetic diversity of seeds, cultivated plants and animals and their related wild species, including through soundly managed and diversified seed and plant banks at the national, regional and international levels, and promote access to and fair and equitable sharing of benefits arising from the utilization of genetic resources and associated traditional knowledge, as internationally agreed
SDG6	Clean Water and Sanitation	6.6	Protect and restore water-related ecosystems
SDG7	Affordable and Clean Energy	7.3	Achievement of twofold the global rate of improvement in energy efficiency
SDG12	Responsible Consumption and Production	12.2	Efficient use and sustainable management of natural resources
SDG13	Climate Action	13.2	Integrate climate change measures into national strategies, planning, and policies
SDG15	Life on Land	15.1	Prioritize and protect the conservation, restoration and sustainable use of terrestrial and inland freshwater ecosystems and their services, in particular forests, wetlands, mountains and drylands, along with obligations under international agreements
SDG15	Life on Land	15.3	Combat desertification, restore degraded land and soil, including land affected by desertification, drought and floods, and strive to achieve a land degradation-neutral world
SDG15	Life on Land	15.9	Merge ecosystem and biodiversity values into national and local planning, development methods, poverty reduction strategies and accounts

The aim of this paper is to summarize the provisioning and regulating ecosystem services that could be derived from the use of underutilized vegetables (*Amaranthus blitum* L., *Crithmum maritimum* L., *Lactuca serriola* L., *Pastinaca sativa* L., *Plantago lanceolata* L., *Portulaca oleracea* L., *Reichardia picroides* L., *Scolymus hispanicus* L., *Sonchus oleraceus* L., *Sylibum marianum* L., *Urtica dioica* L.) across the Mediterranean Region. We conducted a literature review in order to (i) determine the cultivation practices and inputs of the underutilized crop production, (ii) overview the major environmental, nutritional, and livelihood benefits derived, (iii) express those benefits as provisional and regulating ecosystem services interlinked with major SDGs established by UN, and (iv) discuss several risks and issues that must be considered regarding the benefits that underutilized vegetable production could provide.

The above-mentioned vegetable crops were selected based on their widespread distribution and prevalence throughout the Mediterranean region. Although some of these crops are commonly categorized as weeds, they have been recognized for their crucial nutritional value and their use as food sources in the region. Additionally, many of these species possess unique and endemic characteristics that contribute to the cultural identity of the Mediterranean region. The selection of these crops allowed for a comprehensive review of the diverse array of underutilized vegetable crops in the region, highlighting the importance of both cultivated and wild plants. Overall, the selected crops could provide insights into the nutritional and environmental aspects of underutilized vegetable crops in the Mediterranean region.

In preparing this review of the literature we consulted the SCOPUS database to search for peer-reviewed articles. Regarding the environmental requirements, the exact scientific names of the studied underutilized crops were included. In addition, the terms included the exact studied parameter, such as “Fertilizer”, “Climate”, and “Soil”.

Regarding the ecosystem services provided, the exact scientific names of the studied underutilized crops were included. Moreover, the terms “Ecosystem Service”, “Provisioning Service”, and “Regulating Service” were substituted with the examples of the ecosystem services provided such as “Food”, “Raw material”, “Medicinal”, “Soil erosion”, “Carbon sequestration”, “Remediation”, and “Biological control”.

2. Ecology, Environmental Requirements, and Ecosystem Services of the Underutilized Crops

Underutilized leafy greens, which have a high nutritional value, can now be incorporated into existing cultivations to contribute to more nutritious food for the consumer while at the same time making alternatives available to producers and the market as well as enriching biodiversity. Table 3 summarizes the ecological and environmental requirements of the studied underutilized crops based on the literature reviewed. All species mentioned in Table 3 are known as wild weeds growing in unfavorable, biotic, or abiotic environmental conditions such as salinity, drought, and poor soil conditions. These species have been studied to determine their nutritional value and use in the pharmaceutical industry. They have been found to contain high amounts of antioxidant compounds, act against cancer genesis, be anti-inflammatory, and induce the immune system.

However, as presented in the table above, there is a lack of information about the agronomic characteristics of these underutilized species. Therefore, more research must be conducted to gain more knowledge about these species’ cultivation needs to benefit from their nutritional and medicinal value and their ability to grow in unbeneficial conditions. Table 4 presents the major edible parts, specific nutritional value, pharmaceutical use, and other potential uses of the studied underutilized crops. Table 5 summarizes the provisioning and regulating ecosystem services provided by the studied underutilized crops, as described in the subsections below (see also Figure 1).

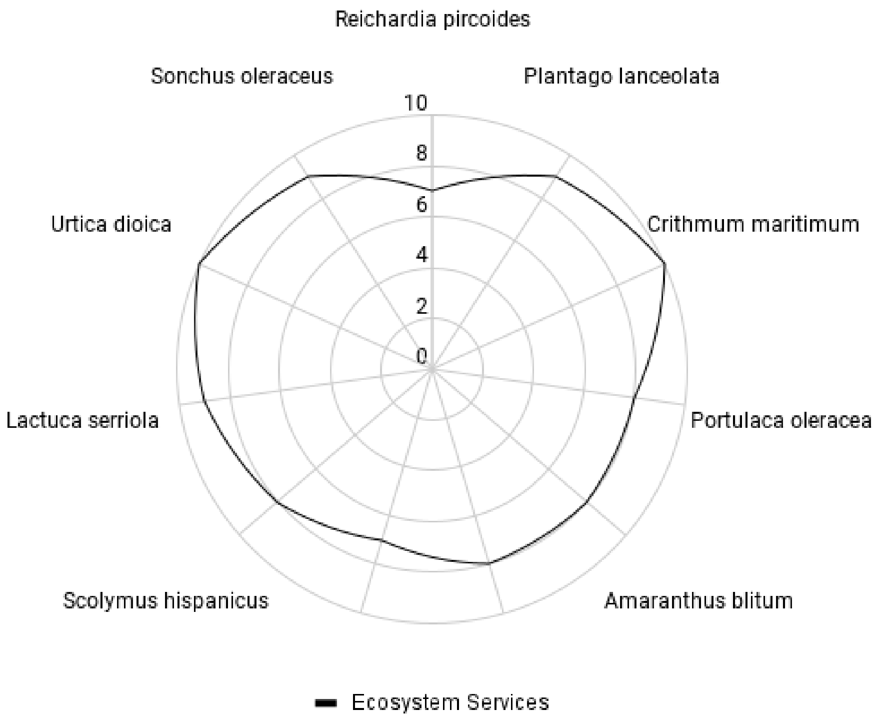

Figure 1. Radar graph illustrating the number of Ecosystem Services that are related with the studied underutilized crops as described in Table 5.

2.1. *Amaranthus blitum* L.

Amaranthus blitum, an annual crop, is native to the Mediterranean region; it is a major weed in crops because it easily multiplies. It is difficult to be eliminated from cultivation due to the germination of its seed even after ten years. *Amaranthus blitum* is a source of phenolics, minerals, flavonoids, and vitamins. It has a high concentration of protein, and the tender tops are harvested from early summer to autumn. Regarding the provided ecosystem services, *Amaranthus blitum* is well-adapted and resilient to abiotic stress, such as drought, high salinity, and heavy metal concentration [23]. In addition, recent research has shown that drought and salinity stress increases the concentration of nutrients and bioactive compounds, such as flavonoids and antioxidants [24]. Its leaves can be eaten boiled with vinegar or lemon and combined with various vegetable products such as pumpkin seeds. Furthermore, it is used in pies with other leafy greens [25–27].

2.2. *Crithmum maritinum* L.

Crithmum maritimum is a flowering *Apiaceae* plant, and it is native to Europe. *Crithmum maritinum* is known for its property to adapt to saline and silty-clay soils. It is resistant to soil salinity and highly saline water, which allows it to be cultivated in saline environments [28]. Its stem, leaves, and seed pods can be consumed as pickles in hot, salted, or spiced vinegar or in fresh salads. *Crithmum maritinum* is a plant rich in carbohydrates and antioxidants [29–31] and it has diuretic properties. Its leaves have high concentrations of vitamin C, carotenoids, and flavonoids [32]. It could accumulate secondary metabolites, absorb toxic ions [33], and reduce soil erosion [34]. *Crithmum maritimum* bioactive substances could be used for aromatic and insecticide purposes [35].

Table 3. Environmental requirements of the studied underutilized crops.

	Amaranthus blitum	*Crithmum maritimum*	*Lactuca serriola*	*Reichardia pircoides*	*Pastinaca sativa*	*Plantago lanceolata*	*Portulaca oleracea*	*Scolymus hispanicus*	*Sonchus oleraceus*	*Sylbum marianum*	*Urtica dioica*
N	10	25 kg ha^{-1}	-	-	100 kg ha^{-1}	60 kg ha^{-1}	140 mg l^{-1}	-	-	49.5 kg ha^{-1}	60–80 kg ha^{-1}
P	10	-	-	-	44 kg ha^{-1}	40 kg ha^{-1}	50 mg l^{-1}	-	-	138 kg ha^{-1}	40–50 kg ha^{-1}
K	20	-	-	-	166 kg ha^{-1}	80 kg ha^{-1}	200 mg l^{-1}	-	-	150 kg ha^{-1}	150–180 kg ha^{-1}
Soil	Saline tolerant	Silty-clay	-	-	Heavy, loamy, humic, non-crusting	-	Saline tolerant	-	Rochy to nutritive soil	Sandy to heavy clay	Loose soil
Water	500 mm	210 mm	-	-	Needs wet habitats	-	Drought tolerant	-	Drought tolerant	180 mm	Moist soil not flooding
Temp °C	15–25	2.9–20.7	15–25	Summer crops	-	Fall or spring	20–35	22–35	Winter crop, heat tolerant	15	Winter crop
pH	>6	6.4	4.5–7	>4	-	6.5–7.3	5.5–6	-	-	5.5–7.6	
Organic Matter	20–40 t ha^{-1}	-	-	-	-	Manure 20,000–35,000 kg ha^{-1}, 2–4 times	-	-	Thrives when fertilized	-	Required
Salinity	-	-	<80 mM	Medium tolerance	-	-	-	Medium tolerance	High tolerance	15 dS/m	-
References	[25]	[34]	[36]	[37–39]	[40]	[39,41]	[42]	[43]	[44]	[45]	[46]

Table 4. Major edible parts, specific nutritional value, pharmaceutical use and other potential uses of the studied underutilized crops.

	Edible Part	Nutritional Value	Pharmaceutical Use	Other Uses
Lactuca serriola	Leaves, young shoots	Polyphenolic compounds	Diuretic, digestive	Oil for paints and soap
Urtica dioica	Leaves	Carotenoids, vitamins C and E, proteins	Antimicrobial, antiulcer, analgesic	Insect repellent, fibre, dyes
Reichardia pircoides	Leaves, root		Depurative, diuretic, hypoglycemic	-
Plantago lanceolata	Leaves, seeds	Iridoid glycosides, flavonoids, phenylethanoid glycosides	Anti-inflammatory	Leaves as fibres for textile
Crithmum maritimum	Leaves	Vitamin C, carotenoids, flavonoids	Diuretic	Oil for perfumes and insecticides
Portulaca oleracea	Flowers, leaves, stalks, seeds	Vitamin C, ω-3 fats	-	-

Table 4. *Cont.*

	Edible Part	Nutritional Value	Pharmaceutical Use	Other Uses
Amaranthus blitum	Leaves	Phenolics, minerals, flavonoids, vitamins, proteins	-	Dyes from the whole plant
Pastinaca sativa	Root, leaves, shoots	Vitamins, minerals, potassium	Antioxidant, anti-inflammatory	Insecticide
Sylibum marianum	Flowers, leaves, stalks, roots		Hypolipidemic, anti-atherosclerosis	-
Scolymus hispanicus	Leaves, roots	Antioxidant and phenolic compounds	Antibacterial	-
Sonchus oleraceus	Leaves, root, stem	Carotenoids, minerals (Fe), vitamin E	Cholesterol, high blood pressure	Leaves for gum and latex

Table 5. Specific provisioning and regulating ecosystem services related to underutilized crop.

	Class	***Amaranthus blitum***	***Crithmum maritimum***	***Lactuca serriola***	***Pastinaca sativa***	***Plantago lanceolata***	***Portulaca oleraceae***	***Reichardia picroides***	***Scolymus hispanicus***	***Sonchus oleraceus***	***Sylibum marianum***	***Urtica dioica***
Provisioning	Cultivated plants for nutritional purposes	+	+	+	+	+	+	+	+	+	+	+
	Materials from cultivated plants	+	+	+	+	+				+		+
	Wild plants used for nutrition	+	+	+	+	+	+	+	+	+	+	+
	Materials from wild plants	+	+	+	+	+				+		+
	Plant materials collected for maintaining or establishing a population	+	+	+	+	+	+	+	+	+	+	+
Regulating	Bio-remediation		+	+		+	+	+	+	+	+	+
	Erosion control		+				+		+			+
	Pest control	+	+	+	+	+	+	+	+	+	+	+
	Disease control	+	+	+	+	+	+	+	+	+	+	+
	Regulation of greenhouse gas emissions	+	+	+	+	+	+	+	+	+	+	+

2.3. *Lactuca serriola* L.

Lactuca serriola is a biennial plant that can reach 1 m in height. It has a thick central stem with thorns. It has established populations on all continents and has the most widespread distribution compared to other *Lactuca* species. It can be grown under cover (glasshouse) under controlled conditions of 32/25 °C day/night and 14 h of light with supplementary lighting. *Lactuca serriola* contains polyphenolic compounds, and its shoots contain milky juice, which is a tranquilizer. Its tender leaves can be eaten boiled or raw, but can be also used as raw material for rubber production [47–49]. The whole plant is rich in a milky sap that is used in medicine for its diuretic and digestive properties. *Lactuca serriola* plants could be cultivated for the phytoremediation of heavy metals [50]. Moreover, they present high adaptability to abiotic stress, such as high temperatures and limited available water, mainly due to its root system that provides better management of available soil water [51]. Consequently, it could maintain high water-use efficiency under severe drought conditions [52] *Lactuca serriola* cultivation could reduce water loss and consequently soil erosion [53]. Based on the above, a set of ecosystem services are provided, such as provision of material, food, and erosion control.

2.4. *Pastinaca sativa* L.

Pastinaca sativa is a root vegetable closely related to carrot and parsley. It is a biennial plant usually grown as an annual plant. It originates from Eurasia, and is characterized as a grassland plant. Its seeds are usually planted in early spring and the harvest begins in late fall after the first frost and continues through winter. Regarding ecosystem services, *Pastinaca sativa* is rich in vitamins and minerals and contains high amounts of potassium. It has been found to contain some vitamins of B complex. It is used in medicine as an antioxidant and anti-inflammatory, but it is also effective against cancer and cardiovascular diseases. It can also be consumed baked or boiled, roasted, fried, grilled, or steamed [54].

2.5. *Plantago lanceolata* L.

Plantago lanceolata is a common grassland and roadside plant native to the Mediterranean region. It can be grown in a greenhouse during summer with the higher nutritional quality found in the young and juvenile stages. It also provides a set of ecosystem services, such as provision of material and food and bioremediation. The leaves of *Plantago lanceolata* contain a notable amount of phenolics and antioxidant compounds that perform as anti-inflammatory and cytotoxic. Iridoid glycosides, flavonoids, and phenylethanoid glycosides are also included in the chemical compounds contained in *Plantago lanceolata*. Its leaves are used in many countries to treat colds and mouth and throat inflammations. They can also be eaten in cooked dishes and mixed salads. *Plantago lanceolata* demonstrates superior bio-potential and its use as a traditional remedy and functional food is validated [55,56]. *Plantago lanceolata* is suitable in temperate and subtropical climates [57]. Although its cultivation is enhanced by rainfall, its deep root system allows it to exhibit drought tolerance [58]. Moreover, its rhizosphere microorganisms could accumulate Cu from soils [59].

2.6. *Portulaca oleracieae* L.

Portulaca oleracea is an annual plant native to Southern Europe. As a spring-to-summer crop, it is tolerant to drought and salinity. Its tender tops are harvested from the beginning of summer until autumn. *Portulaca oleracea* is linked with numerous ecosystem services. It has a high vitamin C content and is the plant with the most ω-3 fats. It can be eaten raw in a salad with olive oil and onions and replace lettuce as a green vegetable [27,31,42,60]. *Portulaca oleracea* shows tolerance to high light intensity, temperatures, humidity, and soil salinity [61,62]. In particular, its photosynthetic activity increases under warm conditions and during intensive solar radiation and is resistant to drought stress [63]. It can be easily cultivated in a range of climatic conditions where other plants of similar nutritional value generally do not grow [64]. *Portulaca oleracea* could be cultivated in order to accumulate heavy metals, such as Zn, Cd, and Pb, from contaminated soils [65,66]. It can also be used to absorb NaCl from soils and gradually to decrease soil erosion [67].

2.7. *Scolymus hispanicus* L.

Scolymus hispanicus is a summer biennial or perennial plant and can reach a height of 1 m. It has a deep, thick root; a central stem; and spiny leaves. It is native to southern Europe and could be found everywhere throughout Greece in uncultivated areas of low altitude. The new tender leaves are harvested before they become spiny, and the tender shoots are gathered from winter to spring. The root and fleshy leaf ridges are gathered in autumn. Regarding the ecosystem services provided, *Scolymus hispanicus* is considered a source of antioxidant and phenolic compounds. It is used in medicine due to its antibacterial and anticancer properties. The new leaves and shoots can be eaten boiled alone or with other greens. The roots and stems are also edible in soups or cooked with meat. They can also be boiled and pickled with vinegar and oil [43]. In cultivation, the plant could be used to absorb soil Cd [68] and remove dyes from wastewater [69].

2.8. *Reichardia picroides* L.

Reichardia picroides is a herbaceous perennial plant growing from a taproot. It forms a basal rosette of leaves with flowering stems that can grow up to 45 cm tall. It is native to the Mediterranean basin and western Asia. Regarding the ecosystem services provided, *Reichardia picroides* is a pH- and salinity-adapting plant. Its leaves are depurative, diuretic, and hypoglycemic. Its roots are used to treat coughs, abdominal pains, and kidney problems. The leaves of *Reichardia pircoides* can be eaten raw or cooked [70]. *Reichardia picroides* is highly resistant to cultivation in saline- and nutrient-poor soils [37,70,71]. It can also be cultivated in order to accumulate NaCl for their phytoremediation properties [72].

2.9. *Sonchus oleraceus* L.

Sonchus oleraceus is an annual crop that reaches 40–80 cm tall and is native to Europe and Western Asia. Its leaves are harvested from early autumn until the end of spring, have a light green color, and contain milky sap. *Sonchus oleraceus* is known to reduce serum cholesterol levels and act against high blood pressure. It also has high concentrations of minerals (Fe), vitamin E, and carotenoids [73]. The leaves of *Sonchus oleraceus* taste a little sweet and are often eaten boiled or used in herb pies along with other greens and herbs [44]. *Sonchus oleraceus* plants are resilient to warm climates with intensely dry summers [74]. Although they could be very productive when cultivated in nutrient-rich soils, they can also be grown in disturbed and rocky soils [75]. Moreover, the *Sonchus* plant presents high salinity tolerance [76]. Lastly, its rhizosphere could absorb NaCl [72] and heavy metals (Zn, Cd) from soils [77]. Consequently, *Sonchus oleraceus* is linked with ecosystem services such as the provision of material and food, erosion control, bioremediation, and lower inputs that reduce greenhouse gas emissions.

2.10. *Sylibum marianum* L.

Sylibum marianum can reach 30 to 200 cm (12 to 79 in) in height and has an overall conical shape. It is native to the Mediterranean basin and grows in various soil types, from sandy soils to much heavier clay soils. It is typically sown directly into the soil during the autumn or spring, with row spacing between 40–75 cm and a distance of 20–30 cm between individual plants. The nutrient requirements for *Sylibum marianum* are low to moderate, thereby reducing its contribution to greenhouse gas emissions since it can adjust to disturbed soils and various climate conditions. Extracts of milk thistle have been used as medical remedies since the era of ancient Greece. As a cultivated plant, it is linked with provisioning ecosystem services. It is used as a cardiovascular protector; for its hypolipidemic and anti-atherosclerosis activities; and for the prevention of insulin resistance, cancer, and Alzheimer's. It is also used as a food remedy [31,45,78,79]. *Sylibum marianum* is easier to grow in areas with intense sunlight and is more productive in warm climates and dry summers [80]. Its cultivation could be used for PCBs' bioremediation from contaminated soils [81].

2.11. *Urtica dioica* L.

Urtica dioica is native to Europe. It is a biennial spiny plant, whose leaves are distinguished by white lines. It is mainly found near grasslands, where it thrives. It is a winter crop that can tolerate temperatures as low as −15 °C. Harvest of its new fresh leaves occurs from autumn until spring and before flowering. Regarding the ecosystem services provided, the nutritional value of *Urtica dioica* is important since it is a source of carotenoids, vitamins, and proteins. Furthermore, the water extract of this plant has antioxidant activity. Because of this content of antioxidants, it is widely used in cosmetics and medicine. The fresh leaves of *Urtica dioica* can also be boiled or sautéed just like spinach. *Urtica dioica* is used, among other herbs, to make delicious nettle pies in Greece. *Urtica dioica* offers antimicrobial, antiulcer, and analgesic activity and could also treat various diseases such as diabetes and inflammation. Moreover, its cultivation could be used for phytoremediation of heavy metals (Pb, Cd, As, Ni, and Cr) [82,83]. *Urtica dioica* cultivation is nitrophilous and potentially could reduce the erosion of over-fertilized soils [84]. Regarding other uses of *Urtica dioica* cultivation, it has a long history as a textile fiber [85,86].

3. Considerations to Be Addressed

In the previous section, the main requirements for the cultivation of the underutilized crops under study were presented. Thereafter, their cultivation was linked to the possible provisioning and regulating ecosystem services of CICES V5.1., the SDGs, and the current environmentally friendly policies of the European Union. Nevertheless, the non-evidence-based selection of cultivation practices or its introduction in some areas may lead to reverse effects, i.e., ecosystem disservices, a possible reduction of producers' income, and a degradation of the final product offered.

In particular, there should be an evidence-based outcome in order to build an inventory of best farming practices that would fill the gaps in the ecological and/or environmental requirements of underutilized crop cultivation. In addition, since all the studied underutilized crops are considered to be weeds, the possibility of developing competition with neighboring crops leading to a reduction in yields should be taken into account. Respectively, the development of allelopathy with specific crops, as well as phenomena of autotoxicity under specific climate conditions, should be examined on an individual case basis. Lastly, it is crucial to investigate the role of microclimate and the specific geographical conditions, such as temperature, salinity, altitude, and humidity, in relation to the potential of any underutilized vegetable cultivation [87]. Underutilized crops could potentially provide crucial ecosystem services, such as greenhouse gas emissions mitigation, improvement of soil structure and fertility, and biodiversity stability. However, it is of high importance to identify the sustainable practices in cultivating these underutilized crops. This could include the development of guidelines for sustainable farming practices that prioritize ecological sustainability. Moreover, new capital-intensive applications, such as precision agriculture, should be taken into account, since they could have essential effects on the required inputs.

For the successful development of the cultivation of underutilized crops, several factors must be considered that often go beyond the possible farming practices in the field and the ecological and/or environmental requirements of the crops. In particular, the impact of the development of underutilized crops through the whole life cycle, from the sourcing of the initial inputs (such as machinery and seeds) to the final disposal or reuse of the waste, needs to be studied. This would enhance the study of the actual environmental impact of crops through their life cycle to compare with other crops, as well as their ability to have higher economic returns.

In addition, the cultivation of underutilized crops should be investigated from a value chain perspective. Specifically, what should be examined is the current ability of underutilized crops production to add new value though the whole stages of their products in order to assess their ability to be profitable, have societal benefits, and have a positive or neutral impact on the natural environment. The accessibility of these products to local and national markets should be studied, as well as consumers' knowledge of the products' offered properties and/or characteristics. In designing the value and supply chains of underutilized vegetable crops, several considerations should be taken into account in order to maintain profitability. These include the role of small-scale farmers; the quality standards designation; methods of post-harvest handling that reduce potential food loss; and the linkages between producers, traders, and consumers [22,88,89]. According to Will [90], regional markets are a critical factor in maintaining the underutilized vegetable crop products, as well as the role of local authorities in promoting these commodities. Consequently, underutilized crops cultivation could lead to changes in supply chains. For instance, storage facilities may need to be redeveloped and new distribution networks and marketing strategies may need to formed to raise consumer awareness regarding these crops' consumption.

Underutilized vegetable crops cultivation could potentially enhance food security and biodiversity through crop diversification, reduce the agricultural inputs and nutrient loss, emit lower greenhouse gases, and finally lead to healthier food products. The above-mentioned benefits are directly linked to the EU's recent policies such as the new CAP 2023-27, the Farm to Fork Strategy, and the Biodiversity Strategy for 2030 (Table 6). It is concluded that highlighting all the benefits of developing underutilized crops (ecosystem services, other uses, nutritional value, integration with EU and UN policies, linkages with SDGs, contribution to climate change adaptation) would enhance the future capacity of this sector to increase demand for products as well as strengthen investment for further development (Figure 2).

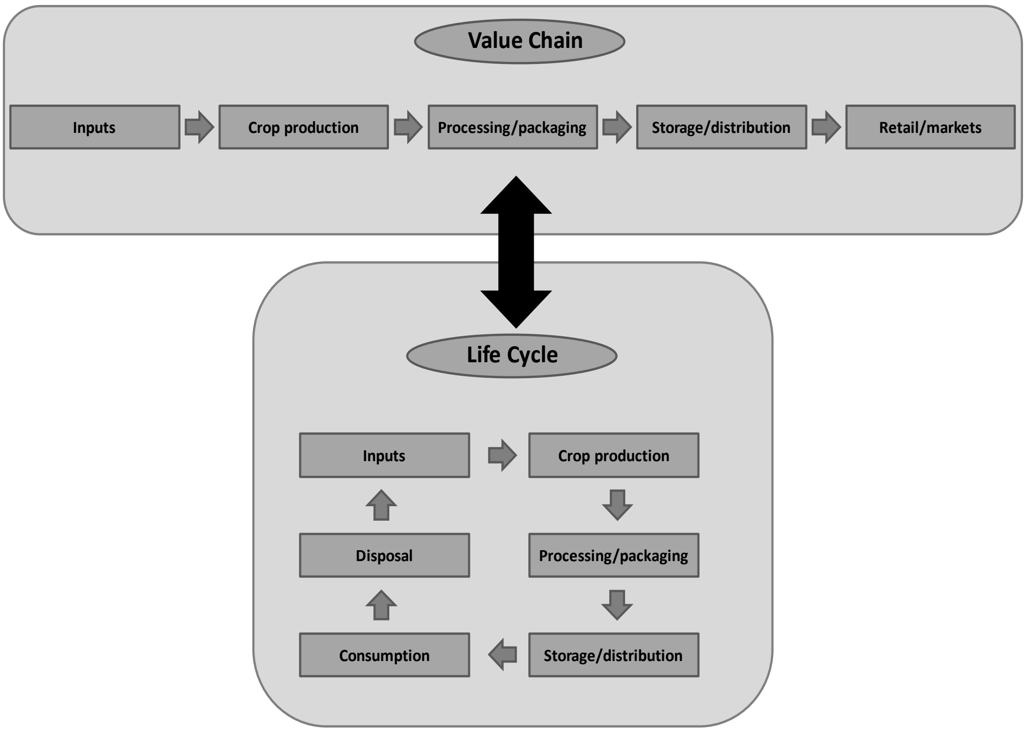

Figure 2. Simplified value chain and life cycle stations of the underutilized crop products that should be thoroughly examined.

Table 6. Underutilized crops' potential benefits linked to EU policies related to environmentally friendly food production.

EU Policy	Specific Objective–Action–Commitment	Related Underutilized Crops' Benefit
CAP 2023-27 [1]	Support viable farm income and the resilience of the agricultural sector across the EU, in order to enhance long-term food security and agricultural diversity, as well as to ensure the economic sustainability of agricultural production	Crop diversification enhances food security and reduces substitution by specific main crops with varying economic output.
	Contribute to climate change mitigation and adaptation, including by reducing greenhouse gas emissions and enhancing carbon sequestration, as well as promoting sustainable energy	Underutilized plants that are resilient and well adapted to abiotic stress require lower input in order to be productive, resulting in lower greenhouse gas emissions
	Foster sustainable development and efficient management of natural resources such as water, soil and air, including by reducing chemical dependency	Underutilized plants that are resilient and well adapted to abiotic stress require lower input in order to be productive, resulting in limited use of fertilizers and pesticides
	Contribute to halting and reversing biodiversity loss, enhance ecosystem services and preserve habitats and landscapes	Crop diversification could preserve ecosystem habitats
	Improve response food produced in a sustainable way	Underutilized crops have a high nutritional value that could substitute or complete a healthy daily diet
Farm to Fork Strategy [2]	Reduce by 50% the use of pesticides until 2030	Underutilized plants could require limited use of pesticides
	Reduce nutrient losses by at least 50% Reduce the use of fertilizers by at least 20% until 2030	Underutilized plants could require limited use of fertilizers due to more efficient use of nutrients
	Creation of a healthy food environment which makes the healthy and sustainable choice the easy choice	Underutilized crops have a high nutritional value that could substitute or complete a healthy daily diet
Biodiversity Strategy for 2030 [3]	The losses of nutrients from fertilizers are reduced by 50%, resulting in the reduction of the use of fertilizers by at least 20%.	Underutilized plants could require limited use of fertilizers
	The risk and use of chemical pesticides is reduced by 50% and the use of more hazardous pesticides is reduced by 50%.	Underutilized plants could require limited use of pesticides

[1] Specific objectives were retrieved from [91] [2] Specific actions were retrieved from [92] [3] Specific commitments were retrieved from [93].

4. Conclusions

Underutilized crops, since they are endemic species, have a lower need for inputs and are highly resistant to abiotic stress. In addition, they provide a set of ecosystem services that are directly linked to the UN SDGs and EU policies for environmentally friendly agricultural production. However, further evidence-based study of the plant characteristics and their ecological interactions should be carried out. Moreover, the environmental impact and economic potential of underutilized crops both through their products' life cycle and through their value chain should be examined.

There are several possible pathways for conducting future studies or research to validate mitigation measures on underutilized crops cultivation as a potential for sustainable agriculture in the Mediterranean region. These may involve (i) conducting field trials in order to test their efficiency in various agro-ecological zones, (ii) assessing the potential market demand for these crops (including issues such as supply chain challenges and profitability, (iii) evaluating and promoting their nutritional and health benefits, (iv) studying the impact of underutilized crops on biodiversity, and (v) conducting surveys of farmers, consumers, and stakeholders to investigate the socio-cultural and potential economic aspects of the adoption of underutilized crops.

The above-mentioned pathways could lead to future policies that support underutilized crops cultivation, such as incentives for the adoption of these crops, educational projects supporting their consumption, and guidelines for their sustainable cultivation. The combination of these factors would support the future sustainable development of agricultural production involving these underutilized crops.

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