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Local farmers, custodians of wild food plant knowledge and uses in the touristified Venice Lagoon

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Abstract

Background The islands of Sant'Erasmo and Vignole, nestled in the Venice Lagoon, are biocultural refugia, where local ecological knowledge (LEK) of local communities, vital for wetland conservation, is being eroded by factors such as rural depopulation, globalization and touristification. This study investigates Local Gastronomic Knowledge (LGK) of Wild Food Plants (WFPs) among farmers and fishers to determine how occupation specialization influences knowledge distribution. It also investigates the ability of farmers to transform LGK into an economic resource by creating (or entering) niche economies, even though being immersed in a touristified and globalized context.

Methods From 2022 to 2025, semi-structured interviews were conducted with 18 farmers (Sant'Erasmo and Vignole) and 31 fishers of the Venice lagoon.

Results We documented 39 wild plant taxa, focusing on folk taxonomy, culinary preparations, and sale of WFPs. A significant occupational knowledge gap was identified: 94% of farmers utilized wild plants (with 70% of them also involved in their sale), naming 39 taxa, whereas fishers reported minimal knowledge representing only 10% of the sample (three out of 31 interviewed) and naming 2 out of the 39 documented taxa, confirming that LGK is tied to everyday contact with specific resources. Farmers demonstrated a very specialized knowledge, including 35% of uses previously unrecorded at the regional or national level.

We dedicate this work to the memory of our dear colleague and co-author Dauro. He was a truly remarkable person—warm, patient, and unfailingly generous with his time and knowledge. Always ready to collaborate, he approached every challenge with openness, kindness, and an enduring sense of positivity. We will miss his unique, genuinely interdisciplinary vision, his ability to see connections where others saw boundaries, and his talent for bringing fresh perspectives. His legacy lives on in these pages, in all his publications, in the ideas we shared. We are deeply grateful to have worked alongside him. He will be greatly missed.

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Background

Over time, through close interaction with the environment, human communities have developed adaptation strategies to local conditions to suit their material, cultural, and spiritual needs, giving rise to a variety of knowledge and practices [1–3].

This *corpus* of information is defined as Local Ecological Knowledge (LEK), representing the ensemble of knowledge, practices, and beliefs regarding ecological relationships gained through direct interaction with local ecosystems [4]. In this sense, LEK is the crucial element that links human communities to their environment,

Conclusions The findings of this study reveal that LGK among farmers, thus people who live in close connection with the soil and vegetation of the Venice lagoon, is still vivid and it is increasingly economically valued. The study also shows a sharp distinction in the LGK on WFPs between farmers and fishers, revealing a strong knowledge specialization tied to their primary occupation, essential in a context of rural depopulation and touristification, for identifying knowledge hotspots and supporting the resilience of local economies. Furthermore, the economic valorization of WFPs (through their incorporation into local short food supply chains) may further encourage their continued use and LGK transmission. We believe this may empower farmers and facilitate the expansion of WFP markets, shedding light on a positive narrative that sees farmers as active custodians of LGK, rather than as passively subjected to globalization, especially in tourist areas as the Venice lagoon is.

Keywords Ethnobotany, Wild food plants, Local gastronomic knowledge, Farmers, Fishers, Rural areas, Niche economy

essential for protecting vulnerable ecosystems, such as wetlands [5].

This link remains strongest in local communities that maintain direct ties to their natural environments [3]. However, LEK is a mosaic of specialized knowledge differentiated by occupation and the degree of contact with specific resources [6]. Indeed, those who have greater contact with particular resources (for example, farmers with plants) tend to possess broader and richer knowledge of those resources [6].

Historically, the Lagoon has been a site of traditional and specialized integration between horticulture (on rural islands, such as Sant'Erasmo and Vignole) and fishing (in its brackish waters; [7]).

However, intellectual and spiritual disconnection, often caused by migration to urban environments or a change in occupation, leads to a rapid erosion of this knowledge, reinforcing the need to document it [6, 8, 9]. Migration is compounded by accelerated socio-cultural and economic dynamics, such as globalized market economies, which erode local knowledge in favor of standardized models [10, 11]. The Venetian Lagoon context is a clear example of such processes, connected to the tourism phenomenon and the globalization of economies and food consumption [12, 13]. Moreover, the rural islands of Venice are experiencing significant depopulation, seen in the sharp demographic decline of Sant'Erasmo and Vignole islands between 2001 and 2024 (from 775 to 71 residents respectively, to 575 and 45; [14]). Nevertheless, due to its unique ecological and social values, the local communities who hold this specialized knowledge remain an essential element for the preservation of the Lagoon [7].

Local Gastronomic Knowledge (LGK), a key component of LEK, defines the relationship between local communities and their food, from procurement and preparation to consumption. Rooted in local biocultural diversity (i.e., the diversity of life in all of its interrelated manifestations: biological, cultural, and linguistic, within a complex socio-ecological adaptive system; [15, 16]), LGK is fundamental for maintaining local food security (i.e., guaranteeing that 'all people have physical, social and economic access to sufficient, safe and nutritious food'; FAO, 2001) [17], as well as food sovereignty (i.e., 'the right of peoples to healthy and culturally appropriate food produced through ecological and sustainable methods'; Nyéléni, 2007, [18–20]). Indeed, wild and weedy products (hereafter referred to as Wild Food Plants, WFPs) are part of a culinary culture whose valorization can help enhance food sovereignty and the creation of short food supply chains [20–22]. WFPs also represent a primary example where both ecological and gastronomic expertise are essential [23]. However, this knowledge is rapidly declining due to the pressures of globalized agri-food systems, rural depopulation, and the neglect of traditional land management [24, 25].

Despite the peculiar vulnerability of the Venice Lagoon (threatened by environmental, economic, and social changes associated with touristification) and the vital role wetlands play in global biodiversity [26, 27], the ethnobotany of these specific ecosystems has been neglected (e.g., Iqbal et al., [28] in Pakistan; [29] in Algeria; [30] in Italy on the brackish wetland of the northwestern Mediterranean basin, Tuscany, Italy; [31] in the Philippines; [32] in Italy). Globally, many areas identified as biodiversity hotspots also reflect an intricate relationship with cultural diversity [33]. Recent years have seen a growing interest in biocultural diversity and its role in sustaining socio-ecological resilience (defined as 'the degree to which the socio-ecological system can build and increase the capacity for learning and adaptation'; Folke, 2006 [34]; [35]). Including a biocultural perspective in the programs and policies for achieving sustainable development can greatly help in addressing some of the major global environmental challenges such as biodiversity loss [36–38]. Thus, we believe preserving, maintaining, using and transmitting LGK over time is paramount.

The overall objective of this study is to investigate the relations between WFPs and people who have dedicated themselves to two different occupations in the same Lagoon of Venice: farmers and fishers. We will focus on the LGK on WFPs of the two groups, hypothesizing that its breadth and richness is more pronounced when

the daily occupation necessitates high levels of contact with plants. Additionally, we will explore the selling of WFPs, hypothesizing that their valorization as an economic resource helps keep LGK alive within the touristified context of the Venice lagoon. Therefore, our specific objectives are:

1. To identify wild plants used as food by farmers and fishers of the Lagoon of Venice;
2. To describe their culinary uses;
3. To determine if and which WFPs are sold to Venetian restaurants and food markets;
4. To assess the correlation between culinary uses and the sale of specific taxa to local markets and restaurants.

Methods

Study area

The Lagoon of Venice is a typical ecotone located between the land (*terra firma*) and the sea, a semi-enclosed bay in the Adriatic Sea northeast of Italy (Fig. 1), and the largest wetland in the Mediterranean Sea [39, 40].

The evolution of the Venice lagoon is the outcome of constant natural and anthropogenic changes [39, 41]. It is protected from the Adriatic Sea by sandbars (the peninsula of Cavallino, and the islands of Lido and Pellestrina), which are interrupted by three inlets-opening [39]. In the lagoon, there are about 60 minor islands (Venice settlements excluded; [42]). Natural islands are the result of the deposition and accumulation of solid materials transported by rivers or are the remnants of dunes or residues of ancient coastal ridges, such as those found in the cases of Vignole and Sant'Erasmo [43]. High water phenomena known as *acqua alta*, mainly result from a combination of tide, seiches, and easterly winds. Spring and fall are the seasons with the most rainfall, while winter is the driest season. Water temperatures closely follow air temperatures, exhibiting a distinct seasonal cycle; the lowest values occur in January, and the highest values in July. Average monthly air temperatures generally range from 3 °C to 24 °C and can reach 30 °C and fall to 0 °C [41].

The flora, fauna and habitats of the Venice lagoon have evolved within the largest 'humid area' of Italy (55,000 ha), being moulded by tides, the interplay of sea currents and river currents, and all subjected to a strong anthropic influence. The result is an ecosystem where several animal and plant taxa live in water layers of different saltiness, in different microclimates and on temporary emerging banks called *barene* (Fig. 2a) and *velme*.

Sant'Erasmo (3.26 km^2; Fig. 2b-f), an island lying northeast of Venice, is now known for market gardening, and since the 1500 s it has been regarded as the market garden of Venice, growing mainly wine grapes (producing a typical wine with a salty taste), fruit trees, and later vegetables too, such as the famous 'Violetto di Sant'Erasmo', an artichoke landrace cultivated also on Vignole (0.44 km^2; Fig. 2g-h) and Mazzorbo (0.52 km^2) islands [7]. On the linguistic front, Venetian (*Venexian*, Italian: *veneziano*; [44]) is the native language of the majority of the inhabitants of Venice. It co-exists in a state of diglossia with Italian, being spoken in informal contexts by most members of all classes and age groups [45].

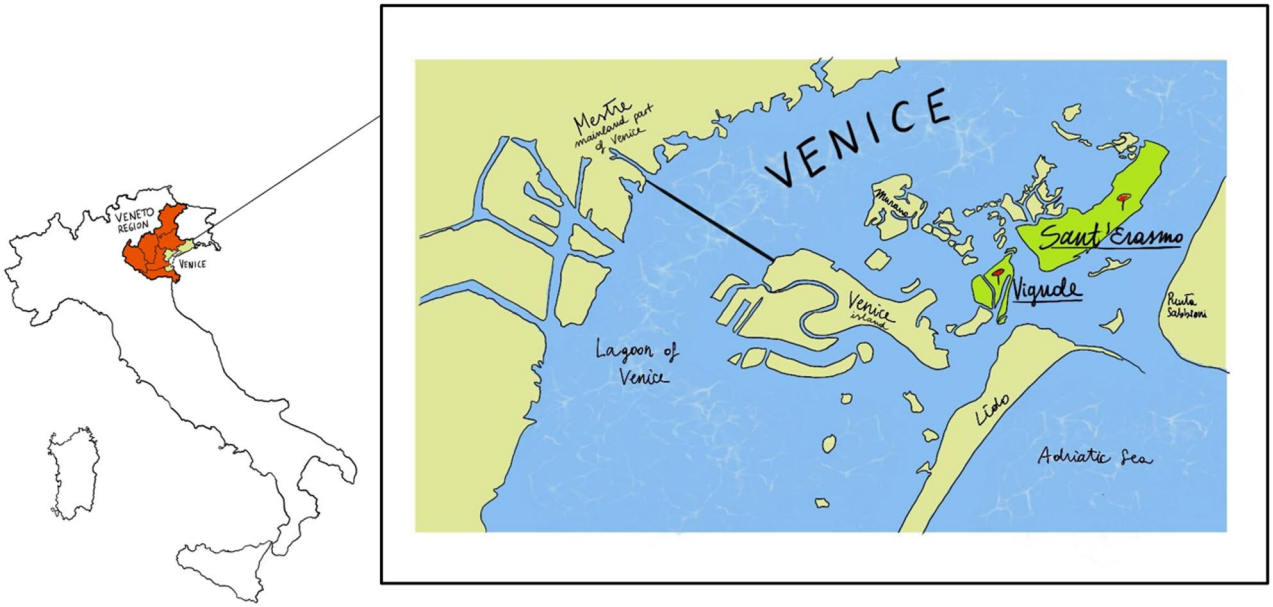

Fig. 1 Map of the study area. Designed with Sketchbook® Pro 9.2.14 (by the first author)

Fig. 2 The Venice lagoon landscape. Lagoonal ecosystem peculiarities: (**a**) *barene*. Sant'Erasmo island: (**b**) a field of artichokes; (**c**) a view of the walled part of the island from the lagoon; (**d**) walking along the embankments (*argini*); (**e**) a view of the typical island's outlets allowing water exchange between lagoonal water and island; (**f**) one of the biggest ditches (*fossi*), part of the island's water drainage system. Vignole island: (**g**) a view of the bridge unifying the old part and the new one of the island; (**h**) the canal separating the old part and the new one

Data collection

Data were collected in two distinct ethnobotanical studies focusing on different resource users within the Lagoon of Venice: local farmers and fishing communities [32, 46]. However, the questions on WFPs were asked from both research groups with the same content and consistency.

Primary data with farmers were collected from April 2023 to September 2025 during several visits, accompanied, between April 2025 and September 2025, by collection of herbarium specimens. We conducted eighteen semi-structured interviews in two contiguous (2 km apart) islands, Vignole (population: 56) and Sant'Erasmo (population: 669), which are administratively part of the Venice municipality and are located, approximately and respectively, 4–5 and 7–8 km from Venice island. Eighteen local farmers (14 from Sant'Erasmo and four from Vignole) who had been living on the islands for over ten years were selected using snowball and purposive sampling techniques. The high representativeness of the sample was assured by the total 18 and five farms in Sant'Erasmo and Vignole, respectively, given the almost nil presence of farms in the other islands of the lagoon. Depending on the expertise of the interviewees, their emotional and/or time availability, the interviews lasted between 0.5 and 2 h. Further clarifying questions on data emerged during phone interviews lasting between 15 and 30 min. Questions concerned the wild flora on the islands, its use in culinary preparations by farmers or their families, and whether it had ever been sold. In two cases, the interviewees were replaced by their sons due to death and old age.

The second fieldwork among fishing communities was conducted separately between February 2022 and April 2024. Data on knowledge and use of WFPs among these fishing communities were collected as part of a published study on their knowledge of invasive macroalgal species affecting their fishery activities in the lagoon [32]. This fieldwork took place in areas close to Lido Malamocco, Lido Faro, and Punta Sabbioni, Murano, Burano, Sant'Erasmo, Sant'Elena, and Chioggia around the Lagoon of Venice. The participants were selected using purposive and snowball sampling techniques, as they were local experts in the fishery (local resource users and fishers engaged in fishing activities, the latter having been doing so for 6 to more than 60 years). Thirty-one people were interviewed: 13 were interviewed individually, and the remaining took part in six group interviews consisting of two to six people, ranging from 30 min to three hours.

Both fieldworks involved qualitative, open-ended semi-structured interviews conducted and voice-recorded after receiving ethical approval from the Ethics Committee of Ca' Foscari and securing consent from the interviewees (verbal consent for the farmers and written consent for the fishing communities).

Data analysis

All the information collected through the interviews was accurately transcribed, anonymized and entered into an Excel table. For each plant taxon identified, we provided the scientific name, its botanical family, the vernacular names reported by interviewees, the parts used, their preparation and culinary uses, and the number of farms where use and sale were mentioned. We considered respondents' emic perspectives, that is, for example, the differentiation between decoction and herbal tea was based on farmers' narratives, not on the authors' discernment. In this case, we reported herbal teas, except for the cases when it was clearly mentioned with a medicinal use. Instead, we did not report decoctions since generally reported in farmers' narratives for medicinal purposes. Excel was then used to generate a table summarizing botanical taxa, folk names, used parts, local preparations, and food uses, and the descriptive pie and bar charts. Excel was also used for the additional comparative analyses provided as supplementary material. Furthermore, the correlation between the number of farmers who use WFPs and those who sell them was calculated through a bivariate linear regression analysis, based on a Pearson correlation, using Past5 software [47].

Botanical identification was carried out by consulting local flora and the nomenclature following Flora del Veneto [48] and Plants of the World Online [49], and in some cases further supported by i) linking the local plant names to those recorded in previous field ethnobotanical studies that were conducted in the Veneto region [50] and ii) by specimen collection of leafy plants, with the assistance of farmers when available. Voucher specimens bearing codes between UVVETBOTWPSEV01-39 were deposited at the Herbarium of Department of Environmental Sciences, Informatics and Statistics, Ca' Foscari University of Venice, Italy (UVV).

Results

Uses of Wild Food Plants among farmers and fishermen in the Lagoon of Venice

We documented the total use of 39 wild plant taxa, belonging to 25 botanical families. Seventeen out of the eighteen farmers reported the use of WFPs, while only three out of the thirty-one fishermen interviewed reported this use.

Wild Food Plants' uses reported by farmers

Among the species reported by the farmers, the dominant plant families were Asteraceae (six species) and Amaryllidaceae, with three species mentioned, as summarized in Table 1.

Farmers reported the use of different parts of WFPs, especially the leaves, aerial parts, and stems, were used for a variety of culinary preparations (Fig. 3).

Among farmers, flowers were reported for several uses, such as for beautifying food in fresh salads (*Bellis perennis*, *Borago officinalis*, *Sambucus nigra*, *Taraxacum* sect. *Taraxacum*) and for herbal teas, as in the case of *Malva sylvestris*.

The three wild plants most frequently mentioned by our respondents were *Papaver rhoeas* (cited by 16 farmers), *Taraxacum* sect. *Taraxacum* (10) and *Beta vulgaris* (10).

The top-mentioned plant, *Papaver rhoeas*, is characterized by its pungent taste. Its young and tender leaves are primarily used in both cooked and fresh salads. Cooked leaves are also used as a filling for homemade pasta, in omelets, as a sauce for pasta and risotto, and in savory pies. Leaves, collected when the plant is young, are also the most commonly used part of *Taraxacum*. Many respondents (7) reported that older leaves are otherwise too stringy and bitter. Cooked leaves are used in minestrone soups, omelets, pasta fillings or sauces, risotto, salads, and savory pies. In one case, a woman (P5) reported using dried leaves for herbal teas. When fresh, the leaves are used in salads. However, as one farmer noted, *Taraxacum* leaves "are used little in mixed salads because they are very bitter". Similarly, another farmer reported that "it is better to mix it with *rosolina* [*Papaver rhoeas*] or *bietina* [*Beta vulgaris*] because eating it alone has a very bitter taste". The buds and flowers of *Taraxacum* are also used. The buds are pickled in oil, salt or vinegar to prepare dandelion capers, and two women reported using the flowers for risotto and adding them fresh to salads (P17 and P10, respectively).

Beta vulgaris was consistently reported as a cooked vegetable for various preparations, including fillings, soups, pesto, risotto, and savory pies. Its stems are often fried in batter, and its leaves are primarily used for salads (Fig. 4).

The plant showing the highest variety of preparations is *Salicornia* spp. (10 uses, 9 in Fig. 4), whose young aerial parts are used, *Taraxacum* (13, 7 in Fig. 4), *Beta vulgaris*, and *Borago officinalis* (7 and 8 uses respectively, both 6 in Fig. 4).

Salicornia, similar to the halophytic plant *Plantago coronopus*, was frequently reported to replace table salt due to its distinct salty taste. Interestingly, one woman (P10) reported *Salicornia* as a taste additive to salt, although she preferred not to specify if she uses it fresh or dried. This woman also demonstrated a clear interest in fermentation. Indeed, she reported fermenting *Salicornia* with sugar to prepare what she calls *fervida*, which are enzymatic preparations made by fermenting fruit and vegetable scraps or wild herbs with sugar (or molasses) and water. Notably, she also prepares fervida with *Equisetum arvense* and *Helianthus tuberosus*, which she uses as fermented vegetables in salads ("one soup spoon in the

Table 1 Botanical taxa, folk names, used parts, local preparations, and food uses reported by farmers on the islands of Sant'Erasmo and Vignole

Family	Taxon and voucher number	Vernacular names	Part(s) used	Preparation	Food use	SE	V
Amaranthaceae	*Beta vulgaris* L. UVVETBOTWPSEV02	SE: bietolina, bieta matta, bieta, bietina, bieta marina, bieta selvatica, bieta selvatica marina; V: bieta selvatica, bietolina, bietina	young* leaves and stems	cooked	for filling	1	
					minestrone soup/ soup	2	
					omelette	2	2
					salad/added to salad	6	3
					sauce (e.g., added to pasta or risotto)	2	
					savoury pie	2	2
				fresh	salad/added to salad		1
	Chenopodium album L. UVVETBOTWPSEV30	SE: farinello, farinaccio; V: spinacio selvatico, bione	young* leaves	cooked	omelette	1	1
					salad/added to salad	1	1
					sauce (e.g., added to pasta or risotto)	1	
					savoury pie		1
				fresh	salad/added to salad		1
	Salicornia spp. (*S. perennans* Willd. UVVETBOTWPSEV32 et al.)	SE: salicornia, asparago di mare, ròscano di barena; V: salicornia	young aerial parts	added fresh to alcoholic drink	taste additive to grappa and digestive	1	
				added to salt	taste additive to salt	1	
				cooked	for flavoring	2	
					fried in batter	1	
					mousse	1	
					sauce (e.g., added to pasta or risotto)	1	
					salad	3	
				fresh	salad	1	1
				fermented	vinegar	1	
Amaryllidaceae	*Allium ampeloprasum* L. UVVETBOTWPSEV25	V: porro selvatico	bulbs, leaves	cooked	salad		1
					sauce (e.g., added to pasta or risotto)		1
	Allium spp. (*A. vineale* L. UVVETBOTWPSEV18 et al.)	SE: aglio selvatico, aglio della vigna, aglio matto, agio, ajo, erba cipollina; V: aglio selvatico, erba cipollina	bulbs	fresh	for flavoring	2	
			flowers	fresh	for flavoring	1	
			leaves	fresh	for flavoring (e.g., eggs benedict, fish, omelette, risotto, salad, salmon)	4	1
Apiaceae	*Apium graveolens* L.	SE: sedano selvatico	aerial parts	cooked	for flavoring (e.g., broth, fish)	1	
	Foeniculum vulgare Mill.	SE: finocchietto selvatico, fenoccio selvatico	young leaves	fresh	herbal tea	1	
			seeds	added dried to alcohol	liqueur	1	
				dried	herbal tea	1	

Table 1 (continued)

Family	Taxon and voucher number	Vernacular names	Part(s) used	Preparation	Food use	SE	V
Asparagaceae	*Asparagus* spp. (*Asparagus officinalis* L. UVVETBOTWPSEV23 et al.)	SE: asparagi (PL.), asparagi amari (PL.), asparagi selvatici (PL.), sparesèe (PL.), sparasèe (PL.), montine (PL.); V: asparagi (PL.), sparesèe (PL.)	young aerial parts	cooked	omelette	1	1
					salad	1	1
					sauce (e.g., added to pasta or risotto)	2	1
					savoury pie	1	
Asteraceae	*Artemisia caerulescens* subsp. *caerulescens* L. UVVETBOTWPSEV35	SE: santonico, santònego, assenzio di mare, assenzio marittimo	aerial parts	added fresh to alcoholic drink	taste additive to grappa	2	
			seeds	dried	for flavoring	1	
	Bellis perennis L. UVVETBOTWPSEV04	SE: pratoline (PL.), margherite (PL.)	flowers	dried	herbal tea	1	
				fresh	added to salad	4	
			leaves	fresh	omelette	1	
	Cichorium intybus L. UVVETBOTWPSEV36	SE: cicoria selvatica; V: cicoria selvatica	young leaves	cooked	omelette		1
					salad/added to salad	1	1
					savoury pie		1
				fresh	salad/added to salad		1
	Cynara cardunculus L.	V: cardo selvatico	leaves, stems	cooked	salad		1
	Helianthus tuberosus L. UVVETBOTWPSEV26	SE: topinambur	roots	cooked	salad	1	
				fermented	added to salad	1	
					vinegar	1	
	Taraxacum sect. *Taraxacum* F.H.Wigg. UVVETBOTWPSEV16	SE: tarassaco, dente di leone, dente di cane, dente de can, piscialletto, pisciacane, radicio de can; V: tarassaco, dente de can, dente de leòn, pisciacàn, pisacàn	buds	pickled in oil/salt/vinegar	dandelion capers	1	
			flowers	cooked	sauce (e.g., added to pasta or risotto)	1	
				dried	herbal tea	1	
				fresh	added to salad	1	
			young* leaves	cooked	for filling (pasta)		1
					minestrone soup/soup	1	
					omelette	2	3
					sauce (e.g., added to pasta or risotto)	1	1
					salad/added to salad	5	4
					savoury pie	2	3
				dried	herbal tea	1	
				fresh	salad/added to salad	3	3
			roots	cooked	salad/added to salad	1	

Table 1 (continued)

Family	Taxon and voucher number	Vernacular names	Part(s) used	Preparation	Food use	SE	V
Boraginaceae	*Borago officinalis* L. UVVETBOTWPSEV14	SE: borragine; V: borragine	young* leaves	cooked	for filling (pasta)		1
					fried in batter		1
					meatballs (with vegetables)		1
					omelette	1	1
					sauce (e.g., added to pasta or risotto)		1
					salad	1	2
			flowers	fresh	added to salad	1	
					natural sweetener added to pastries	1	1
Brassicaceae	*Diplotaxis tenuifolia* (L.) DC. UVVETBOTWPSEV34	SE: rucola selvatica, rùcoa, rùcoea; V: rùcoa selvatica, rucola selvatica	leaves	cooked	sauce (e.g., added to pasta or risotto)	2	
					for flavoring (e.g., risotto)	1	
				fresh	salad	5	1
Cannabaceae	*Humulus lupulus* L.	SE: bruscandi (PL.), bruscàndoli (PL.), bruscàndoi (PL.), luppolo, luppolo selvatico; V: bruscàndoi (PL.)	young aerial parts	cooked	for filling (pasta)		1
					fried in batter	1	
					omelette	6	1
					salad	1	
					sauce (e.g., added to pasta or risotto)	9	1
Caryophyllaceae	*Silene latifolia* subsp. *alba* (Mill.) Greuter and Burdet UVVETBOTWPSEV09	SE: orecchie di coniglio (PL.), orecce de gèvaro (PL.), orece de gèvaro (PL.), silene	leaves	cooked	omelette	1	
					sauce (e.g., added to pasta or risotto)	2	
	Silene vulgaris subsp. *angustifolia* Hayek UVVETBOTWPSEV38	SE: carletti (PL.), silene	leaves	cooked	omelette	3	
					sauce (e.g., added to pasta or risotto)	5	
					salad	2	
Equisetaceae	*Equisetum arvense* L. UVVETBOTWPSEV13	SE: equiseto, erba cavallina	aerial parts	fermented	vinegar	1	
Fabaceae	*Robinia pseudoacacia* L.	SE: acacia (fiori di), gasìa (fiori di)	flower (clusters)	cooked	fried in batter	3	
Lamiaceae	*Lamium purpureum* L.	SE: ortica; V: falsa ortica	leaves	cooked	omelette	1	
					sauce (e.g., added to pasta or risotto)	1	
	Salvia rosmarinus Spenn.	SE: rosmarino, smarinella, smarinèa; V: rosmarino	leaves, sprigs	dried	for flavoring (e.g., roast)	2	1
				fresh	for flavoring (e.g., roast)	2	1
Lauraceae	*Laurus nobilis* L.	SE: alloro, àvrano; V: alloro	leaves	added fresh to alcohol	liqueur		1
				dried	for flavoring (e.g., broth, fish)	2	1
					herbal tea		1
				fresh	for flavoring (e.g., fish, meat)	3	

Table 1 (continued)

Family	Taxon and voucher number	Vernacular names	Part(s) used	Preparation	Food use	SE	V
Malvaceae	*Malva sylvestris* L. UVVETBOTWPSEV20	SE: malva, nalba	flowers	dried	herbal tea	1	
			leaves	dried	herbal tea	1	
				fresh	herbal tea	1	
Moraceae	*Morus alba* L.	SE: gelsi (PL.)	fruits	fresh	snack	1	
Papaveraceae	*Papaver rhoeas* L. UVVETBOTWPSEV06	SE: papavero, pevarèl, ròsole (PL.), pèvari (PL.), rosolina; V: rosolaccio, rosolina, papavero, pevarina, pevarèl	young* leaves	cooked	for filling (pasta)		1
					omelette	3	3
					salad/added to salad	9	4
					sauce (e.g., added to pasta or risotto)	5	1
					savoury pie	3	2
				fresh	salad		2
Plantaginaceae	*Plantago coronopus* L. UVVETBOTWPSEV03	SE: piantaggine marina, erba stella	leaves	cooked	added to salad	1	
					for flavoring	1	
					sauce (e.g., added to pasta or risotto)	1	
	Plantago lanceolata L. UVVETBOTWPSEV17	SE: orecce de gèvaro (PL.), orecchie di coniglio (PL.), piantaggine, piantasme (PL.)	leaves	cooked	salad	1	
Poaceae	*Cynodon dactylon* (L.) Pers. UVVETBOTWPSEV24	SE: gramigna, gramegna	roots	dried	herbal tea	1	
Polygonaceae	*Rumex crispus* L. UVVETBOTWPSEV37	SE: lingua di vacca	roots	cooked	salad	1	
	Rumex spp. (*R. crispus* L. UVVETBOTWPSEV37, *R. obtusifolius* L UVVETBOTWPSEV01 and possibly others)	SE: lingua di vacca	leaves	cooked	salad	1	
Portulacaceae	*Atriplex portulacoides* L. UVVETBOTWPSEV39	SE: portulaca, grassina, erba grassina; V: portulaca, grassigna, erba grassigna	leaves, young stems	cooked	meatballs	1	
					salad	2	1
					sauce (e.g., added to pasta or risotto)	2	
				fresh	added to salad/salad	2	2
					for flavoring (e.g., boiled meat)	1	
Rosaceae	*Rubus ulmifolius* Schott	SE: more (PL.)	fruits, sprouts	fresh	snack	1	
Rutaceae	*Ruta graveolens* L.	SE: ruta	aerial parts	added fresh to alcoholic drink	taste additive to grappa	2	
Urticaceae	*Urtica dioica* L. UVVETBOTWPSEV11	SE: ortica, ortìcoa, ortiga; V: ortica	leaves	added fresh to alcoholic drink	taste additive to grappa and digestive	1	
				cooked	meatballs (with meat or vegetables)	1	
					omelette	2	
					salad	1	
					sauce (e.g., added to pasta or risotto)	7	2

Table 1 (continued)

Family	Taxon and voucher number	Vernacular names	Part(s) used	Preparation	Food use	SE	V
	Urtica urens L. UVVETBOTWPSEV27	SE: ortica, ortiga; V: ortica	Leaves	cooked	sauce (e.g., added to pasta or risotto)		1
Viburnaceae	*Sambucus nigra* L.	SE: sambuco (fiori di)	flower (clusters)	cooked	fried in batter	2	
				fresh	added to salad	1	
					herbal tea	1	
					jam	1	
					syrup as refreshing drink	2	
Violaceae	*Viola odorata* L. UVVETBOTWPSEV05	SE: violette (PL.)	flowers	added fresh to alcoholic drink	taste additive to gin	1	

The table provides a comprehensive list of botanical taxa, their folk names, used parts, local preparations, and traditional food uses reported by farmers in the islands of Sant'Erasmo (SE) and Vignole (V), as well as the frequency of quotation for each species in the two study areas. Notes: An asterisk (*) indicates that the plant part used must be young. PL. stands for plural. The term "et al." refers to other species that emerged from the narratives but could not be identified at the species level.

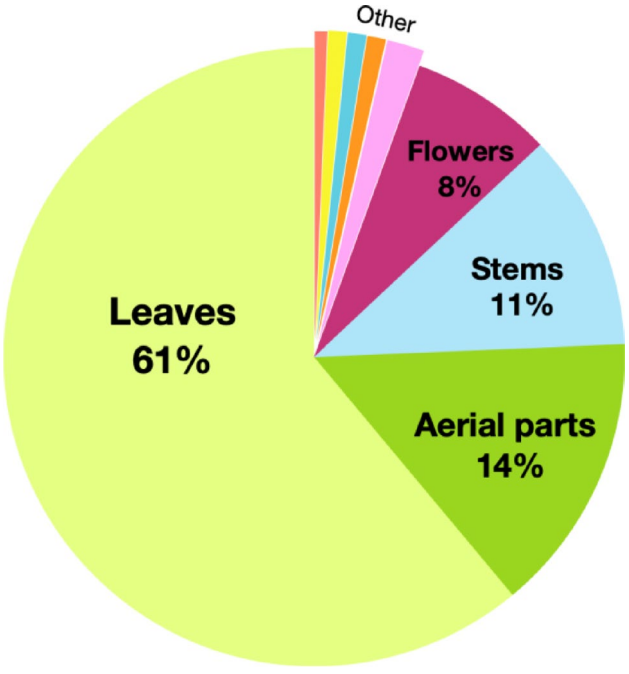

Fig. 3 Citation frequencies of WFPs' parts used by farmers (expressed as percentages). The data includes all citations collected in the study, without distinction for the adjective "young"

fresh salad"). According to the interviewee, this makes the vegetables more digestible. The fervida can also be used as a cooking vinegar.

Salicornia is also used for the preparation of salads (the most mentioned use of the plant), either fresh or cooked, added to salads or enjoyed on its own as a salad. However, one interviewee (P11), who reported boiling it with a bit of lemon, said she avoids eating it, not knowing whether she is prone to thyroid issues, due to the high content of iodine in the plant. The same interviewee reported that it is possible to find it down in the canals and that cooks sometimes go to the island of Sant'Erasmo to collect it. Other preparations include omelettes, mousses, a sauce added to pasta, fried-in-batter *Salicornia*, grappas, and digestives, where the plant is used as a taste additive, or in general for flavoring dishes. *Borago officinalis* was similarly reported for various culinary preparations, for which young leaves are generally used, when, as reported by one interviewee (P10), the plant is more or less 15 cm. *Borago officinalis* is eaten in meatballs with vegetables, in cooked salads, omelettes, fried in batter, as filling for pasta, or as a sauce in risotto. However, not only are the leaves eaten, but also the flowers, used both as a natural sweetener in pastries and to decorate cakes, fresh salads, and food in general.

The most mentioned food uses were the preparation of salads (21 plants), either fresh or cooked, sauces for pasta and/or risotto (17 plants), and omelettes (14 plants; Fig. 4).

Salads are primarily prepared with *Papaver rhoeas* (mentioned by 13 respondents), *Taraxacum* sect. *Taraxacum* (10), and *Beta vulgaris* (9). While young leaves are the main part used from these three plants, the fresh flowers of *Taraxacum* are also incorporated. Two women (P4 and P10) reported using flowers in salads, including those from *Bellis perennis*, *Sambucus nigra*, and *Borago officinalis*. The flowers of the latter two plants also have diverse culinary applications. For instance, to women (P10 and P11) reported frying *Sambucus nigra* flowers in batter, similar to the method used for *Robinia pseudoacacia* flowers. In one instance, it was specified that sugar is added on top of the fried flowers. The flowers are also used to prepare a syrup for refreshing drinks, as reported by two respondents. One woman (P10) shared her method for making the syrup, which is based on a South Tyrolean recipe. She prepares the syrup with fresh elderflowers, lemon, sugar, and water. The mixture is then exposed to the sun for three days, with frequent stirring. Afterward, she adds a percentage of apple vinegar, boils it for five to ten minutes at most, and bottles the syrup. It can be preserved for up to a year, or even

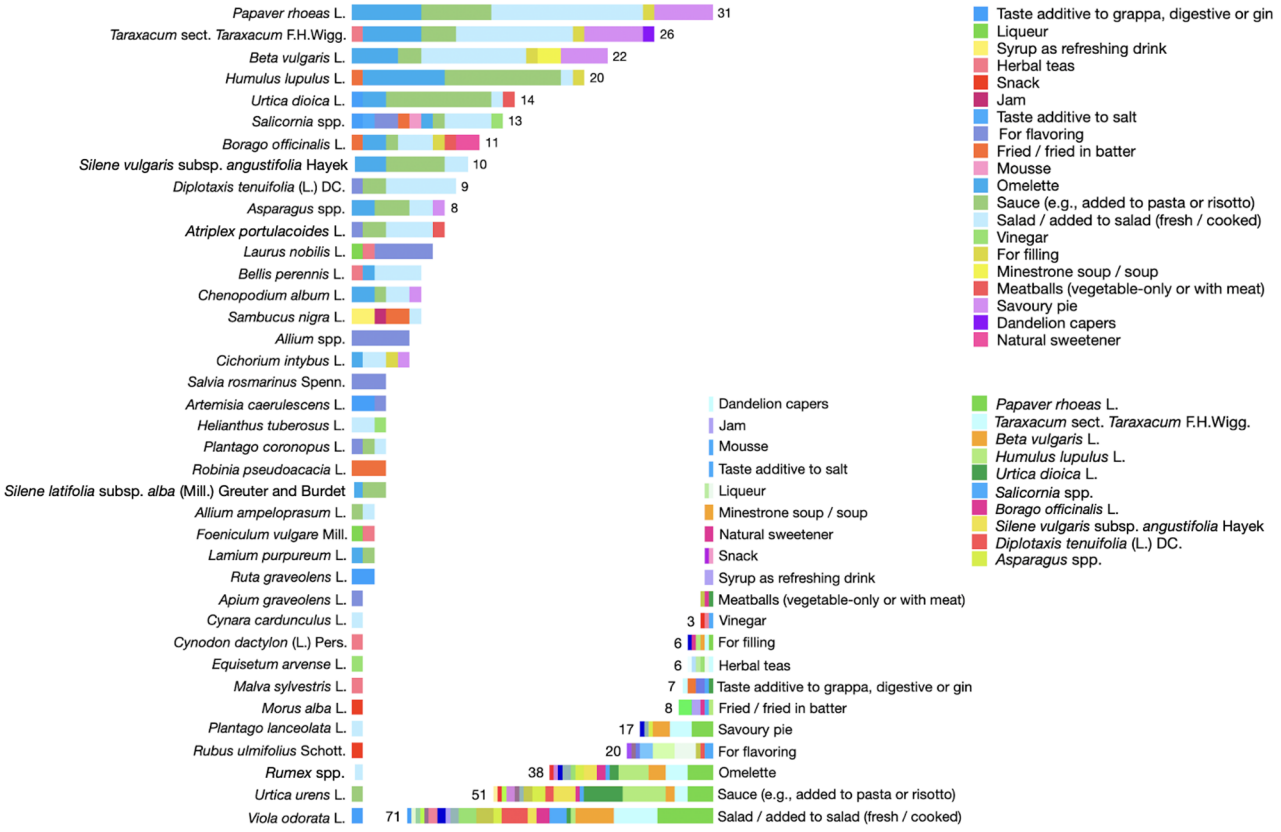

Fig. 4 Bar charts showing the raw frequencies of WFPs and uses mentioned, differentiated by color. The first chart reports the frequency of uses for each plant, while the second chart shows the frequency of plants for each use (its legend shows the top ten mentioned plants). For visual simplification, some uses were merged for this analysis (e.g., 'salad' and 'added to salad')

longer. However, once the bottle is opened, she recommended keeping the syrup in the fridge. Another woman (P11) who shared her recipe for elderflower syrup said she learned it from an elderly woman in Trentino. Her method involves covering the fresh elderflowers with lemon slices, covering them with a pot lid, and letting them rest for 48 h. Afterward, she slowly cooks the mixture in a pot for three minutes. She then boils water and sugar separately before combining them with the filtered flowers and lemons. This syrup can be preserved all year and added to water or Prosecco. In addition to syrups, *Sambucus nigra* flowers are also used for jams. One woman (P10) reported using fresh flowers, which she cooks with sugar, water, and lemon to create the jam.

Herbal teas are prepared from several wild plants, including *Bellis perennis*, *Cynodon dactylon*, *Foeniculum vulgare*, *Laurus nobilis*, *Malva sylvestris*, and *Taraxacum* sect. *Taraxacum*. Only the dried flowers and leaves of *Taraxacum* are used for this purpose, while *Malva sylvestris* teas can be made from either dried or fresh leaves, as well as dried flowers. Locally referred to as *gramigna* or *gramegna*, only the dried roots of *Cynodon dactylon* are used for herbal tea. One woman (P11) specified the exact time she collects the roots: "The roots of *gramegna* are delicious. In winter, I make herbal tea from the weed's roots. When the spring season begins, I clean the artichoke plants, and when I see that the roots are nice and robust, I put them to dry and use them to make teas". The flowers of *Bellis perennis*, locally known as *pratoline* or *margherite*, are also used dried for herbal tea. The same woman reported leaving the flowers in the sun to dry for two days, and she prefers it to chamomile because she believes "wild plants are not only tastier but also have more nutritional benefits". Finally, *Foeniculum vulgare*, referred to as *fenoccio selvatico* or *finocchietto selvatico*, was mentioned by a woman (P5) on the island of Sant'Erasmo who uses its dried seeds or fresh young leaves for tea.

The name *ortica* was given by farmers to three plant taxa: *Urtica dioica*, *Urtica urens*, and *Lamium purpureum*. The latter is also known as *falsa ortica* (indeed, it belongs to the Lamiaceae family, unlike the first two, which belong to the Urticaceae family) and has typical pink flowers. However, *Urtica dioica* was the most frequently mentioned among the three. Other preparations with ortìcoe (*Urtica dioica*) include cooked salads, meatballs (with or without meat), omelets, sauces for pasta or risotto, and alcoholic beverages, such as taste additives to

digestives and grappas. Other plants used as taste additives to grappas are *Ruta graveolens* (mentioned by two farmers), *Artemisia caerulescens* (two), and *Salicornia perennans*.

Both, *ruta* and *santonico* (also called *santònego*, *assenzio di mare*, and *assenzio marittimo*) are used in their fresh aerial parts and infused in grappa. A farmer (P17) in Sant'Erasmo described the recipe: "we put the *santonico* inside the grappa. It is a plant with a very strong taste. You put it inside the bottle and leave it there to macerate. You find it in the Lagoon in July only". The same farmer also reported another use of this plant: the use of its dried seeds for flavoring food.

The only plant mentioned as a taste additive to gin was *Viola odorata*. The woman (P10) who reported on this plant uses its flowers to add not only flavor but also color to gin. She infuses the fresh flowers (violette) in the gin at room temperature, adds a little sugar, lets it infuse, and then filters it. She said that, after this, the flowers release all their color and become incredibly transparent, and the *gin alla violetta* results in a pinkish alcoholic drink.

For the preparation of liqueurs, *Foeniculum vulgare* and *Laurus nobilis* were mentioned. The elderly farmer (P17) who mentioned the use of *fenoccio selvatico* reported that it has a powerful smell and that his brother used to put dried *fenoccio selvatico* seeds in alcohol, after which sugar is added to create a liqueur "like anise or like sambuca". With regard to *Laurus nobilis*, the leaves are used, and the liqueur is called *allorino*.

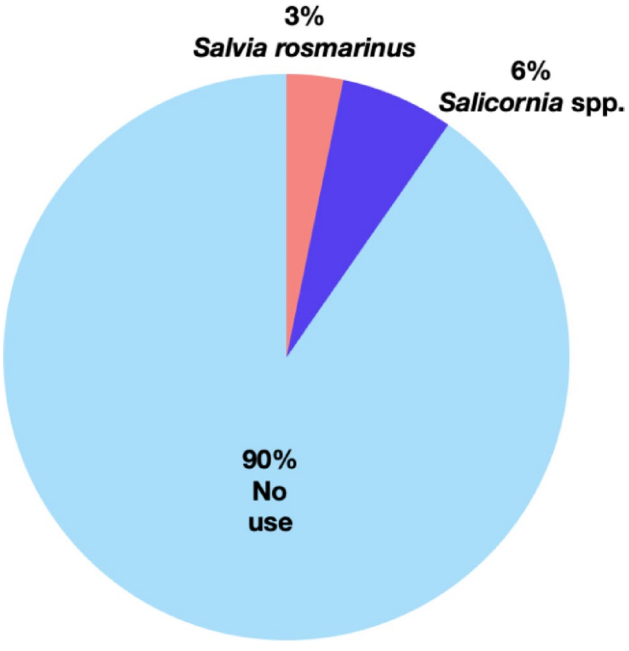

Fig. 5 Citation frequencies of WFPs used among fishers (expressed as percentages)

Wild Food Plants' uses reported by fishers

Differently, only three out of 31 fishermen reported using WFPs: one specifically mentioned *Salvia rosmarinus*, while two mentioned *Salicornia* (Fig. 5).

While the fisherman (FP23) who mentioned *Salvia rosmarinus* provided no details regarding the plant's use, the narrative concerning *Salicornia* was notably detailed. *Salicornia*, also known as *asparago di mare* and *rovo*, was reported as a rediscovered plant, eaten by some people or found in certain restaurants. People eat it when it is softer, that is, "when there has been a sufficient supply of water". One of the two fishermen (FP24) who reported its use specified that it must be collected early in the morning, while the dew is still present. The same fisherman explained in detail how to cook the plant: the tips (apices) are cut off and blanched. "Once blanched, the tough inner core is removed. The resulting fleshy part is very salty and is used to impart a peculiar marine flavor to specific dishes, such as fish". The fisherman reported that his wife also dries it and then grinds it to salt food. According to the interviewee's narrative, this was a past practice used to salt fresh water during winter, substituting for common salt when it was unavailable.

Wild food plants: a niche market for farmers of Sant'Erasmo and Vignole Islands (Lagoon of Venice)

Our results unveiled that ethnobotanical knowledge represents a source of supplementary income for farmers on Sant'Erasmo and Vignole islands. In contrast, we found that fishers, while (only negligibly) utilizing WFPs, do not sell them.

Overall, 12 of the 17 farmers who use WFPs reported selling them, with the most sold plants being *Papaver rhoeas* (10 farmers), *Taraxacum* sect. *Taraxacum* (six farmers) and *Beta vulgaris* (four farmers) among the total 18 sold taxa that were mentioned (Fig. 6).

Three farmers (P2, P4, P6) reported they do not sell wild plants because they are seen as a symbol of backwardness and poverty, while others have managed to find a market for them, making them profitable. Either affluent buyers who use them, riding the wave of the emerging gourmet food trend, such as fine dining restaurants, or people who simply buy them because they recognize their higher nutritional value. In this context, one farmer (P1) stated: "We use them, but not a lot, wild plants are just a recent trend that gained momentum". One farmer (P6) reported instead the opportunity of selling wild plants, both on economic and environmental perspectives: "*rosolina* [*Papaver rhoeas*], dandelion and wild beet, we sell tons of it. They do not need anything, no fertilizers, and you can still sell them!". Other farmers (P3 and P13) reported they are selling fewer wild plants, for example: "*Rosolina* isn't sold as much anymore, it used to be more popular" (P13).

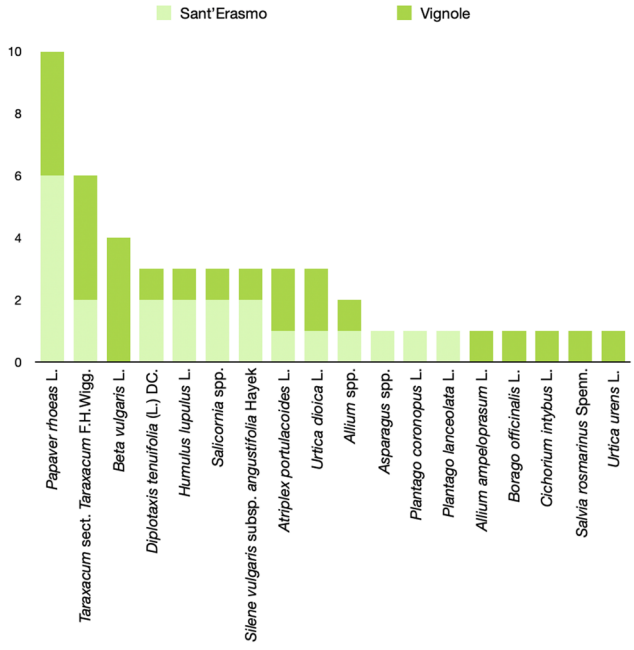

Fig. 6 Number of sellers for each plant taxon, categorized by island

In this regard, farmers have differing views on how wild plant retail has evolved through the years.

Both in Sant'Erasmo and Vignole islands, some respondents (P2, P3, P5, P8) stated that wild plants were used for feeding animals, as mentioned for *Taraxacum*, and as reported by one farmer (P2) who referred to *Urtica dioica* as a plant once used for feeding ducks and chickens, after boiling and cutting it finely. Indeed, one farmer (P4) said: "I don't use them, because we had the mindset that those herbs were meant for animal fodder". Instead, another farmer (P2) reported: "We use them in our cuisine, we like them a lot, although when sharing it with some people, they told us they are not animals and these plants are fodder plants for goats". Two interviewees (P2, P4) reported this association to animal fodder as the reason why not many people use them today. In contrast, three farmers (P4, P6, P10) reported that they are becoming quite popular nowadays, especially in restaurants. "*Roscani di barena*, as we call *Salicornia*, and by extension, all types of wild vegetables that grow in the *barene*, are really trendy now. They used to be just cow feed, but now even chefs are using them. I sold a good amount last year; there was high demand" (P6). Another farmer, although stating wild plants are used in restaurants, reported that they are now ever less used: "they are disappearing from tables now. Few people ask for them; many don't know what they are, and young people don't even have the time to prepare them. In the '90s, you would find crates of *rosolina* at the market, but now we only cut them when someone asks for them, like restaurants" (P3). A young farmer (P7) reported that while *Salicornia* is increasingly used in restaurants, it is not used in home cooking due to its high price. In this regard, one farmer (P1) documented that the imported variety is primarily from Israel and is widely used in gourmet restaurants. Nevertheless, another farmer (P11) argued that some chefs visit Sant'Erasmo to procure local Salicornia for refined culinary creations. Meanwhile, another farmer (P1), thanks to a group project, has selected seeds from the spontaneous plants growing along his field ditches, and now cultivates and sells a local variety. Based on the latter narrative, this variety is *Salicornia europaea*, which we have identified as *Salicornia perennans*.

Consequently, we observed the correlation between the number of farmers reporting the use of specific WFPs and the number of farmers selling them. We found a significant positive correlation between the two: $R^2 = 0.88$; $p < 0.001$ (Fig. 7).

Specifically, the R^2 value indicates a very strong relationship, suggesting that the number of people using a specific plant is a reliable predictor of its commercial frequency. The p-value confirms that this result is not a coincidence, but a solid trend observed across the interviewed farmers. Taxa such as *Papaver rhoeas* and *Cichorium intybus* occupy the upper-right quadrant of the plot, representing the most used and frequently sold species. Conversely, several taxa located near the origin of the axes (those with $x = 0$) remain confined to culinary use with no recorded market presence.

Discussion

Our results reveal two primary findings. First, most farmers in the Venice lagoon use wild plants for culinary purposes, with 39 taxa being recorded, whereas fishermen largely do not. Second, we found that approximately 70% of these farmers sell WFPs (18 taxa) to both the Venetian market and local restaurants, and that the more WFPs are known and used, the more they are sold.

On the one hand, our first finding reveals that people not working in agriculture are less knowledgeable about plants and use them less. This result shows a direct link between the interviewee's main occupation and the embedding of knowledge about wild plants, thus confirming our hypothesis that a stronger link to a specific environment due to the main occupation leads to a wider knowledge and use of that environment's specific resources [6, 51]. The significant gap in WEP knowledge between farmers and fishermen highlights a high degree of occupational specialization rooted in daily interaction with the lagoon's terrestrial and aquatic elements, as well as in the respective specialized (vegetable and fish) markets. Their specialization is not merely folk-taxonomic (knowing the plant's name) but process-oriented. Indeed, it involves an intimate understanding of the plants'

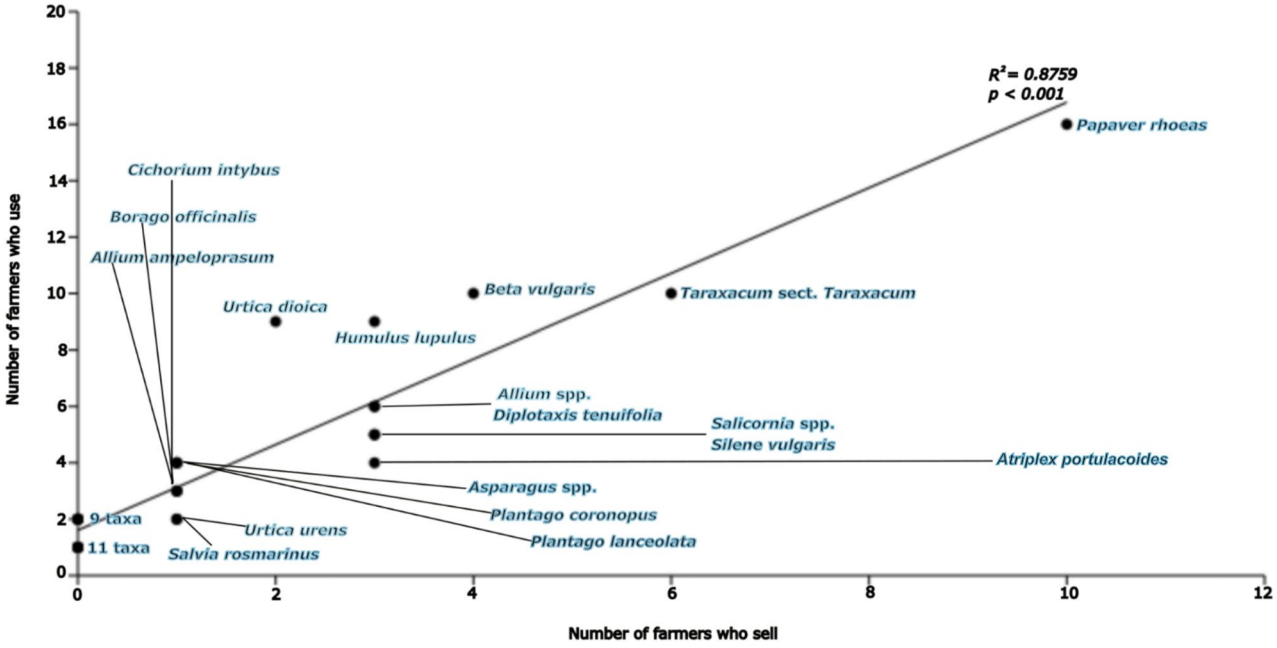

Fig. 7 Linear regression analysis between the number of farmers who use Wild Food Plants (WFPs; Y-axis) and the number of farmers who sell them (X-axis). The regression line shows a strong positive correlation ($R^2 = 0.88$; $p < 0.001$), indicating that species with higher culinary use are more likely to be sold (and vice versa). Selected *taxa* are labeled to highlight the most representative species. The plot and statistical analysis were generated using Past5® software

phenology and their transformation possibilities (e.g., fermentation, infusion in alcohol).

On the other hand, the first finding unveils that almost all of the plants recorded in this study and mainly used by farmers align (either totally or partially) with both the Italian and regional contexts, generally confirming data from Scortegagna's 'Flora popolare veneta' [50] and the AlimurgITA Database ([52]; Additional file 1). More specifically, approximately 60% of the plants currently used in the Venice lagoon area match the national Italian context (Additional file 2). The remaining plants display two distinct patterns: 10% of these recorded uses align only with the regional context, meaning are not reported outside the Veneto region (Additional file 2), while the larger proportion (approximately 35%) constitutes uses that are largely novel to both the regional and Italian contexts (Additional file 2). In general, the most common uses of the WFPs recorded in our study, were also found beyond Italy, on a wider (also global) scale (e.g., Türkmen et al., [53]; Ríos et al., [54]; [55]).

The taxa with more recorded uses were *Taraxacum* sect. *Taraxacum*, *Salicornia perennans* and *Borago officinalis*. The taxon *Taraxacum* sect. *Taraxacum*, which is found in all regions of Italy [52], was reported in our study as being used for the preparation of fillings, fresh and cooked salads, minestrone soups, omelets, risotto sauces, savory pies, as well as for herbal teas and pickles made from its buds (used as capers). The uses we recorded were consistent with the national context (Additional file 1). The national uses, recorded in all Italian regions, are broadly supported by Baldi et al.,'s [56] review, which provides an overview of WFPs traditionally used in the gastronomy of Tuscany. The authors reported the plant as used, other than as a coffee substitute, as a cooked vegetable, and for the preparation of omelets, pickles, quiche filling, ravioli filling, risotto, and salads in almost all regions of Italy (except for Molise and Aosta Valley). In the European context, a combined analysis of ethnobotanical literature and a field survey on the traditional use of wild-grown edible plants in the Slovene ethnic area [57] identifies the leaves of dandelion as a common wild ingredient for salads. In the Balkan region, a food ethnobotanical field study conducted by Pieroni et al., [58] among the Gorani of South Kosovo, a South-Slavic ethnic minority, confirms that *Taraxacum* is a primary resource in their traditional food heritage, where the young leaves are used for salad preparations. Expanding beyond European borders, a study on northwestern Patagonia showed that *Taraxacum officinale*'s leaves and stems are mostly eaten either raw in salads or cooked, added to stews along with other vegetables and meat, with leaves and stems being the most commonly used edible parts [59]. On a global scale, a review on, among others, the traditional culinary uses of *Taraxacum*, highlights its versatile role in cuisines around the world, where its fresh leaves are utilized in the preparation of salads, soups, pastries, raw and cooked dishes,

while its flowers and roots are used in desserts, beverages and food additives [53].

In contrast to *Taraxacum*, we recorded uses of *Salicornia perennans* that were mostly new at both the national and regional scale. *Salicornia perennans* was reported in the Italian dataset (AlimurgITA) as used for food purposes in the Apulia, Molise, and Tuscany regions. In the 'Flora popolare veneta' dataset, however, the species was not specifically mentioned but was likely included under the term 'and allied species' within the section dedicated to *Salicornia veneta* and *Arthrocnemum fruticosum* (= *Sarcocornia fruticosa*).

Accogli et al., [60] review, while not recording food uses of *S. perennans* specifically, reported the food uses in the Apulia region of the most important halophyte species (including *Salicornia* spp.) as well as the conflicting classification systems.

Differently, Biscotti et al.'s [61] research article, which focuses on the traditional food uses of wild vegetables in Apulia (also in the light of Italian ethnobotanical literature), reports uses specifically of *Salicornia perennans* Willd. subsp. *perennans* (and *Salicornia fruticosa*). Notably, they were reported as commonly boiled in the Apulia region, either alone or as a side dish in fish recipes [61]. The research article also documents the dramatic rise in interest for *Salicornia* spp., as well as the successful domestication of "salicornie" and its commercial success in the Gargano area, where more and more cultivations of *Salicornia perennans* Willd. subsp. *perennans* are underway thanks to the demand coming from restaurants. A previous research article conducted by Biscotti and Pieroni [62] does not specifically mention *S. perennans* yet reports uses of *Salicornia* spp. in the Apulia region: *Salicornia emerici* Duval-Jouve, *S. patula* Duval-Jouve, and *Sarcocornia fruticosa* (L.) A. J. Scott, whose young stems are boiled and dressed with olive oil, vinegar or lemon juice, or otherwise pickled.

In addition to Biscotti et al.'s [61] research article, we found the already mentioned ethnobotanical review from Baldi et al., [56], which references *Salicornia perennans* Willd. However, it does not report any culinary purposes of the plant, despite citing Biscotti et al., [61] and Biscotti and Pieroni [62].

In our research, farmers reported using *S. perennans* in several ways: as a fresh-taste additive to grappa and salt, cooked for flavoring, fried in batter, in mousses, in omelets, for the preparation of pasta sauces, and fermented for vinegar. Of all the uses we documented, our main national and regional reference datasets highlighted the common uses of its fleshy leaves and stems. These are typically consumed raw in salads, or steamed or lightly sautéed as a light side dish for meat, fish, and soup dishes. The branches, on the other hand, are reported as being used after boiling or for the preparation of pickles.

It is notable that the use of *Salicornia* as a taste additive for salt had not been reported anywhere in the ethnobotanical literature, nor had the practice of drying and milling it as a salt substitute (practice reported only by one fisherman). Similarly, fermented *Salicornia* was not reported anywhere in the Italy. Yet, Loconsole et al., [63] reported two studies indicating that in India, shoots can also be transformed into beverages such as *nuruk* (fermentation starter), *makgeolli* (rice wine), or vinegar [64, 65]. One study also found that *Salicornia* enhances the propagation of fermenting microorganisms and improves vinegar quality [66].

In this broader context, while specific ethnobotanical studies focusing exclusively on *S. perennans* were not found outside of Italy, the culinary use of related taxa within the *Salicornia* and *Sarcocornia* genera is well-documented on a global scale. Expanding to the European context, a synthetic gastroethnobotanical review on a global scale (specifically focusing on halophytes as food) reports that these species are widely integrated into traditional diets [54]. In the UK, these plants have a long documented history of consumption as a cooked vegetable and in pickles, while in the Valencian region of Spain, they are traditionally consumed brined in vinegar [54]. Moving beyond European borders, to a broader global scale, according to the same global gastroethnobotanical review [54], *Salicornia* species are identified as an essential culinary ingredient in the popular *mezze* dishes along the Aegean and Mediterranean coasts of Turkey, confirming their importance in Middle Eastern culinary traditions.

Another plant whose uses are consistent with both the national and regional ones (though few are new) is *Borago officinalis*, mentioned by Paura et al., [52] as being the most widely used taxon in Italy together with *Cichorium intybus*. In our study, it was recorded for the preparation of salads, pasta or risotto sauces, omelets, pasta fillings, fried in batter, for vegetarian meatballs, as well as a natural sweetener added to pastries. The national uses, recorded in all Italian regions by Paura et al., [52], are broadly supported by Baldi et al.'s [56] review. The authors reported the plant as being used fried, in omelets, for pasta/dumplings, quiche filling, ravioli filling, risotto, and salads. However, their documentation noted its uses in all regions except for Aosta Valley, Trentino-Alto Adige, Friuli-Venezia Giulia, Veneto, Lazio, and Abruzzo. Conversely, we found no ethnobotanical literature focusing on the Veneto region that reported the food uses of *Borago officinalis* (aside from the Italian database by [52]). Furthermore, no ethnobotanical studies conducted in Italy documented the use of its edible flowers as a natural sweetener in pastries. Carboni et al., [67] review, however, reported that various authors had previously identified high quantities of total sugars within

B. officinalis flowers. In the European context, the traditional culinary use of *B. officinalis* is well-documented, as in the Slovene ethnic area, where the aerial parts are specifically gathered for use in salads, soups, and as garnishes [57]. In the Iberian Peninsula, instead, a review on edible wild relatives of cultivated plants reports that the plant is a highly appreciated food, particularly in Northern Spain (La Rioja, Navarra, and Aragón), where the petiole and midrib of the leaves are consumed raw in salads or, more frequently, stewed in soups and omelettes [68]. Beyond Spain, its culinary properties are widely recognized across Germany, France, and Great Britain [68]. Within the Mediterranean basin, an ethnobotanical review of 41 selected wild edible plants confirms that *B. officinalis* is commonly consumed as a vegetable, with its seeds also being sporadically used as a food source [69]. In the same geographical context, an ethnobotanical review focused on edible flowers reports that the flowers are traditionally utilized in salads, fritters, and soups, or as an aromatizer for vinegar [70]. In the Turkish context, Ramezani et al.,'s, [55] review documented that the aerial parts are commonly sautéed with eggs or utilized as fillings for traditional pastries, while in Iran, the dried flowers represent a primary ingredient for daily recreational beverages and syrups. On a global scale, a synthetic review [55] confirms the species as a staple in the traditional cuisines of Turkey, Iran, and North Africa.

The second result revealed that approximately 70% of the farmers find wild plants profitable, by selling them mainly to (Venetian) markets and gourmet restaurants. This shift mirrors practices found worldwide (although in other regions wild plants still remain overlooked or dismissed): from the traditional markets of Mexico and India, where these plants are highly prized, to Spanish supermarkets selling packaged wild thistle and asparagus. Similarly, in the United States, species once dismissed as 'pests', like dandelions, are now being commercialized and even sold as seeds for home cultivation, reflecting a growing recognition of their superior nutritional value [71].

The significant positive correlation found between the number of farmers reporting the use of specific WFPs and the number of farmers selling them, suggests that the market availability of the identified WFPs is closely linked to their culinary use among farmers or vice versa. The rest of the farmers do not sell them, mostly reporting that people do not look for them as much as their parents or grandparents used to.

On the one hand, as some farmers reported, WFPs are not used by a certain target of people, for example, upwardly mobile individuals with a history of economic hardship, and/or people with a production-focused entrepreneurial mindset. These people indeed generally associate wild plants to 'fodder plants for goats' and their use to a state of backwardness and poverty, which constitute disincentives to sales and purchasing choices. These beliefs resonate with what Baldi et al., [56] wrote about consumption of WFPs as often ignored and marginalized by modern agricultural production systems as considered an emergency practice to integrate an otherwise poor diet. Similarly, Mattalia et al., [72] reported that in some Mediterranean contexts, there is a tendency to consider wild plant foraging as a sign of poverty, a symbol of backwardness, and a lack of resources. Beyond the European context, a study by Ladio et al., [59] on edible exotic weeds for food security and food sovereignty in north-western Patagonia, highlighted that several farmers still resist commercializing these plants, perceiving them as substandard products associated with poverty or shame, suggesting that the transition of wild plants from 'pests' to 'resources' is a complex socio-cultural process. However, the authors also documented a biocultural shift consequent to a participatory workshops promoting 'buenezas' (good weeds) at an urban family farmers market, resulting in increased awareness and sale of edible weeds now central to family farmers' markets, since 2009 (with *Taraxacum officinale* and *Chenopodium album* being the most regularly sold).

On the other hand, there are farmers who see the oportunity of selling WFPs, both from an economic and environmental perspective, since they are plants that do not require any external input to grow, and they are profitable. Moreover, their good tolerance to different kinds of stress, such as drought, salinity, high temperature, and nutrient shortage, is particularly relevant in brackish soils typical of the Venice lagoon agriculture and affected by increased salinity, making them also promising crops for cultivation [56, 73]. The practice of domestication is exemplified by a farmer in Sant'Erasmo, who cultivates and sells *Salicornia perennans* after domesticating a species that originally grew wild in the ditches bordering his fields. This case reveals a successful adaptive capacity within a lagoonal environment characterized by increasingly saline soils, counteracting the trend of importing *Salicornia* from abroad (e.g., from Israel, as reported by one local farmer), despite the natural abundance of the species within the Venice lagoon.

However, Venice Lagoon farmers sell WFPs on the local market or to gourmet restaurants. The primary target (local market) may consist of consumers seeking authentic and distinctive lagoon flavors, as well as health-conscious individuals who recognize the superior nutritional profile of WFPs (such as their antioxidant properties and ecological benefits; [74]). This aligns with recent studies on Venetian culinary heritage [75], which suggest that a growing awareness of how food choices impact both health and the environment has made local consumers increasingly receptive to innovations that reflect these

concerns yet do not dilute the authenticity of Venetian cuisine. The second one (gourmet restaurants) may probably be local restaurants focussed on selling an authentic and peculiar image of Venice to Venetians as well as to tourists, often proposing an experimental niche cuisine by adding innovative elements to traditional plates, in line with Baldi et al.'s ([56]; and references within) perspective. Indeed, a revival of interest in WFPs is taking place, especially rooted among the more highly educated young or middle-aged classes, and it is part of a process aimed at rediscovering the local cultural heritage associated with regional culinary traditions [56].

However, in the Venice lagoon, several chefs (defined by [76]; as 'change-makers from the kitchen') began to use wild vegetables to experiment with different tastes and textures in their recipes, reinventing culinary traditions with the proposal of new local gastronomies [56]. In this sense, the role of local restaurants is paramount, as they act as conduits between local producers and the visiting tourists (or consumers in general), communicating with both groups and being aware of local conditions and issues [77]. Local festivals and farmers' markets, whose primary function is to facilitate the exchange of agricultural products, also play a crucial and simultaneous role. They are inherently branded with the destination's unique gastronomic culture and identity, making them a significant draw for culinary tourists [78–80]. By connecting visitors, residents, and the region's local food and culture, they help the local economy thrive and can counteract the negative effects of globalization and the marginalization of LEK that threaten Venice and its lagoon [79, 81, 82]. In a similar vein, Everett and Aitchison, [77] suggest that deglobalization in tourist areas, like the Venice lagoon, can be achieved by reconnecting visitors with the landscape through local food production networks. Thus, developing and promoting local gastronomic products, such as WFPs and associated foraging activities, can enhance the natural and cultural resources of the country's interior. This approach also strengthens cultural identity, promotes respect for the environment and rural culture, and thus helps prevent the disappearance of rural communities [80]. However, to be deeply sustainable, these initiatives must be carefully managed to prevent the overexploitation of local resources and the commodification of local knowledge and communities [83].

Conclusions

The findings of this study reveal that LGK among farmers, thus people who live in close connection with the soil and vegetation of the Venice lagoon, is still vivid and it is increasingly economically valued. Differently, fishers, who instead live more in contact with the sea, largely neither know nor use WFPs in their culinary preparations.

This distinction is crucial for preservation projects, since it suggests that local knowledge is not evenly distributed nor an ubiquitous heritage but is rather punctiform and tied to occupation specialization. This is paramount to safeguard LGK from the risk of progressive depletion related to the ongoing disappearance of the rural communities and touristification, especially in vulnerable socioecosystems such as the Venice lagoon, since it helps identify where specific knowledge hotspots lie.

Furthermore, we found that WFPs serve as a supplementary source of income for a significant portion of the interviewed farmers, thereby revealing the possibility, even in a globalized and touristified context, to create market niches based on local knowledge and biodiversity. Notably, our findings suggest that the deeper the culinary familiarity with these species, the greater the likelihood of their successful market integration.

In conclusion, we believe that recognizing and valorizing the biocultural ties connecting local communities to their environment may contribute to the preservation of specialized knowledge. Besides, in highly vulnerable tourist areas, like the Venice lagoon, the integration of WFPs into local short food supply chains offers space for this LGK to be alive, highlighting the role of farmers as active contributors to the local food culture.

Abbreviations

LEK	Local ecological knowledge
LGK	Local gastronomic knowledge
PL	Plural
SE	Sant'Erasmo
V	Vignole
WFPs	Wild food plants

Supplementary Information

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Supplementary Material 1

Supplementary Material 2

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Author contributions

GM and RS designed the study. TF and JNM conducted the fieldwork. TF analysed the data and conducted the herbarium voucher preparation. TF, RS, EF conducted the plant identification. TF and GM drafted the manuscript. GM, RS, JNM, EF, DMZ, LBDP provided comments and suggestions on the draft manuscript. GM and RS supervised the study. All authors read and approved the final manuscript.

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Data availability
The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Declarations

Ethics approval and consent to participate
The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Ethical approval for the study was obtained from the Ca' Foscari Ethics Committee (protocol code 3/2023 of 14 March 2023).

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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