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Assessment of the Nutritional Value of Selected Wild Food Plants in Türkiye and Their Promotion for Improved Nutrition

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Abstract: Türkiye represents one of the world's biodiversity hotspots, containing over 11,000 species of plants, with an estimated 10% being edible. Wild food plants, especially in rural areas, are collected and eaten or sold in local markets, complementing people's diets, and represent a source of additional income for foraging households. Yet, the use of wild food plants is declining, with both their dietary and cultural values being undermined. Wild food plants can be used as a healthy dietary alternative to imported and ultra-processed foods, particularly as the Turkish population increasingly suffers from diet-related diseases. Using a unique and innovative approach to mainstream biodiversity for food and nutrition, wild food plants from five different regions of Türkiye were analyzed to determine their nutrient composition, and to evaluate their contribution not only to diets and nutrition, but to promoting a more sustainable food system. Examples are presented of how the approach was put into practice and how action was taken to (i) strengthen the evidence of the nutritional value of wild food plants; (ii) use this knowledge to shape new policies and identify emerging markets for food biodiversity; and, (iii) improve awareness of consumers, using capacity building and farmer training, gastronomy, and cultural events.

Keywords: wild food plants; Türkiye; biodiversity for food and nutrition; biodiversity mainstreaming; cross-sectoral policies; value chain development; awareness raising

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1. Introduction

The earliest documented ethnobotanical study of Turkish wild flora dates to 40 to 90 CE, when the Greek botanist Pedanius Dioscorides published *De Materia Medica* on Anatolian folk medicine [1]. Since then, most research focused on the medicinal properties of wild plants, which are species that grow spontaneously in self-sustaining populations outside cultivated areas, in field margins, forests, woodland, grassland, and wetlands, independently of human activity, from where they are collected [2]. It is only in the last two decades that field studies in Türkiye started to document the use of wild plant species used for food. From 2000 to 2020, 33 ethnobotanical surveys were undertaken by Turkish scientists to document the existence and use of Turkish wild food plants (WFP) across half of the country's 81 provinces and in all of Türkiye's regions [3–35] (Figure 1).

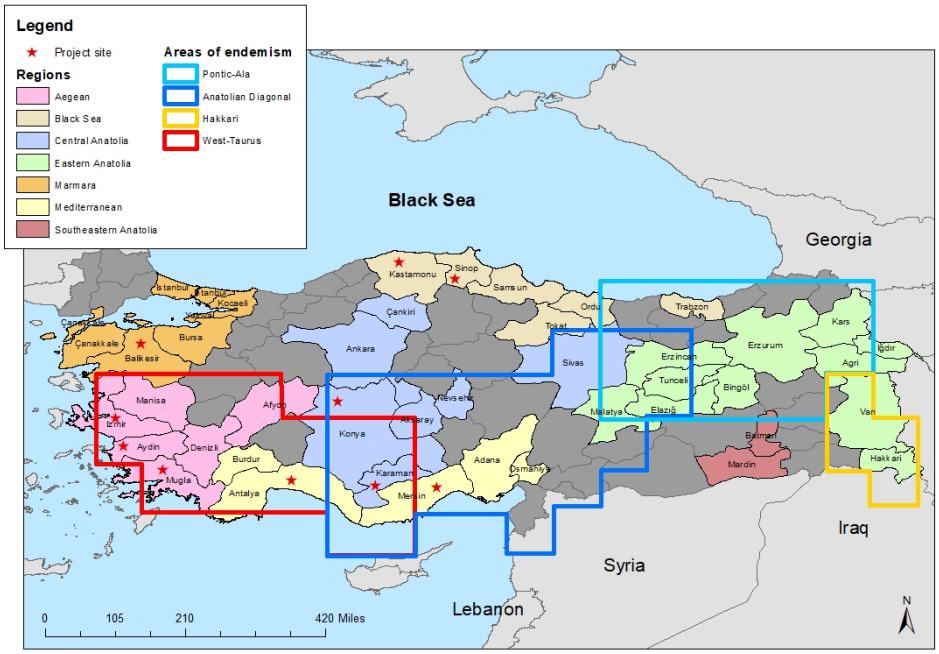

Figure 1. The colored provinces on the map of Türkiye indicate, per region, where ethnobotanical studies on WFP were carried out based on the reviewed literature. The red stars on the map indicate the location of the BFN project pilot sites. Most of the surveyed provinces fall within the four areas of endemism conceptualized by Noorozi et al. [36].

Further, from 2012 to 2019, the GEF-supported project *Mainstreaming Biodiversity Conservation and Sustainable Use for Improved Nutrition and Well-Being* (Biodiversity for Food and Nutrition Project, or BFN for short) was implemented in Türkiye, among other countries, to strengthen the conservation and sustainable use of biodiversity for food and nutrition, by improving the knowledge base of locally important edible biodiversity. Using an innovative, holistic approach illustrated in Figure 2, nutritional data generated on locally important WFP was used to mainstream local diversity in relevant policy and development programs, and raise awareness of the importance of conserving and using this diversity to improve diets [37–39].

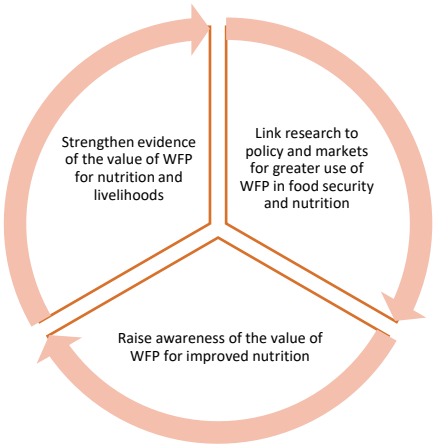

Figure 2. The unique, holistic approach adopted by country partners in the BFN project to mainstream agrobiodiversity, including WFP, into research, policies, and practices targeting food and nutrition security. Adapted from Borelli et al. [37].

Most of the areas where the above-mentioned studies were undertaken overlap with the four areas of endemism identified by Noorozi et al. [36] (Figure 1), which are characterized by plant species richness and endemic diversity. At the intersection of three of the

world's 34 biodiversity hotspots (Mediterranean, Caucasian, Irano-Anatolian), Türkiye's topographic and environmental heterogeneity results in a diversity of habitats that promote increased speciation rates [36]. Home to 11,707 plant species, of which one third (3649) are endemic [1,40], Türkiye has one of the richest floras of the temperate zone. Turkish Ethnobotany Database records from 1928–2014 reveal that 1406 plant taxa have been used as a food source in the past [41].

Collectively, the studies established that collecting wild edibles is still a common practice among rural communities across Türkiye, albeit mostly among older generations, particularly women [4,8–10,14,21,25,39], and where, for historical and geographical reasons, people remain relatively isolated [20,23].

The ethnobotanical studies helped to capture the irreplaceable loss of traditional knowledge that often accompanies the migration of young people from rural to urban areas [11,22,26,27]. Yet, the existence of Turkish WFP is also threatened by overexploitation and unsustainable collection practices, over-grazing, the over-use of herbicides, but, most importantly, by land-use changes and habitat destruction, which account for 62% of the threats reported to these genetic resources [1,4,15,21,42–45].

Despite the recognition that WFP could provide important dietary contributions to rural communities, the studies supplied limited evidence of the nutrient composition of WFP, other than suggesting that "wild leafy vegetables probably provide the same level of nutrients as cultivated species" [8,23] or reporting information on single species, including from neighboring countries [46–49]. This lack of evidence is a missed opportunity to harness the nutritional properties of WFP to help counteract the diet-related problems that the country is facing. Türkiye has, in fact, made limited progress towards controlling rising levels of non-communicable diseases (NCDs) and meeting its national and global nutrition targets [50,51], thus, undermining the country's economic development [52]. The BFN project partly filled this knowledge gap by determining the nutritional properties of 39 WFP, and made some headway in using this evidence to mainstream biodiversity for food and nutrition, including WFP, in national policy and programs for improved diets and nutrition. The methodology used and examples of how the unique approach developed by BFN was put into practice in Türkiye is presented in the sections below.

2. Materials and Methods

2.1. Study Areas and Ethnobotanical Studies

Based on preliminary ethnobotanical work undertaken by Tan and Taskin [53], and on baseline assessments carried out as part of the BFN project to identify the regions with highest concentrations of WFP and associated traditional knowledge [39], the BFN project in Türkiye focused on five geographically distinct areas—the Aegean, Black Sea, Central Anatolia, Marmara, and Mediterranean Regions. Ten provinces within these regions were chosen as the project sites (Figure 1), which included:

- Aegean: İzmir, Aydın, and Muğla;
- Black Sea: Kastamonu and Sinop;
- Central Anatolia: Konya and Karaman;
- Marmara: Balıkesir;
- Mediterranean: Antalya and Mersin.

Data collection and sampling protocols were developed for ethnobotanical studies, and training of enumerators was carried out to collect information from local markets, local restaurants, supermarkets, and a select number of villages on the trade and consumption of WFP and to assess their socio-economic importance. Overall, the survey was carried out in 133 villages. A total of 2587 questionnaires documented information from collectors and consumers living in rural areas, while feedback from 1086 urban consumers was collected across the target regions. Data were obtained on collection methods, collection sites, and commercial value of WFP, as well as information on the species' foraging seasons, and preparation and consumption practices.

2.2. Prioritization Process

With such a wide selection of WFP taxa to choose from, and with nutritional label testing costing up to USD 1000 for a single species [38], it became necessary to establish a set of criteria to reduce the list of WFP for food composition analysis to a manageable number. A tailor-made sustainability index (Table 1) was developed to rank and evaluate the WFP based on known nutritional, environmental, and economic data. Criteria include the species' likely nutritional benefits based on pre-existing food composition data, conservation status and level of endemism, distribution, market potential, multi-functionality, traditional and modern food uses, as well as value chain upgrading and market development potential.

Table 1. The predefined criteria used to narrow down the list of WFP for food composition analysis and future value chain upgrading and market development.

Nutritional	Environmental	Economic
-Iron content	**Conservation status**	**Collection/Production**
-Calcium content	-Ex situ, in situ/on farm	-Constraints
-Fiber content		-Distance from
-Antioxidant ratio		collection/production sites
-Beta-carotene content		-Collection, production stability
	Cultivation	**Market characteristics**
	-Ease of production	-Readily identifiable
	-Growth rate	-Ease of packaging
	-High adaptability	-Shelf-life attributes
	-Vegetation period	
	-Annual growth	
	Threats	
	-Habitat destruction and fragmentation	
	-Pollution	
	-Overexploitation	
	-Unsustainable collection practices	
	Distribution	
	-Widespread	
	Habitat preferences	

Source: Adapted from Gee et al. [38].

Using the sustainability index, the sample size was narrowed down to 39 WFP (Table S1—Supplementary Materials), as well as one mushroom (*Lactarius deliciosus*), three landraces of cowpea (*Vigna unguiculata*), einkorn wheat (*Triticum monococcum*), and taro (*Colocasia esculenta*). To further optimize resources, a desk review was carried out to identify existing data available in food composition databases and tables, as well as in the scientific literature. Where data were missing, unreliable, or incomplete, the project undertook plant collections for laboratory analysis.

2.3. Sampling Protocol and Sample Preparation

Standardized sampling and analytical protocols described in Greenfield and Southgate [54] were used for sample collection (including quantity, number of batches to capture variation, size and property of samples), storage (temperature regulation), and plant sample transfer (packaging, means of transport). Sampling forms were used to record local food names, sampling region, origin of sample, date, and other relevant details. Plants were taxonomically classified using the "Flora of Turkey and the East Aegean Islands" [55]. Herbarium specimens were conserved at the Aegean Agricultural Research Institute. Representative composite samples for food composition analysis were prepared for each species using three batches of 600 g each. The plant samples were transported to the laboratory in a cold system at 20 ± 5 °C on the same day of collection to prevent nutrient loss.

2.4. Nutrient Analysis

Available carbohydrate, moisture, protein, fat, dietary fiber, and crude ash were assayed for all 39 WFP using proximate analysis. Inductively coupled plasma mass spectrometry (ICP-MS) was used to establish micronutrient content for the species, including minerals (Fe, P, Ca, Mg, K, Na, Zn, Cu) and vitamins (vitamin C, B1, B2, niacin, beta-carotene, alpha tocopherol). Detailed information on the analytical methods used can be found in Guzelsoy et al. [56].

Due to increased interest in the health-promoting effects of plant polyphenols conferred by their antioxidant, anti-inflammatory, antitumor, and antimicrobial properties [57,58], polyphenols analysis and antioxidant activity evaluation was also carried out using 2,2-diphenyl-1-picrylhydrazyl radical scavenging effect(DPPH) and Trolox equivalent antioxidant capacity/ABTS radical cation decolorization assay method(TEAC) [59]. Relevant results for selected WFP are presented in Section 3.2.

Additionally, aromatic compounds were determined for fennel (*Foeniculum vulgare* Mill.), sorrel (*Rumex acetosella* L.), foxtail lily (*Eremurus spectabilis* M. Bieb.), golden thistle (*Scolymus hispanicus* L.), and catbriers (*Smilax excelsa*), using a sampling method in combination with headspace solid phase microextraction (HSSPME), simultaneous distillation extraction (SDE) and steam distillation (SD), followed by gas chromatography–mass spectrometry (GC–MS) detection, following the protocol developed by Zhang and Li [60].

3. Results

Work undertaken by BFN Türkiye helped validate previously reported qualitative and quantitative assessments of the value of Turkish WFP. In the following section, outcomes are presented stemming from the ethnobotanical surveys undertaken in five target regions, the food composition analysis of target WFP, and the project's policy mainstreaming and awareness-raising efforts to raise the recognition and understanding of WFP as important dietary allies to fight food and nutrition insecurity in the country.

3.1. Ethnobotanical Data

In accord with previous ethnobotanical studies, the surveys undertaken in Türkiye during the BFN project established that awareness and consumption of WFP is higher in rural areas, with marked differences within settlements, as well as within households in the same settlement. In contrast, in urban centers, only 32% of the respondents acknowledge consuming WFP, and awareness of WFP is largely limited to the most common species found on sale in local markets.

As with previous studies, the surveys helped confirm that WFP are still widely used in local and traditional cooking in the target geographies (Table S1—Supplementary Materials). Some are reportedly eaten raw, while others are cooked, requiring more complex processing and preparation. WFP are used in savory and sweet dishes alike, such as in the preparation of the traditional molasses-like syrup *pekmez* made from the berries of Syrian juniper (*Juniperus drupacea*), or of *helva* made with the roots of *Gypsophila arrostii*. In most of the study sites, leafy greens, roots, and fruits are reported to be eaten raw, directly after gathering. Many WFP are used in salads with an olive oil and lemon dressing or with yoghurt. Others are preserved for year-round storage by deep-freezing or pickling. Other preparation methods include frying or sautéing in olive oil, use in omelets, or as filling for pies and in Turkish *börek*. The leaves of some species are also used to make stuffed rolls (*dolma/sarma*) filled with rice and/or minced meat cooked and eaten with yoghurt. Other WFP are used to make traditional soups called *çorba*. Some WFP are reported as being multipurpose and used in traditional medicine, such as sweet flag (*Acorus calamus*). Of the identified WFP, 29 species are used in traditional herbal medicine for curing almost 40 ailments, including diabetes, indigestion, common colds, kidney stones, coughs, cardiovascular problems, mouth, and toothache.

Across the target regions, interviewed WFP consumers are generally above 50 years of age, have only completed primary education, are farmers or employed in agriculture (93% in the Black Sea Region), and are collectors themselves. In each region, which is characterized by its own distinct flora, the quantities of WFP consumed varies. Most respondents report eating wild edibles once to twice per week and selling the largest proportion of their collection to local markets. The rarer and harder to collect species are kept and consumed at home.

3.2. Nutritional Analysis

Macronutrient analysis of the 39 WFP reveals that *Ferulago trachycarpa*, knotgrass (*Polygonum cognatum*), and catbriers (*S. excelsa*) contain the highest amounts of dietary fiber (10.80, 5.70, and 5.17 g/100 g, respectively) providing more than 20% of the Dietary Reference Intake (DRI) [61]. Compared to common parsley (*Petroselinum crispum*), which is widely consumed in Türkiye, *F. trachycarpa* contains 2.5 times the amounts of dietary fiber (Figure 3), useful for lowering the risk of coronary heart disease, hypertension, diabetes, obesity, and gastrointestinal problems [62,63].

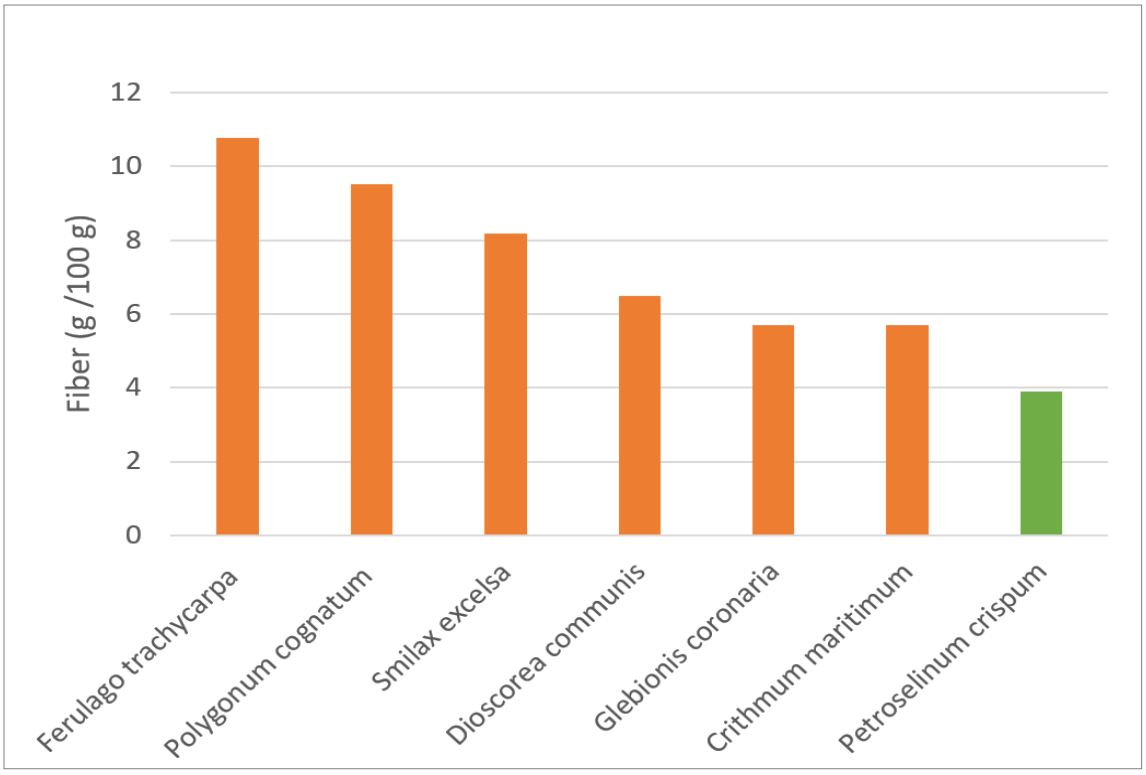

Figure 3. Dietary fiber content of several Turkish WFP expressed as g per 100 g of fresh weight (FW). In the bar chart, fiber content of the studied WFP is shown in the orange bars while that of common parsley (*Petroselinum crispum*) is shown in green.

Antioxidant activity analysis reveals that *F. trachycarpa*, knotgrass (*P. cognatum*), and catbriers (*S. excelsa*) contain the highest amounts of dietary fiber (10.80, 5.70, and 5.17 g/100 g, respectively) providing more than 20% of the Dietary Reference Intake (DRI) [61].

Analysis shows most WFP to be excellent sources of minerals, particularly iron (Fe) (Figure 4), zinc (Zn) (Figure 5), calcium (Ca) (Figure 6), and phosphorous (P) to a lesser extent. Knotgrass (*P. cognatum*) and watercress (*Nasturtium officinale*) are rich in iron, providing over 100% of the DRI requirements per 100 g of fresh weight. The highest contents of zinc are observed in crown daisy (*Glebionis coronaria*). Furthermore, mineral concentrations varies widely among the studied species.

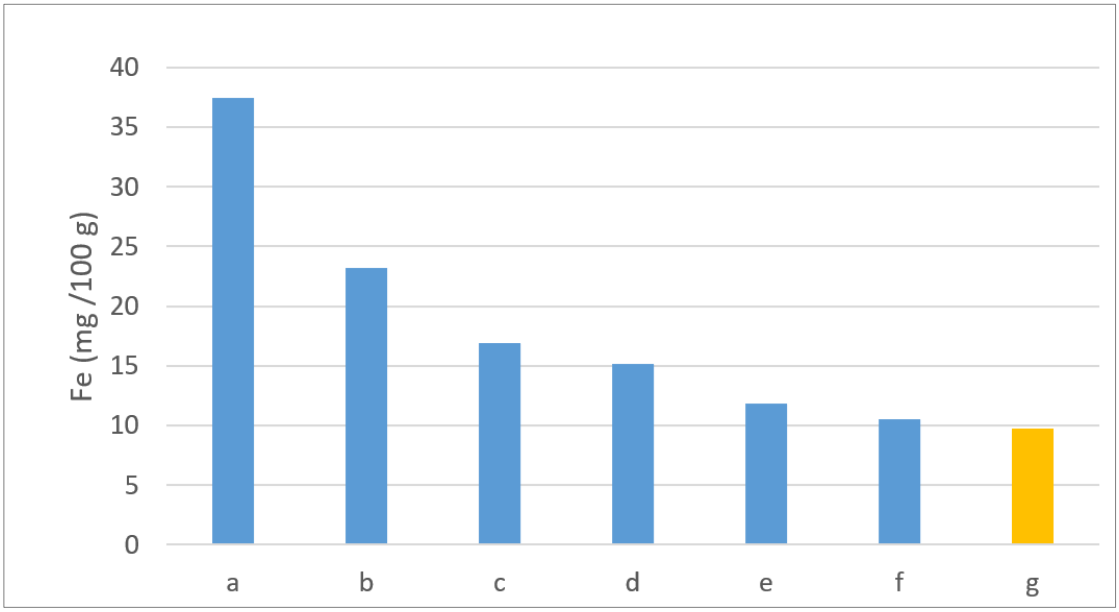

Figure 4. Variation in iron (Fe) concentration in selected WFP compared to spinach. Quantities are expressed as mg per 100 g of fresh weight (FW). a. knotgrass (*P. cognatum*); b. watercress (*N. officinale*); c. Elm-leaved sumach (*Rhus coriaria*); d. purple salsify (*Tragopogon porrifolius*); e. berberis (*Berberis crataegina*); f. chicory (*Cichorium intybus*); g. spinach (*Spinacia oleracea*).

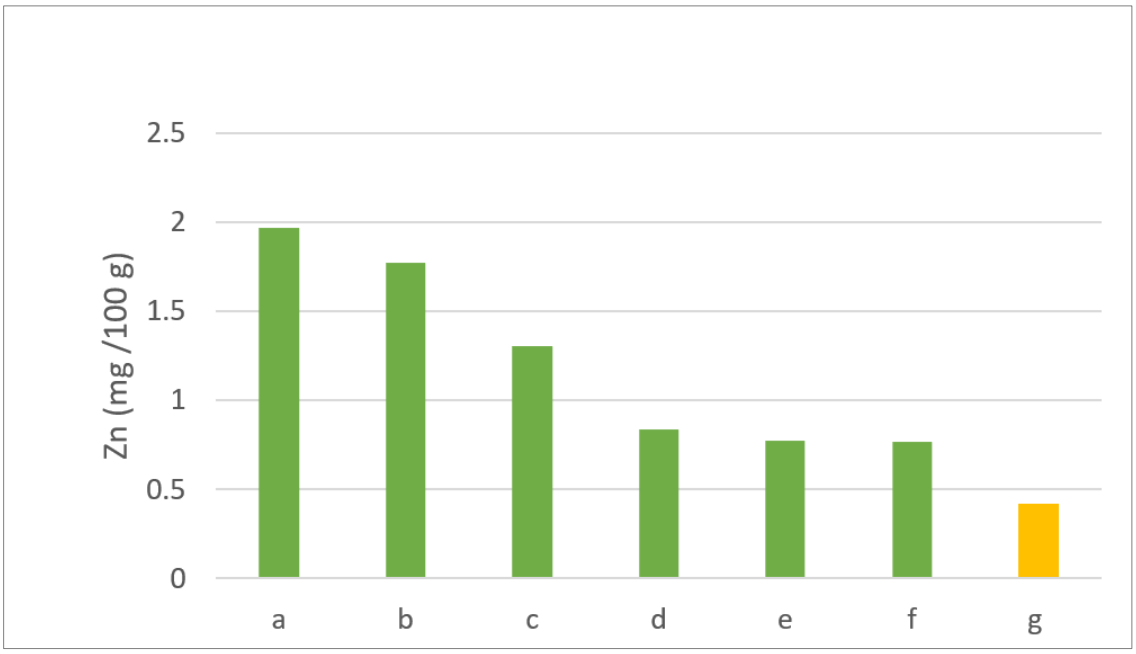

Figure 5. Variation in zinc (Zn) concentration in selected WFP compared to spinach. Quantities are expressed as mg per 100 g of fresh weight (FW). a. crown daisy (*G. coronaria*); b. berberis (*B. crataegina*); c. shepherd's purse (*Capsella bursa-pastoris*); d. wild lupin (*Lupinus albus*); e. capers (*Capparis spinosa*); f. catbriers (*S. excelsa*); g. spinach (*S. oleracea*).

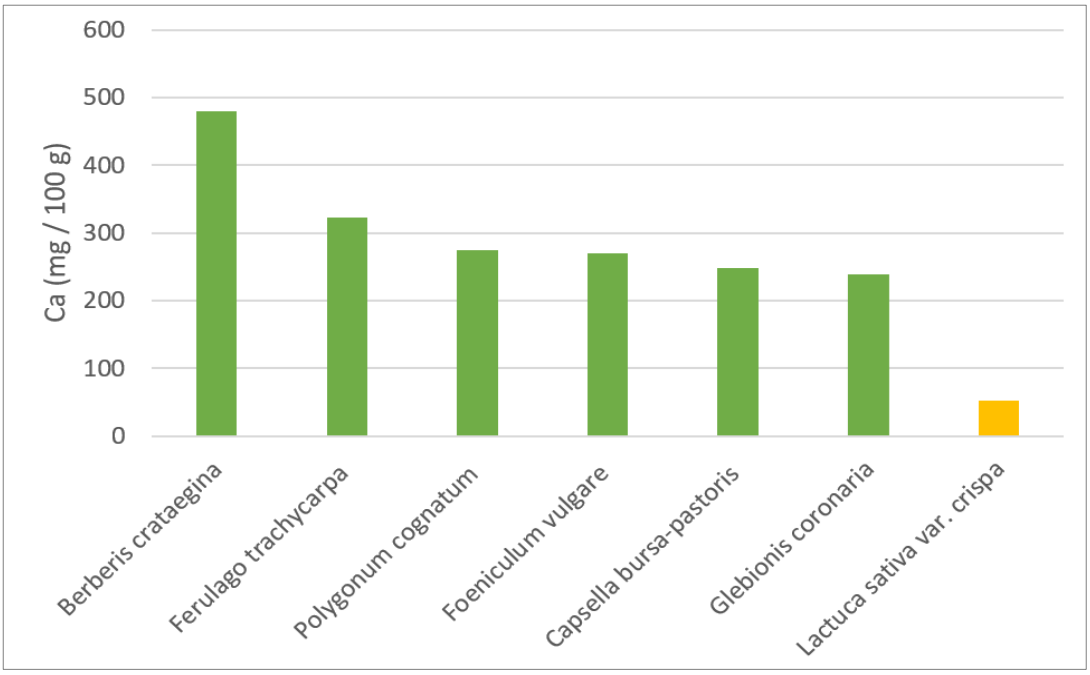

Figure 6. Variation in calcium concentration in selected WFP compared to curled lettuce (*Lactuca sativa* var. *crispa*). Quantities are expressed as mg per 100 g of fresh weight (FW).

Many WFP are found to be rich sources of vitamin C (Figure 7) when compared to some commonly used fruits and vegetables. The vitamin C content of the fresh samples is highly variable, ranging from 2.0 to 129.4 mg/100 g. Vitamin C is highest in foxtail lily (*E. spectabilis*), with the plant providing nearly 100% of the DRI per 100 g [DRI is 75 mg/day for women and 90 mg/day for men] [64]. However, most WFP are consumed cooked. Thermal instability of vitamin C during cooking should be considered when evaluating vitamin C content of studied plants [65,66].

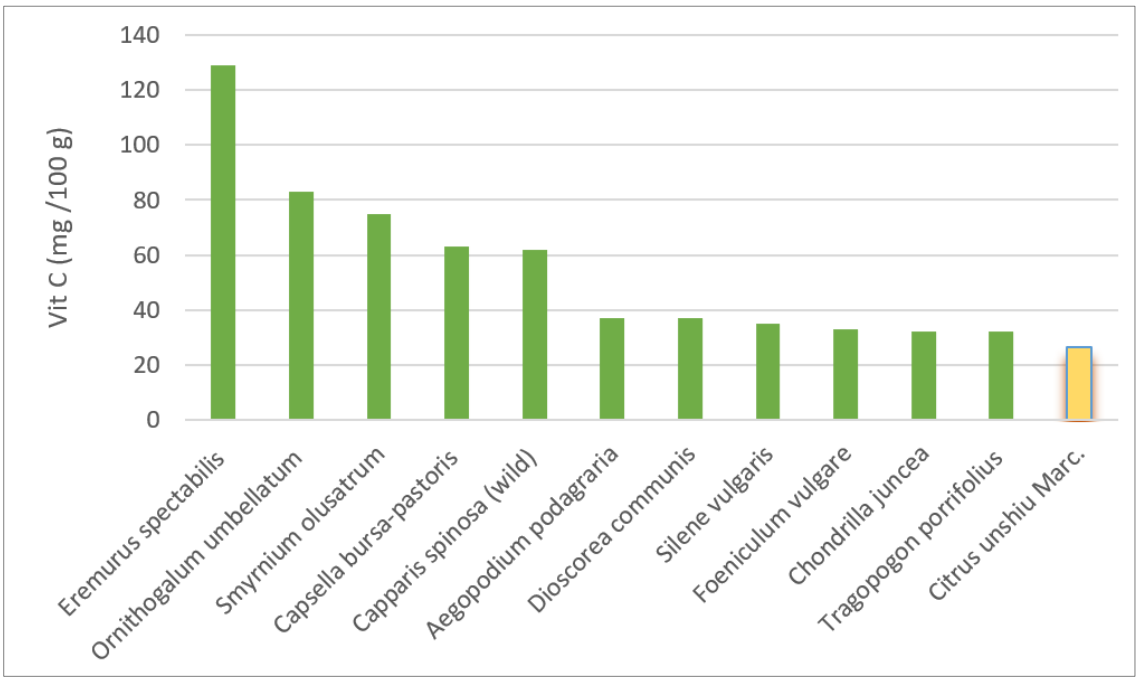

Figure 7. Variation in vitamin C concentration in selected WFP. Quantities are expressed as mg per 100 g of fresh weight (FW).

Regarding phenolic compounds, foxtail lily (*E. spectabilis*), belonging to the Liliaceae family, is found to contain considerable amounts of quercetin 3-O-rutinoside hydrate and ferulic acid, while high levels of chlorogenic acid and isorhamnetin 3-O-glucoside are detected in golden thistle (*Scolymus hispanicus* L.), identifying selected WFP as important and valuable sources of natural antioxidants (Figure 8). Interest in these compounds dramatically increased in the last decade, due to their biological and health-promoting effects [67–69].

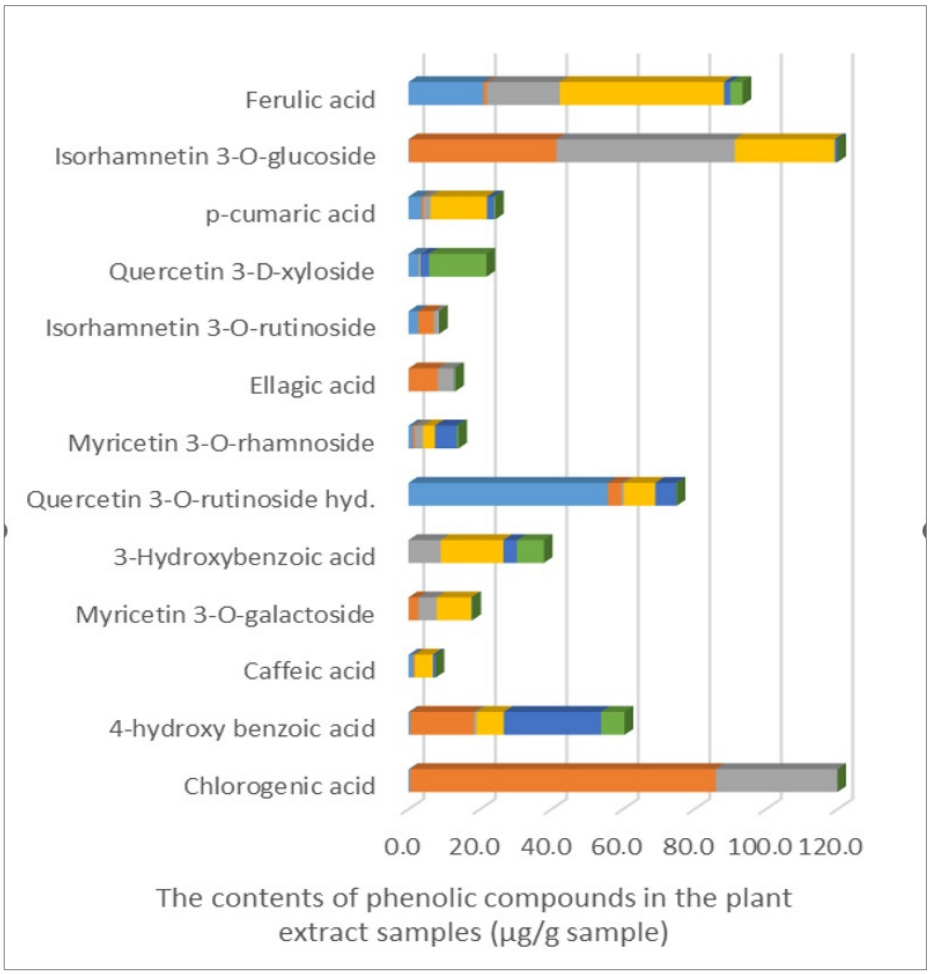

Figure 8. Phenolic compounds determined in a. foxtail lily (*E. spectabilis*); b. golden thistle (*S. hispanicus*); c. fennel (*F. vulgare*); d. watercress (*N. officinale*); e. sorrel (*R. acetosella*); and f. curly dock (*Rumex crispus*).

A total of 59 volatile compounds from seven different chemical groups including aldehydes, ketones, hydrocarbons, esters, alcohols, terpenes, and furans are also identified (Figure 9). Plant volatile compounds provide medicinal and aromatic plants with their typical sensory properties, aromatic features, and disease prevention characteristics, as well as enhancing the plants' resistance to stress and interactions with other plants [70,71]. While wild fennel (*F. vulgare*) and sorrel (*R. acetosella*) are found to be rich in terpenoid hydrocarbons, alcohol and ester compounds are dominant in foxtail lily (*E. spectabilis*) and catbriers (*S. excelsa*). The volatile oils typical of fennel seeds have antioxidant, anti-inflammatory, antidiabetic, antimicrobial, and antimutagenic activities [72,73].

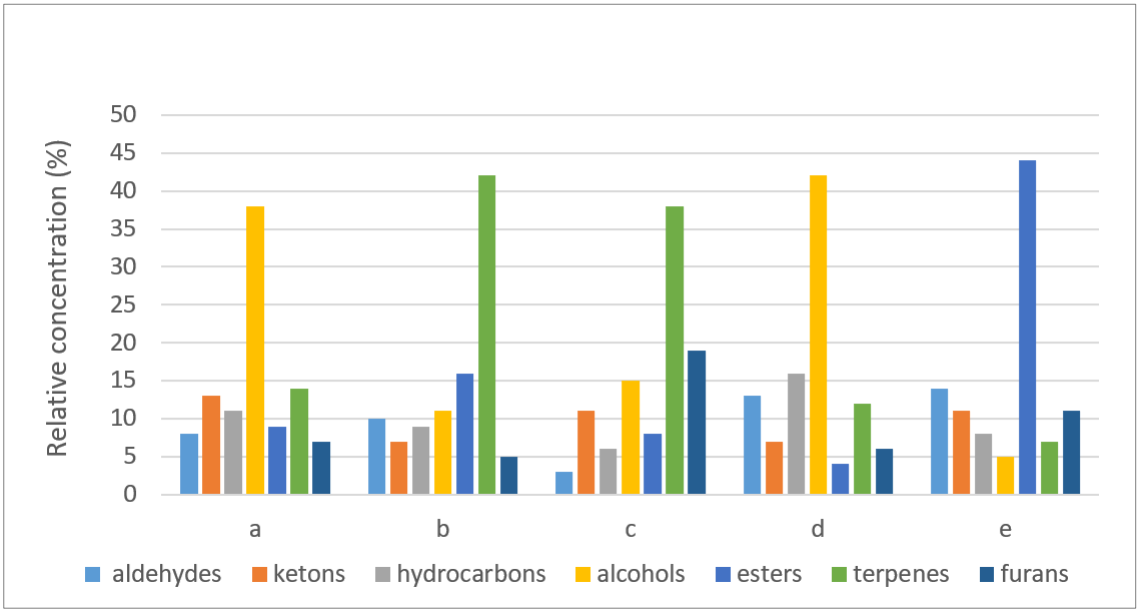

Figure 9. Volatile compounds determined in a. foxtail lily (*E. spectabilis*); b. fennel (*F. vulgare*); c. sorrel (*R. acetosella*); d. catbriers (*S. excelsa*); e. golden thistle (*S. hispanicus*).

Food composition data and associated traditional knowledge generated as part of the BFN project on the 39 selected WFP are included in the Turkish Food Composition Database [74], as well as in the FAO/INFOODS Food Composition Database for Biodiversity [75] and made available to others to use. Additional nutritional data were also identified from other national data holders with which collaborative agreements were established. This includes the Ministry of Health, the Universities of Gazi, Selçuk, and Akdeniz, as well as the Association of Turkish Dieticians and the Association of Siyez Producers (NGO).

3.3. Mainstreaming Nutrient-Rich Wild Edibles in Türkiye

The findings from the food compositional analysis of targeted WFP in Türkiye clearly highlight their significant nutritional value. However, such nutrient-rich biodiversity is often under-valued, and rarely considered in policy and decision-making related to food systems, food security, and nutrition. Further, investment and development decisions often fail to take this diversity into account [42,76]. This is beginning to change, with global attention shifting to the health and environmental benefits of consuming a wide diversity of nutrient- and phytonutrient-rich biodiverse foods, and improving diets becoming an important health and economic goal for more and more countries [77–81].

Biodiversity mainstreaming, defined as "the process of embedding biodiversity considerations into policies, strategies, and practices of key public and private actors that impact or rely on biodiversity, so that it is conserved and sustainably used both locally and globally", is an important strategy to address this lack of consideration [82]. The Food and Agriculture Organization (FAO) of the United Nations additionally understands that mainstreaming biodiversity for improving diets and nutrition involves the promotion of knowledge, conservation, development, and use of local crop varieties, cultivars, and animal breeds, as well as wild, neglected, and under-utilized species in policies and practices [83].

3.3.1. Policies

In Türkiye, the research partnerships established under the BFN project, and knowledge generated on the nutritional value of WFP, were used to support the development of an enabling environment for better promotion and mainstreaming of local biodiversity for food and nutrition [38]. As a starting point, a national cross-sectoral policy platform was

established bringing together the Health, Agriculture, Environment, and Education ministries, research and extension services, and academia, as well as key national stakeholder groups and partners (e.g., consumers and producers). Policies and strategies with a bearing on the conservation and use of WFP, and of nutrient-rich biodiversity more broadly, were reviewed to identify entry points for biodiversity mainstreaming (Box 1).

Box 1. The key national strategies, policies and plans reviewed and targeted by BFN-Türkiye. The project was able to influence the first seven policy instruments (in bold) to recognize the conservation and use of local biodiversity for food and nutrition as an important strategy for national food and nutrition security.

- **National Biodiversity Strategy and Action Plan (NBSAP)**
- **MFAL 2013–2017 Strategic Plan**
- **10th National Development Plan 2014–2018**
- **GDAR Agricultural Research Master Plan 2016–2020**
- **Healthy Nutrition and Active Life Program 2014–2017**
- **Nutrition Friendly School Initiative**
- **Nutrition and Health Research of Türkiye 2017**
- **Technical and Vocational Education and Training (TVET) programs**
- Türkiye's National Dietary Guidelines (2016)
- ME Science Teaching Programs/Curriculum
- The Higher Education Strategy (2007–2025)
- Vocational and Education Training (VET) Strategy (2014–2018)
- Türkiye's Skills Vision 2020
- Action Plan for Strengthening the Link between Education and Employment (İMEİGEP)
- Strategy Document of the Ministry of Agriculture and Forestry (2019–2023)
- National Rural Development Strategy (2021–2023)
- 11th Development Plan (2019–2023)

To facilitate the mainstreaming process, platform stakeholders were provided with nutritional evidence, case studies, awareness materials, technical bulletins, and policy recommendations. This resulted, following a lengthy and time-consuming process, in nutrient-rich biodiversity being included as a valuable resource in several policy regulations, programs, and master plans originally reviewed by the policy platform. These policy instruments are listed in bold in Box 1, and encourage research, awareness, and key actions related to nutrient-rich biodiversity, including targeting efforts to document traditional knowledge and nutrient value, and to invest in agricultural production for local cultivars and domestication efforts for the most promising wild species.

3.3.2. Markets and Awareness

Information generated as part of the project was also used to improve the promotion and marketing of WFP and other nutrient-rich biodiversity, while paying attention to issues of domestication and sustainability to meet growing consumer demand (e.g., golden thistle, Box 2). Increased interest in WFP was raised by value chain development, being mindful of emerging market opportunities. Links with alternative food movements and gastronomy initiatives, the organization of cooking workshops and demonstrations, the publication of recipe books, and participation in cultural food festivals all helped raise the profile of WFP in the country.

Partnerships were fostered with co-organized editions of the Alaçatı Herb Festival, which continues to this day. The Alaçatı Herb Festival is a four-day event in the Aegean region, bringing together foragers and producers, artisans, and chefs and attracting many thousands of visitors and tourists to celebrate local WFP. The festival also acts as a platform for sharing knowledge about wild biodiversity and Turkish food culture, with the involvement of celebrity chefs helping to popularize the consumption of WFP among younger generations. Competitions to identify and reward foragers who collect the most diversity of wild plants are held (Figure 10), as are contests for the best recipes and dishes served up

to a festival panel. The event has opened the market for WFP in the region, an opportunity largely taken up by the enterprising women of Alaçatı who produce and sell local and traditional food products. Additional food festivals that promote WFP in the country are the Çamlık Herb Festival, the Aci Ot (Black bryony) festival, the Gastro Alaturka event, and the Samsun Regional Herb Dishes Festival.

Figure 10. The competition for WFP collectors held during the 2018 edition of the Alaçatı Herb Festival. Prizes are awarded to the first three collectors of the greatest number of species and with the deepest knowledge of the species' food and medicinal uses. Winners are awarded a gold bullion coined by the State Mint ranging in value from USD 100 to 400. During this edition, over 200 WFP were recorded by scientists, along with previously unknown information about the species. *Credit*: BFN-Türkiye.

Box 2. Golden thistle: A Mediterranean favorite.

The roots and immature leaves of golden thistle (*S. hispanicus*) are a Turkish culinary favourite as well as well-known herbal remedy [37].
The thorny plant, which is traditionally collected in Spring from fallow fields and road verges and sold in local markets, is easily domesticated. It was, therefore, possible for the BFN project to promote the species and increase demand for it without risking over-exploitation. In the İzmir province, the Aegean Agricultural Research Institute and the University of Anadolu worked with farmers to select, characterize, and evaluate the species. Selected seeds were later distributed to farmers accompanied by guidelines for the sustainable production of golden thistle that addressed critical aspects such as climate and soil conditions, plant management, harvest, and seed production [38,53,84]. Post-harvest studies also determined the shelf life and market potential of golden thistle, while value chain analysis determined the distribution of economic benefits across the value chain. Production of golden thistle versus collection from the wild turned out to be slightly more expensive (1 EUR/kg as opposed to 0.76 EUR/kg), but clear benefits for farmers to invest in golden thistle cultivation were demonstrated. This includes high net gains, low production costs, and increased demand for the crop, as well as the fact that it can grow on marginal lands with little to no external inputs [36].

3.3.3. Education

As in many parts of the world, the diets of school-aged children in Türkiye changed dramatically in recent decades, with lifestyle changes and a move away from traditional foods in favor of a more western-style diet and the consumption of ultra-processed foods. This resulted in issues of childhood obesity and micronutrient deficiencies, which have implications for the long-term health and wellbeing, as well as the cognitive and educational achievement of Turkish children. Schools were, therefore, recognized as important platforms for interventions promoting lifelong healthy eating habits, including greater awareness of food cultures and the environmental and social impact of food choices [85,86].

The integration of knowledge about diet diversification, conservation, and sustainable use of biodiversity in school systems, particularly in school nutrition policies such as the Turkish Nutrition Friendly School Program, was seen as a key objective, including the incorporation of more knowledge on WFP and nutrient-rich biodiversity into school curricula. Programs and policies that were a focus for this are listed in Box 1.

'Green' vocational training offers an effective entry point for intergenerational knowledge transmission of WFP, and of biodiversity for food and nutrition more broadly, by providing unique skills to young people [38]. Partnering with vocational training schools, such as the Halım Foçalı Vocational School, was identified as a way of mentoring and empowering upcoming student chefs to raise the profile of WFP and associated traditional collection practices through a series of lectures and hands-on, land-based learning activities. Through this approach, student chefs were trained on the nutritional value of WFP, on how to recognize and collect the species during nature walks, and use them in cooking classes [87]. During the Foça Science Education Festival, the students involved in this program organized a presentation to visiting teachers, students, and parents entitled 'Students in Nature and in the Kitchen'. Activities undertaken as part of this project fostered interest from the National Education and Development Directorate of Foça to extend the program to other schools, and officially include traditional WFP as part of the school curriculum [87].

Other opportunities to promote and raise awareness about the value of WFP among young people was through the Youth Leadership Agricultural Camps Initiative jointly organized by the Ministry of Agriculture, Food, and Livestock and the Ministry of Education. In 2018, biodiversity for food and nutrition was chosen for the year's theme and children learnt about native WFP and biodiversity. Preparatory stages for this initiative included running training-of-trainer workshops on the topic. Between April and June 2018, approximately 2500 4th grade students across Türkiye's 81 provinces took part in the camps, becoming peer-to-peer ambassadors promoting the multiple benefits of WFP [87].

4. Conclusions

The article reviews the contribution of WFP to food security, nutrition, and livelihoods of the Turkish population over the last two decades, while offering a comprehensive set of tried and tested best practices and lessons learned for mainstreaming biodiversity that could be upscaled or applied in other regions.

The evidence highlighted in the paper suggests that the contribution of WFP to the food security, nutrition, and livelihoods of the Turkish population continues to be significant, particularly in rural areas, where WFP are regularly collected, sold, and consumed. Food composition data, traditional knowledge, and the benefits of using WFP to tackle malnutrition were also documented, showing that most WFP are excellent sources of limiting macro- and micro-nutrients. With 39 species analyzed, the project added a significant body of knowledge to existing information on the nutritional value of WFP and made the information publicly available on the Turkish Food Composition Database [74], as well as in the FAO/INFOODS Food Composition Database for Biodiversity [75].

Information generated as part of the BFN project was used to support the development of an enabling policy environment for the promotion of WFP, and for biodiversity for food and nutrition more broadly. Evidence of the nutritional value of WFP was critical to ensure key national stakeholder groups and partners could develop planning, policy,

and regulatory instruments to positively encourage the use of this diversity as part of national nutrition and food security programs and strategies, as well as to enhance the conservation of these genetic resources. The various cross-sectoral working groups and platforms established within the project framework also used the information generated to explore favorable marketing and trade of WFP and related products, particularly in urban areas, where emerging market opportunities exist for organic and natural food products inherently rich in bioactive compounds and nutraceuticals.

Scientific evidence of the nutritional quality of WFP was also critical to reorient food systems towards making greater use of locally important food species and reverse negative perceptions commonly associated with WFP, which are often perceived as famine foods to fall upon when other crops fail, and household budgets do not allow additional food purchases [88–91]. The paper illustrates how practitioners can make the most of recurring events that revolve around gastronomy and ecotourism, such as the Alaçatı Herb Festival, or national campaigns on healthy eating targeting younger generations. It also demonstrates the strategic importance of partnering with the health and education sectors to stimulate interest and demand for diverse and healthy foods from the consumers of tomorrow.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/su141711015/s1. Table S1: BFN priority WFP of Türkiye.

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