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Bio-Cultural Diversity for Food Security: Traditional Wild Food Plants and Their Folk Cuisine in Lakki Marwat, Northwestern Pakistan

Tehsin Ullah [1], Shujaul Mulk Khan [1,2,*], Abdullah Abdullah [1], Naji Sulaiman [3,*], Ateef Ullah [1], Muhammad Sirab Khan [4], Shakil Ahmad Zeb [1] and Andrea Pieroni [3,5]

1 Department of Plant Sciences, Quaid-i-Azam University Islamabad, Islamabad 45320, Pakistan
2 Pakistan Academy of Science, 3 Constitution Ave., G-5/2 G-5, Islamabad 44000, Pakistan
3 University of Gastronomic Sciences, Piazza Vittorio Emanuele II 9, 12042 Pollenzo, Italy
4 Department of Botany, University of Science and Technology, Bannu P.O. Box 28123, Pakistan; sirabkhan246@gmail.com
5 Department of Medical Analysis, Tishk International University, Erbil 44001, Iraq
* Correspondence: smkhan@qau.edu.pk (S.M.K.); n.sulaiman@unisg.it (N.S.)

Abstract: Ethnobotanical studies on foraging are essential for documenting neglected or previously unknown wild food plants, which may be crucial for promoting the diversification of food sources and contributing to food security and sovereignty. The Pashtuns of the Marwat tribe in NW Pakistan are renowned for their traditional customs and food systems. Studying the wild food plants (WFPs) and their associated bio-cultural diversity is quintessential for fostering food security and sovereignty in the region. The research presented here investigated the area's wild food plants traditionally gathered and consumed. The field survey was conducted in 2023 with 87 study participants. A total of 41 plant species belonging to 24 botanical families was documented. The findings include food uses for *Atriplex tatarica*, *Amaranthus graecizans*, and *Beta vulgaris* subsp. *maritima* that have rarely been recorded in Pakistan. Moreover, the use of *Citrulus colocynthus* fruits in jam and *Zygophyllum indicum* leaves and stems in beverages are novel contributions to the gastronomy of NW Pakistan. The comparison with other food ethnobotanical studies conducted in North Pakistan suggests some similarities between the Lakki Marwat traditional WFPs and those from other semi-arid areas in North Pakistan, both Pashtun and non-Pashtun. While the findings underline the significant role of WFPs in local cuisine, we observed that this local knowledge is also threatened: the rapid spread of fast and industrialized food, modernization, and cultural dilution has led to an alarming reduction in these practices among the younger generations. Therefore, suitable measures to safeguard traditional plants, food knowledge, practices, and the associated culture are urgently needed. The urgency of this situation cannot be overstated, and it is crucial that we act now. Furthermore, preserving wild food plant-related cultural heritage may be fundamental to promoting food security and public health.

Keywords: ethnobotany; food heritage; traditional knowledge; wild food plants

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1. Introduction

The gathering and hunting of biodiversity for consumption is an essential and crucial tradition across different regions and societies worldwide [1]. Wild food plant species (WFPs) have been integral components of the human food system since the beginning of human civilization [2], and these plants have been and are often harvested at the edge of farming systems and domestically consumed; rarely, some of them are locally marketed [3]. WFPs are, however, crucial for food security in marginal areas, and their nutritional benefits and healing properties make them prototypical, traditional, domestic "food medicines" [4–7]. In fact, many studies have highlighted the pharmacological benefits of WFPs [7–9], disclosing that they are rich in various bioactive substances, including

carbohydrates, antioxidants, vitamins, and essential fatty acids [10–12]. These properties make them crucial for the mitigation of malnutrition [13]. Despite the long-lasting role of WFPs, their role in human food is decreasing due to modernization, urbanization, and industrialization [14]. However, in recent decades, the vital role of WFPs in promoting food security has attracted attention [15,16]. Historically, WFPs have been a significant source of food scarcity, famine, and outbreaks [17], and have become a more debatable topic in recent decades [15].

Pakistan is among the most populous countries in the world, facing the issue of food security despite its rich natural resources and landscape and cultural diversities [18]. Pakistan is ranked the 11th most food-insecure nation globally [19], with about 60% of the population considered food insecure [20]. The issue of food insecurity in Pakistan is linked to a continued increase in the human population, leading to climatic changes, deforestation, droughts, floods, etc. [21]. The Global Hunger Index (GHI) reveals widespread food security-related issues nationwide [22]. After COVID-19, due to the economic and political crisis, the prices of edible items increased by fifty percent. In NW Pakistani tribal regions, locals generally own a small piece of land where they cultivate various vegetables and crops; additionally, they primarily collect different WFPs while grazing animals.

Ethnobiologists have increasingly documented in the past three decades Traditional (or Local) Ecological Knowledge (TEK/LEK) and practices about the gathering and consumption of WFPs in different regions across the globe [23–27]. Some of these authors have explicitly underlined that WFPs could play a crucial role in rural development and the enhancement of food security [28–31]. At the same time, others (co-authoring this article) have also highlighted that a few WFPs could become future novel crops and, therefore, play a crucial role in areas influenced by food instabilities [1].

Despite wild edible plants being foraged and consumed differently across different regions, plant diversity and culture (ethnicity and religious affiliations) are essential variables affecting wild plant foraging and attached culinary processes and consumption ways. Modalities of these plant resources, primarily because of the cultural characteristics, have influenced the transmission of wild plant knowledge within single rural and often peripheral communities in a unique way [1,12,32,33].

Moreover, in recent years, several studies have focused on different wild vegetables and fruits collected and consumed in the rural and remote areas of Pakistan [15,16,20,30,32]; despite this, however, a few places, such as Lakki Marwat in southern Khyber Pakhtunkhwa Province (NW Pakistan), remain unexplored.

The Lakki Marwat region is famous for its century-old culture and customs. The local inhabitants are descendants of the Lohanis of the Lodhi Pashtun tribe, who also inhabit other parts of Khyber Pakhtunkhwa. Most of the Lakki Marwat local people are farmers growing crops during different seasons, and most of the district's territory is rainy or rainfed. The primary staple crops cultivated in the area are wheat, barley, maize, and mungbean [34]. Often, and increasingly in the past decade, insufficient rainfall occurs, leading to a scarcity of vegetables and crops, enhancing the custom of collecting various WFPs for consumption. However, the ongoing modernization and globalization processes also created a decline in the TEK linked to WFPs. The younger generation often prefers fast food over cultural foods, and they are frequently unaware of the exact WFP's identity and possible use.

Therefore, the current research focuses on the following objectives: (1) to document the traditional use, market value, and importance of WFPs in the local food system of the Marwat tribe living in the Lakki Marwat region of Khyber Pakhtunkhwa; (2) to compare the documented WFP usages with the those previously published in the food ethnobotanical literature of Pakistan; and (3) to disentangle and reflect (upon) those variables responsible for the change, modifications, and, ultimately, long-term evolution of foraging-centered LEK in the traditional food system of Lakki Marwat.

2. Materials and Methods

2.1. Study Area

Lakki Marwat is located in the southern part of Khyber Pakhtunkhwa Province, NW Pakistan. It is positioned at 32.161° north longitude and 70.191° east latitude with an elevation of about 200–300 m.a.s.l. The region is bounded by Isakhel in the east, Waziristan in the west, Bannu in the northwest and Karak in the north. Lakki Marwat has a totalò surface of 3164 Km^2 with about 12,000 hectares of cultivated land. The region has a unique landscape presenting hills on the periphery, while the central area remains predominantly flat (Figure 1). The Touchi and Kurram Rivers flow through the region, with the Kurram River being the longest, eventually merging with the Sindhu River south of Isakhel, The arable land is divided among the local people into small pieces of land that are used for cultivating various vegetables and crops [34].

Figure 1. Typical landscape of Lakki Marwat (photo credit: T.U.).

Lakki Marwat has a semi-arid climate with considerable seasonal variations. Summer, spanning seven months from April to October, is characterized by hot and dry breezes, and the temperature remains in the range of 35–48 °C. Winter lasts from November to February, with temperatures ranging from 4 °C to 27 °C. Storms commonly happen during May and June, while precipitation is generally low, ranging from 290–350 mm yearly, with an average humidity range of 24–30% [34].

Therefore, considering the dynamics of climate and weather during different seasons, the people of Lakki Marwat grow various crops in the region. In addition to rainfall, tube wells and canal water play a crucial role in shaping the agriculture of the study region. Many farmers cultivate various crops using traditional techniques, including cows and camels.

The cultural fabric of Lakki Marwat is deeply interwoven with the Pashtuns' cultural heritage, i.e., the Pashtunwali or Malmaista. Hospitality is an ancient cultural code of Pathans in general and Marwat people in particular that has shaped the community's social norms since time immemorial. They prepare and offer various cultural foods and especially sweets on different occasions. Moreover, Marwat culture is marked by donning cultural attire and footwear. Most people wear Amama (turban), an evolved form of Pagri used in other parts of the country. The Amama used in the Marwat region comprises many turns prepared of clothes that are a few meters long. It is impressively prominent; it keeps people safe from heatwaves in summer and warm winter. Lakki Marwat Pashtuns are also recognized by the unique sheets they drape over their shoulders.

2.2. Field Study and Data Collection

The current study was conducted in 24 villages in the Lakki Marwat District from August to September and October to November 2023 (Figure 2). Interviews were conducted

following the Code of Ethics of the International Society of Ethnobiology [35]. Participants were fully informed about the study's aims and that the results would finally be published in an academic journal. Prior oral informed consent was obtained from each study participant. Knowledgeable participants were selected through snowball sampling [36]. Eighty-seven informants were interviewed, including 20 female and 67 male community members. The characteristics of the sample are reported in Table 1.

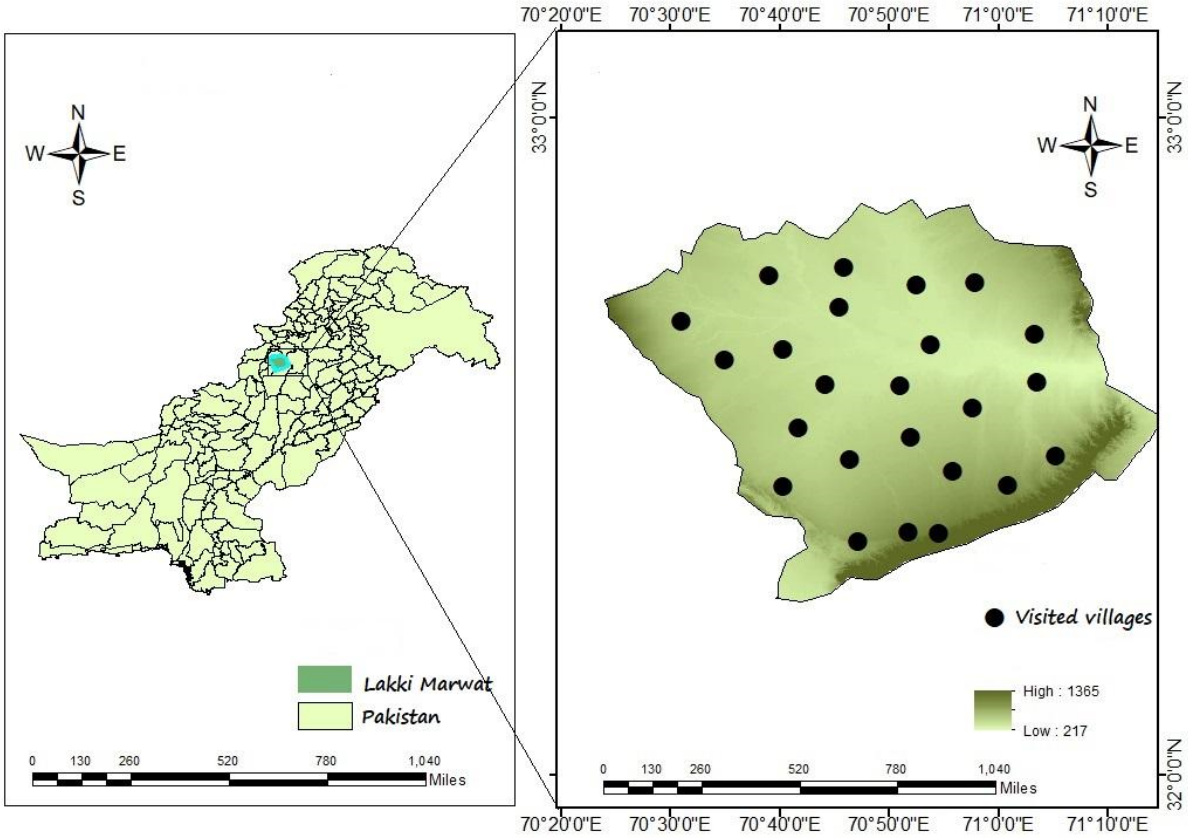

Figure 2. Study area.

Table 1. Age and education of the study participants.

Literacy/Educational Level		
	Number of Informants	**Percentage**
Illiterate	35	40.22
Primary school	20	22.98
Middle school	15	17.24
Secondary school	12	13.79
University	5	5.74
Age ranges		
	Number of informants	Percentage
21–30	9	10.34
31–40	20	22.98
41–50	25	28.73
51–60	15	17.24
61–70	12	13.79
71–80	6	6.89

The first author, who is native to the region, conducted the interviews in Pashto. Participants were asked about the local names, parts used, collection times, recipes, and possible market value of local WFP species they gathered in the past and are still gathering today.

The interviewees were also asked about their settlement, age, place of birth, and occupation.

All the data based on these interviews were tabulated. After interviewing 3–4 people in each village, a short field excursion with the interviewees was arranged to collect all available WFPs. Voucher specimens were deposited in the Herbarium of Pakistan, Quaid-i-Azam University, Islamabad, Pakistan.

The Flora of Pakistan was used to identify collected plant specimens [37], and then plant names were cross-checked against the WFO Plant List database [38].

2.3. Data Analysis

2.3.1. Cultural Saliency

Two indexes were calculated to determine the cultural saliency of the quoted WFPs: RCF and UR.

RFC (Relative Frequency of Citation) was calculated with this formula:

$$\text{RFC} = \frac{FC}{N} \ (0 < \text{RFC} < 1)$$

N = total number of informants questioned during the survey; FC = number of respondents citing a specific plant taxon.

The total number of use reports (URs) for each species is one of the most widely used metrics for researching the cultural significance of plants [39]. It is simply the sum of the reports for each species across informants.

2.3.2. Comparison with the Pakistani Food Ethnobotanical Literature

Additionally, documented plant uses were compared and discussed with previous food ethnobotanical studies conducted in NW Pakistan [2,7,15,16,20,30,32,40–52], and two similarity indexes were calculated: JI and QS. These indexes were employed to check the similarities and differences between our data and previously published studies in the surrounding regions.

The Jaccard's similarity index (JI%) was calculated by comparing the current data with previously published studies using the following formula [53]:

$$\text{JI} = c \times \frac{100}{a + b - c}$$

a = number of all species used in area A; b = number of all species used in area B; c = number of species used in areas A and B.

The Sorensen's similarity index (QS) was developed by botanist Thorvald Sorensen and published in 1948. The comparison with previously published data collected from different regions was performed by applying the formula [53]:

$$\text{QS} = \frac{2c}{a + b} \times 100$$

a = number of species used only in area A; b = number of species used only in area B; c = number of species used in areas A and B.

3. Results and Discussion

3.1. Traditional Lakki Marwat Food System and Wild Edible Plants

Lakki Marwat has a unique and centuries-old food system mainly based on WFPs, dairy products, cereals, and vegetable crops cultivated in their fields. Every family in

the study area uses rare animals (buffaloes, goats, cattle, or sheep) to fulfil their daily dairy requirement [34]. Although dairy products, cultivated crops, and vegetables form the backbone of the local cuisine, WFPs significantly contribute to this cuisine. WFPs are typically gathered while grazing the animals. Some of the traditional foods have a long history in the local food culture heritage, such as *duzaro dodai* (cornbread), *gungrai* (gruel made from boiled wheat, white or black peas, and corn), *painda* (spicy chicken stew with onions, tomatoes, and potatoes consumed on *chapati bread*), a myriad of simple sweet preparations (especially consumed during festivities, such us *dodhi halwa*, *cheghani samya*, *nikhri*, and *churry*); however, a crucial part of the local food heritage is represented by pan-fried, wild, leafy vegetables. Many of these foods are not limited to specific meals or specific times. The vast majority of the reported species in Table 2 is indigenous to the study area, however some species, such as *Beta vulgaris* subsp. *maritima* (L.) Thell., are exotic.

Table 2. Traditional food uses of local wild plants in the study area.

Botanical Name and Family	Voucher Code	Local Name(s)	Plant Habit (H: Herb; T: Tree)	Part Used	Local Culinary Uses	Market Availability	UR (Use Report)	RFC (Relative Frequency of Citation)
Allium griffithianum Boiss. Amaryllidaceae	133698	Pyaizokai	H	Whole plant	Salads	–	21	0.24
Amaranthus graecizans L. Amaranthaceae	133699	Khatakai	H	Leaves	Leaves are boiled in water and then pan-fried with onions and chilies, and eventually tomato paste is added	–	15	0.17
Amaranthus viridis L. Amaranthaceae	1336701	Tora ranjaka	H	Leaves	See *A. graecizans*	–	18	0.20
Atriplex tatarica L. Amaranthaceae	1336700	Shorakai	H	Leaves	See *A. graecizans*	+	20	0.22
Beta vulgaris subsp.maritima (L.) Thell. Amaranthaceae	1336702	Patawar	H	Leaves	See *A. graecizans*	+	45	0.51
Capparis decidua Edgew. Capparaceae	1336705	Keera	T	Fruits	Consumed raw	–	15	0.17
Caralluma tuberculata N.E.Br. Apocynaceae	1336704	Pamanai	H	Whole aerial parts	Cut into small pieces and marinated with salt for 30 min; then, it is cooked with tomatoes, onions, chilies, and coriander	+	23	0.26
Carthamus oxyacantha M.Bieb. Asteraceae	1336706	Kunjala	H	Leaves and fruits	Leaves: see *A. graecizans*; ripen fruits: consumed directly with jaggery			
Chenopodium album L. Amaranthaceae	1336708	Batoo	H	Leaves	See *A. graecizans*	–	37	0.42
Citrullus colocynthis (L.) Schrad. Cucurbitaceae	1336705	Marghun	H	Fruits	The epicarp is removed and the rest of the fruit is boiled with water and sugar to obtain a "medicinal" jam; unripe fruits are used pickled (*achar*)	+	22	0.25
Convolvulus arvensis L. Convolvulaceae	1336703	Perkhatla	H	Leaves	See *A. graecizans*	–	6	0.06

Table 2. *Cont.*

Botanical Name and Family	Voucher Code	Local Name(s)	Plant Habit (H: Herb; T: Tree)	Part Used	Local Culinary Uses	Market Availability	UR (Use Report)	RFC (Relative Frequency of Citation)
Cordia myxa L. Boraginaceae	1336707	Lasorra	T	Fruits	Consumed raw	–	23	0.26
Digera muricata Mart. Amaranthaceae	1336709	Ranjaka	H	Leaves	See *A. graecizans*; also cooked with pulses, potatoes, and rice	+	32	0.36
Eruca vesicaria (L.) Cav. Brassicaceae	1336710	Shursham/ Jamao	H	Leaves	Salads	+	25	0.28
Malva neglecta Wallr. Malvaceae	1336718	Kharenda	H	Leaves	See *A. graecizans*	–	23	0.26
Malva parviflora L. Malvaceae	1336711	Puchkai	H	Leaves	Cooked with onions and tomatoes	–	32	0.36
Medicago monantha (C.A.Mey) Trautv. Fabaceae	1336713	Toora kunda	H	Leaves	Cooked with onions and tomatoes	–	24	0.27
Medicago polymorpha L. Fabaceae	1336712	Kunda /Malkunda	H	Leaves	Cooked with onions and tomatoes or rice, potatoes, pulses, yoghurt, or beef	–	28	0.32
Melilotus indicus (L.) All. *Fabaceae*	1336717	Khosye bothye	H	Leaves	Cooked with onions and tomatoes	–	15	0.17
Mentha longifolia L. Lamiaceae	1336714	Welanai	H	Leaves	Seasoning: chutney, whey, rice custard, and other sweets	–	25	0.28
Morus alba L. Moraceae	1336715	Speen toot	T	Fruits	Consumed fresh	+	31	0.2
Morus nigra L. Moraceae	1336716	Toor toot	T	Fruits	Consumed fresh: juice, jams, and syrups	+	33	0.37
Nannorrhops ritchieana (Griff.) Aitch. Arecaceae	1336719	Mazarai	T	Fruits	Consumed fresh	–	18	0.2
Olea ferruginea Wall. ex Aitch. Oleaceae	1336721	Jhangli zaitoon	T	Fruits	Consumed fresh	–	8	0.09
Oxalis corniculata L. Oxalidaceae	1336720	Tarwakai	H	Leaves	Cooked with onions, chilies, tomatoes, and spinach leaves, or with rice, potatoes, and pulses	–	42	0.48
Phoenix sylvestris (L.) Roxb. Arecaceae	1336722	Kajor	T	Fruits	Consumed fresh	+	75	0.86
Plantago ovata Forssk. Plantaginaceae	1336725	Asphighol	H	Seeds	Mixed with water. The resulting suspension is drunk	–	6	0.06
Portulaca oleracea L. Portulacaceae	1336723	Warkharrai	H	Leaves	See *A. graecizans*	+	35	0.40
Punica granatum L. Punicaceae	1336724	Jangali anar	T	Fruits	Consumed fresh	–	10	0.11
Rumex dentatus L. Polygonaceae	1336726	Toorakai	H	Leaves	Cooked with onions and tomatoes	–	23	0.26
Silene conoidea L. Caryophyllaceae	1336728	Pathoseye	H	Fruits	Consumed raw	–	7	0.08

Table 2. *Cont.*

Botanical Name and Family	Voucher Code	Local Name(s)	Plant Habit (H: Herb; T: Tree)	Part Used	Local Culinary Uses	Market Availability	UR (Use Report)	RFC (Relative Frequency of Citation)
Sisymbrium irio L. Brassicaceae	1336727	Sago bothe	H	Leaves	Cooked with onions and tomatoes	–	11	0.12
Solanum nigrum L. Solanaceae	1336729	Kunsabai	H	Leaves and fruits	Consumed as fresh fruits only sporadically in a few places; most commonly, the leaves are boiled and then pan-fried with other ingredients		11	0.12
Trianthema portulacastrum L. Aizoaceae	1336730	Pandraosh	H	Leaves	Cooked with onions and tomatoes	–	15	0.17
Trifolium repens L. Fabaceae	1336731	Shaotala	H	Leaves	Cooked with onions and tomatoes	–	14	0.16
Vicia sativa L. Fabaceae	1336732	Matar	H	Fruits	Consumed raw	–	10	0.11
Ziziphus jujuba Mill. and *Z. oxyphylla* Edgew. Rhamnaceae	1336736	Bera	T	Fruits	Consumed raw	–		
Ziziphus mauritiana (Lam). Rhamnaceae	1336733	Kobli Bera	T	Fruits	See *Z. jujuba*	+	38	0.43
Ziziphus nummularia (Burm.f.) Wight & Arn. Rhamnaceae	1336734	Karkarrna	T	Fruits	See *Z. jujuba*	–	29	0.33
Zygophyllum indicum L. Zygophyllaceae	1336737	Splaghzai	H	Stems and leaves	Infusion	–	13	0.14

Table 2 reports the WFPs documented in the study area and their local, folk, culinary preparations.

3.2. WFP Consumption Categories and the Importance of Food Medicines

All WFPs were assigned to distinct food categories based on their consumption mode [13]. Plants were categorized into salads, cooked vegetables, fruits, beverages, and jams (Figure 3).

The predominant categories are represented by cooked (mostly pan-fried) wild, leafy vegetables and raw wild fruits; only a few taxa were used in salads or for other preparations (Figure 4).

During the field survey, locals quoted twenty WFPs used as pan-fried leafy vegetables; the most commonly used ones were *Medicago*, *Beta*, *Chenopodium*, *Oxalis*, *Amaranthus*, *Digera*, *Portulaca*, and *Caralluma* species (see Table 2 and Figure 3). *Digera muricata* is especially renowned in the study area and is consumed in large amounts, although its consumption is not crucial in other parts of Pakistan.

Some WFPs were often mentioned as culturally salient for their perceived food–medical properties: while *Eruca vesicaria* represents the most important plant species used in a salad (which is also believed to have blood purification potential), *Mentha longifolia* is used in sauces and is considered able "to cool" the stomach and improve digestive problems.

Moreover, two unusual food plants were recorded in this domain of the plant food–medicinal continuum: *Citrullus colocynthis* (used to prepare a specific sugar-free jam that is devoted explicitly to diabetic family members or those affected by stomach aches, especially if consumed before breakfast) and *Zygophyllum indicum*, used in infusions (adding a lot of sugar to overcome the bitter taste) as a blood purifier and for cancer prevention.

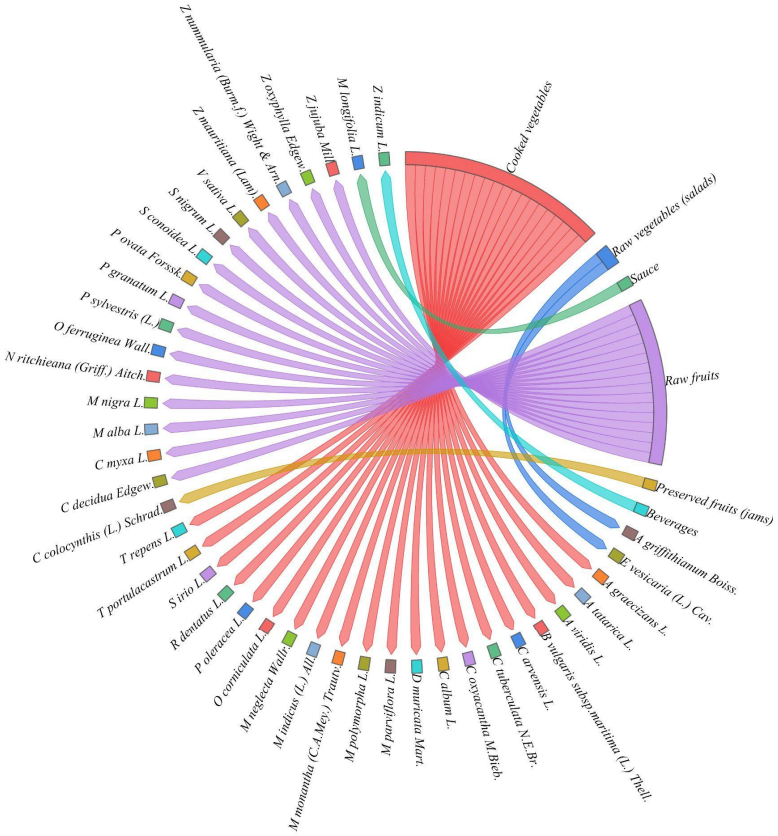

Figure 3. Chord diagram showing WFP consumption categories in the study area.

3.3. WFPs' Foraging Decline and Market Value

According to our study participants, climate change directly affects the availability of WFPs because locals observed a considerable shift in precipitation patterns, with shortages of water in the spring determining, in turn, a decrease in wild leafy vegetables. According to the study participants, there has been a remarkable increase in the human population and urbanization in the area, and many agricultural plots were converted into residential areas. Such changes in land use have led to changes in the accessibility to WFP foraging. We observed that, with urbanization and changes that occurred in the region in the past decades, there has been a decline in traditional knowledge about WFPs, where the younger generation tends to lack an awareness of specific WFPs and their traditional uses.

Nevertheless, some of the WFPs gathered are inextricably linked to shepherding activities, which are declining. Traditionally, shepherds collect WFPs when they bring their cows, goats, and sheep to plains and hills to graze and collect WFPs, which they use as food directly or indirectly.

According to a 79-year-old male study participant belonging to the Marwat tribe in Chandu Khel:

> *"When we go to graze our animals and feel hungry, we collect Ziziphus fruits and leaves Rumex and Eruca spp. and eat them as a snack; these make our body healthy and energised."*

We observed that a few WFPs are also sometimes sold in the local markets of Lakki Marwat (see Table 2). Among them, multiple varieties of *Phoenix dactylifera* are brought to the market from various territories of Lakki Marwat. A specific halwa (*khajoor halwa*) is prepared by mixing date paste (*Phoenix dactylifera*) with coconut powder. This product is highly economically important in the local market and is sold nationally in other Pakistani regions. *Digera muricata* is also widely available in local markets, and a considerable amount can be earned from selling this vegetable. We observed that WFP products in local markets

have lower prices than other cultivated species, which makes them more affordable to local people who are unable to forage.

Figure 4. Some popular wild, leafy vegetables in the study area: (**A**): leaves of *Eruca vesicaria*; (**B**): *Beta vulgaris* subsp. *maritima*; (**C**): *Oxalis corniculata*; (**D**): *Medicago polymorpha*. (photo credit: T.U.).

3.4. Comparison with Other Pakistani Food Ethnobotanical Studies

We compared our results with other food ethnobotanical studies previously conducted in Pakistan (Table 3).

Table 3. Comparison of the ethnobotany of wild food plants in our present study and other studies.

Name (Elevation Range m.a.s.l)	Code	LM	LMONLY	OTH	OTHONLY	COMM	JI%	QS%	References
Bajaur region, Hindu Kush Mountain Range, KP (600–2467)	BRHKMRKP	41	61	23	18	38	29	117	[20]
Swat Valley Northern Pakistan (600–6000)	SVNP	41	47	05	36	42	6	16	[46]
Bajaur, Near the Pak–Afghan Border, Pakistan (600–2467)	PBPABP	41	96	21	20	75	18	44	[54]

Table 3. *Cont.*

Name (Elevation Range m.a.s.l)	Code	LM	LMONLY	OTH	OTHONLY	COMM	JI%	QS%	References
Kurram District, Khyber Pakhtunkhwa, Northwest Pakistan (1200–4000)	KDKPNWP	41	55	15	26	40	18	45	[32]
Afghan Refugees Mansehra District, Pakistan (800–4500)	ARMDP	41	48	04	37	44	4	12	[7]
Ishkoman and Yasin Valleys, North Pakistan (1500–4100)	IYVNP	41	39	06	35	33	8	17	[43]
Lawat, District Neelum, Azad Jammu and Kashmir, Pakistan (1200–3600)	LDNAJKP	41	61	04	37	57	4	8	[55]
Noorpur Thal District Khushab, Punjab, Pakistan (200–400)	NTDKPP	41	63	11	30	52	11	26	[56]
Malam Jabba Valley, District Swat, Pakistan (2300–2840)	MJVDSP	41	187	8	33	179	3	7	[57]
Lesser Himalayas (Batagram, Mansehra, Haripur, and Abbottabad), Pakistan (800–2400)	LHBMHAP1	41	20	06	35	14	10	32	[45]
Lesser Himalayas (Batagram, Mansehra, Haripur, and Abbottabad), Pakistan (800–2400)	LHBMHAP1	41	35	11	30	24	16	40	[15]
Sibi District, Balochistan, Pakistan (100–1500)	SDBP	41	75	10	31	65	9	20	[51]
Gadoon Valley, NW Pakistan (800–1600)	GVNWP	41	51	14	27	37	17	43	[16]
Northwest Pakistan (800–4300)	NWP	41	25	06	35	19	10	22	[44]
Kohistan Upper Khyber Pakhtunkhwa (KP), Pakistan (600–4150)	KUKPP	41	64	12	29	52	12	29	[49]
Kasur District Semi-Arid Region of Punjab, Pakistan (150–300)	KDSARPP	41	71	20	21	51	21	55	[48]
Thakht-e-Sulaiman Hills, Northwest Pakistan (1000–3500)	TSHNWP	41	51	07	34	44	8	17	[30]

Table 3. *Cont.*

Name (Elevation Range m.a.s.l)	Code	LM	LMONLY	OTH	OTHONLY	COMM	JI%	QS%	References
District Harnai of Balochistan Province, Pakistan (1500–3500)	DHBPP	41	59	09	32	50	9	21	[47]

LM: total number of species quoted in the present study (Lakki Marwat); LMONLY: number of species used only in Lakki Marwat (in comparison with another area); OTH: total number of species used in the comparative area; OTHONLY: number of species used only in the comparative area; COMM: number of species used in Lakki Marwat and comparative area; JI%: Jaccard's similarity index; QS%: Sorenson's similarity index.

Three taxa, *Atriplex tatarica*, *Amaranthus graecizans*, and *Beta vulgaris* subsp. *Maritima*, seem to have been recorded for their food use in our study area but not in the other considered Pakistani regions. Moreover, the wild food ethnobotanies of other arid areas, such as Pashtun (Bajaur, Waziristan, and Kurram), have major overlaps with those of the current study [20,54].

Regions like Malam Jabba Valley (MJVDSP) and Bajaur near the Pak–Afghan Border (PBPABP) have high numbers of shared species (187 and 96, respectively). On the other hand, the Lesser Himalayas (LHBMHAP1) and Northwest Pakistan (NWP) show much lower numbers of shared species with Lakki Marwat (20 and 25 species, respectively). These similarities and differences are often the result of a complex interplay between similar ecologies/floras and cultural customs.

The high reported number of species appears in Malam Jabba Valley (MJVDSP with 179) is possibly due to distinct ecological characteristics or isolated ethnobotanical knowledge practices. Kasur District, the Semi-Arid Region of Punjab (KDSARPP), has a high JI% of 21%, showing a considerable ethnobotanical overlap with Lakki Marwat. This might be influenced by similar semi-arid environments. In contrast, Malam Jabba Valley (MJVDSP) has a very low JI% (3%), despite having a high number of shared species, which may be due to the extensive number of unique species in Malam Jabba compared to Lakki Marwat. Regions that are geographically close or have similar climates to Lakki Marwat, like Kasur District and North Waziristan, show stronger ethnobotanical similarities. This suggests that the environment plays a significant role in the availability and selection of wild food plants.

4. Conclusions

We record 41 wild food plant species as Lakki Marwat's wild plant food heritage. The most dominant WFP categories include cooked vegetables and raw wild fruits.

According to the current study, wild leafy vegetables, typically pan-fried in the study area, play a significant role in Lakki Marwat's local cuisine culture; however, according to our informants, in the current climate change scenario, the limited amount of rainfall and the resulting water shortage in the study area seem to decrease the availability of these wild food sources. Moreover, in the study area, the ancient practice foraging is decreasing among youngsters due to the introduction of fast food and modernization. This study witnessed the importance of wild plant food medicines, two of which have been rarely recorded in South-Asian literature: the jam of *Citrullus colocynthis* fruits, which is considered locally as an anti-diabetic, and the infusion of aerial parts of *Zygophyllum indicum* is another essential plant used as a beverage for blood purification and cancer treatment.

Additionally, eleven species (approx. one-fourth of the total) are locally marketed and are critical to fostering the domestic, small-scale household economy. Therefore, wild food plants play a crucial role in traditional communities living in Lakki Marwat. To learn more about the local natural resources and gastronomy of Lakki Marwat, further studies are mandatory to conserve this important cultural heritage, which is declining due to urbanization and modernization. The current research is vital for preserving wild food plants and their consumption and cooking techniques.

Our study provides a comprehensive analysis of WFPs in Lakki Marwat. Based on the current research, it is recommended that Marwat's gastronomy be further explored and investigated to bolster our understanding of its crucial role in fostering food security and sovereignty. Accurate data on how people forage and consume WFPs from the surrounding environment are needed to advance this research area.

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