Promising alternative wild phytofoods to mitigate the environmental aridity and food insecurity in Balochistan Province, NW Pakistan: A cross - cultural approach

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Research

Abstract

Background: The current paper elaborates the wild edible plants (WFPs) diversity, associated folk knowledge and cross-cultural comparison of three ethnic groups of the Balochistan Province, Pakistan.

Methods: The field trips were carried out in spring 2018 to winter 2020 employing purposive sampling techniques for respondents. We used semi-structured interviews with open ended questions. A total of 195 interviews yielded 140 plant species in 44 families and 105 genera.

Results: Family Brassicaceae (10.17%) showed maximum representation with Asteraceae (10%), and Apiaceae (6.42%). Eight used categories i.e. eaten fresh (47 spp. 33.57%), as cooked vegetable (46 spp., 32.85%), vegetable and salad (15 spp, 10.71%), salad (14 spp, 10%), beverages only (8 spp, 5.71%), and flavor (7 spp, 5%) were found based on consumption. Among used parts, leaves (54 spp., 38.57%) were the most used part followed by fruits (44 spp, 31.42%), tubers (13, 9.28%), bulb (11, 7.8% species), whole plant (8, 5.7%), flowers (4, 2.8%), seeds (4, 2.8), shoots (3, 2.14) young stem (2, 1.42). Seventy-five (75) species (53.57%) were cited for commonly by all tribes while the rest 65 (46.42%) differently. Pashtuns hold comparatively significant traditional knowledge and exclusively utilized 44 (31.42%) plant species. Similarly, the Pushtoons

and Balochis were sharing 13 (9.28%) plant species. Jaccard index (JI) discovered that 92 plant species have never been reported from the province before for example *Ferula costata*, *F. oopoda*, *Ferula assa-foetida*, *Allium zhobicum*, *Asphodelus tenuifolius*, and *Menoicus linifolius* etc.

Conclusion: Effect of age, gender and different inter-cultural folk heterogeneity observed profound impact on overall knowledge volume. Several geo-climatic changes and anthropo-zoogenic factors are causing the fragmentation of existing knowledge. The promotion of these wild edible plants (WFPs) as crops would underpin the food sustainability and socioeconomic development in the current scenario of food insecurity.

Key words: food ethnobotany; cross-cultural heritage; arid land; food security; wild edibles

Background

Pakistan displays 80% of its total area as arid, semi-arid and hyper arid comprising the deserts of Punjab, Sindh and Balochistan Provinces (Baig & Al-Subaiee 2009). Balochistan (60° - 70°E and 24°.0 - 32°.0 N) is the largest and least populated of four Pakistan's provinces displaying maximum arid landforms. It covers an area of 347190 Km2 i.e. 44% of the country's north-western terrains in the altitudinal range of 1500 to 3578 above sea level. Topographically, ethnically, culturally and biologically, it is regarded as rich province (Ahmed 2020, Naz *et al.* 2020). Generally, the vegetation cover is scanty. The coastal areas populated by halophytes and mangrove species. The plain desert areas are inhabited by thermo- and xerophytic species. The elevated terrains display forest stands of olive, Juniper forest stands. More than 1200 species to be occur in the province (Saqib *et al.* 2025). Considerable literature found on the subject of ethnobotany mainly addressing the medicinal plants (Shah *et al.* 2006, Qiasrani *et al.* 2021).

Astonishingly, the province has been subjected to hostile social conditions, political instability, tribal culture and feudalism for decades (Harrison 1978, Khetran 2011, Naz *et al.* 2020, Shah & Khan 2022, Tabassum & Bhatti 2020) etc. Moreover, annual flood, drought hits, mining activities, climate change and population expansion pushing the region towards distinctive ecological and social deterioration. Currently, Balochistan is enduring rapid and extensive urbanization due to CPEC (Pak-China Economic Corridor) efforts. This mega project is believed to be a game changer project for the provincial development but its profound geo-climatic impacts cannot be neglected (Khetran & Saeed 2017). These latent factors may prone to ecosystem disability of deserts, mountains, excessive land use, and extraction of vegetation and habitat destruction leading biodiversity loss. As a result, regional developmental efforts have caused large scale social turbulence, outmigration, mass displacement and ecosystem imbalances leading the declining, fragmentation and dispersion of plant based folk knowledge. Socio-economically, Balochistan presents a typically dominated agro-pastoral human communities as the 93% of the province is rangeland. They are distant from main urban centers and limited farming; animal husbandry and biological resources are their common subsistence. Wild food plants (WFPs) have played a central role in their food systems as "functional foods" due to their availability, easy access, nutritional and medicinal value (Abdullah *et al.* 2021, Basra *et al.* 2018).

The importance of wild food plants in the social livelihood of marginalized communities, poverty reduction, nutritional balance, food security, and agricultural diversification of remote traditional communities has been addressed in several studies (Daniel & Shimane 2011, Khruomo & Deb 2018, Kidane & Kejela 2021, Sundriyal and Sundriyal, 2001). Although botanical literature addressing floristic diversity, medicinal plants, phytosociology (Ahmed *et al.* 2020, Anjum *et al.* 2020, HAQ *et al.* 2021, Imran *et al.* 2013, Shah *et al.* 2006, Tareen *et al.* 2010, Zaidi & Crow 2005). The studies based on wild food plants are scarce. These circumstances made the studies urgent on regional biological diversity and conservation. We hypothesized that the province with ample remote human populations characterized with poor socio-economics and agro-pastoralism possesses substantial folk knowledge of wild plant species in their food chain for survival. The present study has been conducted with three objectives 1) to record the folk knowledge about WFPs 2) to document the WFPs along with their taxonomic and folk nomenclature 2) to present a cross-cultural comparison of three ethnic groups of Balochi, Birohi and Pushtoon.

Materials and Methods

Study area

Balochistan (30.12 N; 67.01 E) is the largest, least populated and underprivileged province of Pakistan dominated with mountainous and arid desert terrains (Khawaja & Xinhai 2013, Mushtaq & Mirza 2022). It is bounded in the west by Iran, in the east by Punjab and Sindh (provinces of Pakistan), in the south by Arabian Sea and in the north by Afghanistan as shown in Figure 1. The province hosts 12.34 million total population (Ahmad 2005, Ahmed 2019) comprising 52% Baloch and 36%

Pashtuns and 12% collectively Birohis, Hazaras, Sindhis, Punjabis, Uzbeks, and Turkmens (Ahmed & Khan 2020, Raj 2022). Balochistan has long history rooted back in the Stone Age (Khan 2002) and recent archaeological research at Mehrgarh has discovered 9000 years old interesting human civilization (Gupta *et al.* 2006, Jarrige *et al.* 2013). In the old days, Balochistan also remained crossroad and ruling land of the world-famous conquerors and warriors such as Alexander (325 B. C.), Selecus Nicator, Graeco-Bactrians), Macedonians, Arabs, Ghaznavies, Mangols and Mughals. In 712, Muslim started to rule Balochistan and continued till 1838. British took the ruling reign of the region in 1839 in some territories. After 1947 partition, the princely states of Mekran, Kharan, Lasbela and Kalat state acceded to Pakistan 1947. In 1955, Balochistan was merged into one unit of West Pakistan and emerged as one of the four new provinces of Pakistan (Khan 2012, Majeed 2015). Topographically, it exhibits variety of physical features covering 80% area by mountainous, 15% inter-mountainous flood plains and deserts and 5% coastal plains. It exhibits five physiographic zones i.e. upper and lower highlands; plains, and deserts (Abbas *et al.* 2018, Rafiq *et al.* 2022). Mountain ranges of Koh-e-Sulaiman, Tobak Kakari, Murdar, Zarghoon, Takatu, and Chiltan are also found. Rivers such as Zhob, Nari, Bolan, Pishin, Lora, Mula, Hub, Porali, Hingol, Rakshan and Dash are the main water courses. The coastline stretches for about 760 kilometers, with several peninsulas and promontories with desolated sea ports. Major part of the province is mountainous and dry presenting only 5% arable lands characterized with arid and semi-arid environmental conditions (Abbas *et al.* 2018, Ashraf & Routray 2015). It serves as the reservoir of raw materials for national industries across the country such as iron, copper, gold, silver, lead, zinc, barite, chromite, coal, gypsum, limestone (marble), silica sand and many more (Akhtar *et al.* 2021, Malkani 2012, Malkani *et al.* 2017). Generally, the climate is arid and semi to hyper arid but changes with respect to topographic features (Qaisrani *et al.* 2021). Mainly the winter is very cold and characterized with scanty snowfall and temperature falls below -1C. Summer is hot and dry particularly the plains' temperature goes up to 50°C. Precipitation pattern is unpredictable receiving average rainfall ranges from 30 to 300 mm (Ahmed *et al.* 2016) shaping diverse ecological systems, habitat variability, species richness. Floristically, it falls in the Irano-Turanian region which contributes more 45% plant taxa in the Flora of Pakistan. Mangroves, scrub forest, sub-tropical, desert and riverine forest are the main regional vegetation formation. Greek Juniper (Juniperus excelsa) and Chilgoza Pine (Pinus gerardiana) are the principal forest trees (Qutab-ud-Din *et al.* 1989, Sultani *et al.* 1993). However, the juniper forest is the world's oldest woods and declared as Biosphere reserve in 2013 by Pakistani Government.

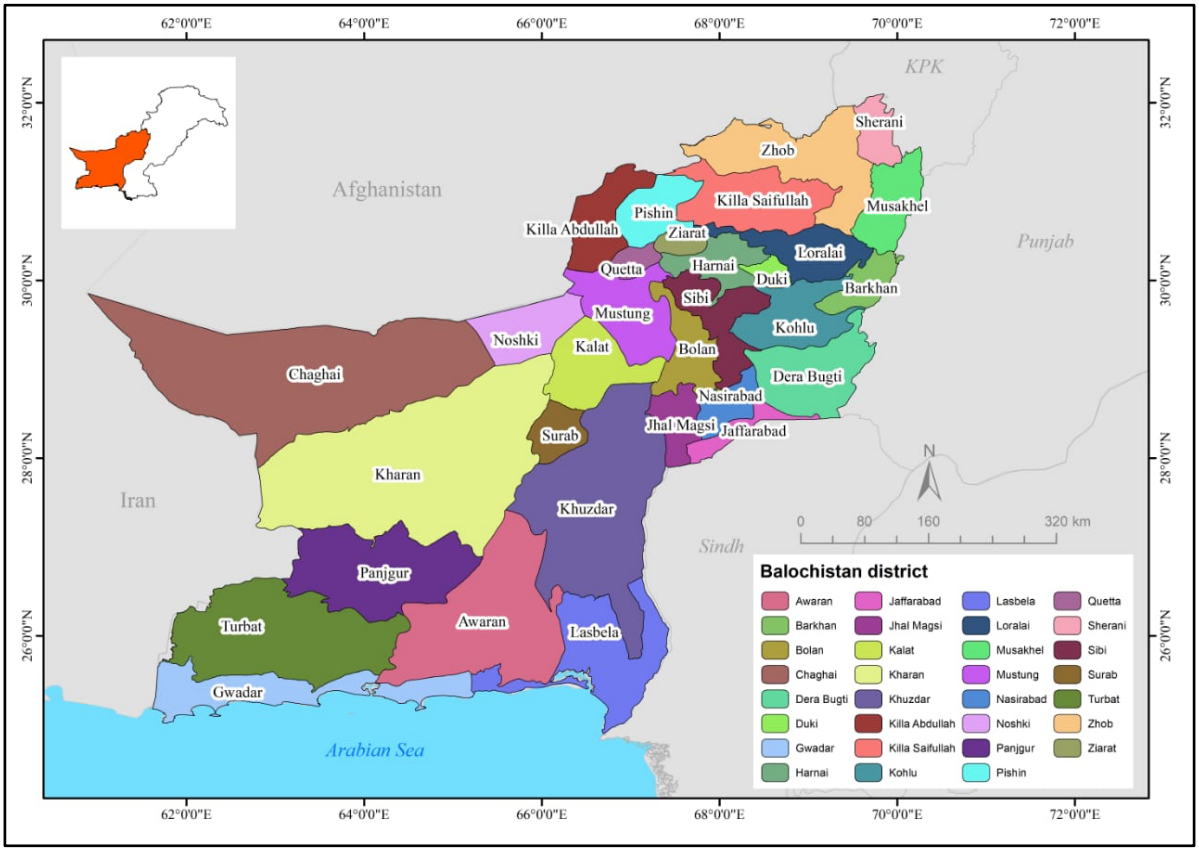

Figure 1. The map of the Balochistan Province showing surveyed localities.

Data collection

The field surveys were conducted consecutively for three years from spring 2018 to winter 2020. Purposive sampling techniques (Tongco 2007) were used and participants engaged with farming, pastoralism, ethnobotanical plant collection and horticulture. Informed consent from all participants was verbally obtained prior to conducting interviews and ethical guidelines prescribed by the International Society of Ethnobiology (ISE, 2008) were followed. During the course of survey, in-depth semi-structured interviews (Abbas *et al.* 2021) were conducted with 195 selected villagers (100 Pushtoons, 50 Balochis and 45 Birohis). Communication was made in houses, markets, village gathering areas and pasture lands.

Mostly, the conversations were made in Pushtoo by authors (2, 4, and 5) but used Urdu language as *Lingua Franca* with Balochi and Birohi people. The participants were ranged in ages from 20 to 80 years with 50 average ages. Respondents were asked about local name(s), gathering areas, the plant part(s) used, preparations recipes and marketing details. Respondents were asked to show the plant materials (fresh or dried), whenever available. The plants were photographed, collected in the field and identified by local guides. The taxonomic nomenclature was based on Flora of Pakistan (Nasir, and Ali, 1970-1989; Ali, and Nasir, 1990-1991; Ali, and Qaiser, 1993-2018). Botanical nomenclature was cross checked using World Online Flora http://www.worldfloraonline.org/. The identified specimens were given voucher numbers, labeled, stamped and stored in Karachi University Herbarium Karachi, Pakistan.

Data analysis

Relative Frequency of Citations

The tool was used to set up the priority order among the listed plants. The RFCs was estimated by using the following equation (Vitalini *et al.* 2013). This indicates a comparative importance of a particular species in a given community.

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

Where

FC is the number of respondents that stated that particular plant species

N is the total number of respondents in whole study

A comparison of the ethnobotanical data among the considered linguistic groups was carried out by Jaccard Similarity Index (for each pair of the considered communities) (Abdul Aziz *et al.* 2020), used for gauging the similarity and diversity of sample sets, following the application designed by (González-Tejero *et al.* 2008).

The Jaccard similarity index was calculated as follows:

$$J(X, Y) = |X\backslash Y|/|\ X\ [Y|;$$

X = Individual set of plant uses recorded among group X;

Y = individual set of plant uses recorded among group Y.

Furthermore, the collected data were qualitatively compared with the existing Pakistani food ethnobotanical literature (Abdul Aziz *et al.* 2020) in order to identify possible novel plant uses

Results

Respondents' demography

A total 195 (150 men, 65 women) indigenous people were interviewed comprising 100 Pushtoons, 50 Balochis and 45 Birohis. Based on social subsistence they were comprised of peasant (45%), farmers (23%), shepherds (42%), wood cutters (10%), and gems miners (3%) and traditional healers (30%). Fifty-five (28%) people were above 60 years followed 45 (23%) (between 40 and 60) and 30 (15%) (Between 20 and 40). The respondents were from Pushtoon, Balochi and Birohi ethnicity as depicted in Table 1. All participants were Muslims. Small Christian and Hindu communities also reside in urban areas of the province.

Taxonomic and habit diversity of WFPs

The present study came up with the inventory of 140 wild edible plant taxa in 44 families and 105 genera. The families showed maximum presentation were Brassicaceae (15 species) followed Asteraceae (14 species), Apiaceae and Liliaceae (9 species each); Lamiaceae (8 species), and Rhamnaceae, Rosaceae and Polygonaceae (6 species each) and percentage of WFPs against region diversity are given in Table 2. The visualization of plant collection and identification is given in Figure 2. The habit of

recorded species was annual herbs (68 species) the most utilized group followed by shrubs (38), perennial herbs (22) and trees (10) are shown in Figure 3.

Table 1. Demographic features of participants.

Variables		Pushtoon	Balochi	Barahvi
Sex ratio	Men	70	30	30
	Women	30	20	15
Religion (faith)	Muslim (Sunni)	Muslim (Sunni)	Muslim (Sunni)	Muslim (Sunni)
Age	Between 20 - 40 years	30	25	22
	Between 40 - 60 years	45	50	55
	Between 60 - 80 years	55	65	70
Education Level	Illiterate	68	70	70
	Primary	35	30	28
	Middle	15	10	9
	High School	5	4	4
	Graduate	3	2	2
	Masters	2	2	2
	Above master	2	1	1
Livelihoods	Farmers	45	30	40
	Shepherds	42	55	45
	Wood cutters	10	5	6
	Gemstone workers	3	2	2
	Healers	30	20	25

Figure 2. Plant collection and identification in the field (author 1 and 2).

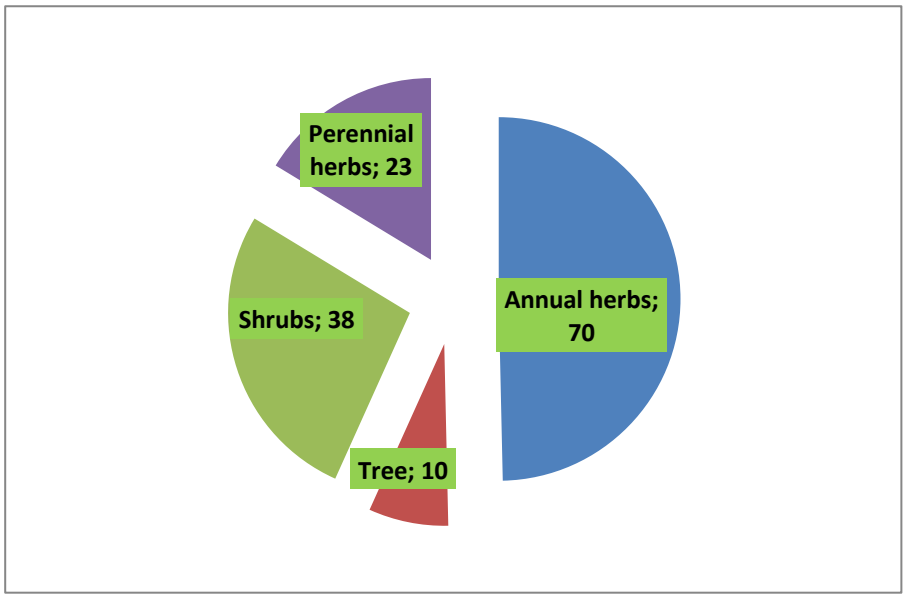

Figure 3. Habit diversity of locally using food plants.

Table 2. Presentation of families in wild edible plants of the region.

Family	No. of species	Total No. of species	%	Family	No. of species	Total No. of species	%
Aizoaceae	1	140	0.714	Nyctaginaceae	1	140	0.71
Amaranthaceae	2	140	1.428	Oleaceae	1	140	0.714
Amaryllidaceae	8	140	5.714	Oxalidaceae	1	140	0.714
Anacardiaceae	3	140	2.142	Pinaceae	1	140	0.714
Apiaceae	9	140	6.428	Plantaginaceae	1	140	0.7142
Arecaceae	1	140	0.714	Poaceae	2	140	1.4285
Asclepiadaceae	2	140	1.428	Polygonaceae	6	140	4.285
Asphodelaceae	1	140	0.714	Portulacaceae	1	140	0.714
Asteraceae	14	140	10	Lythraceae	1	140	0.714
Boraginaceous	2	140	1.428	Rhamnaceae	6	140	4.285
Brassicaceae	15	140	10.714	Rosaceae	6	140	4.285
Capparaceae	2	140	1.428	Salvodoraceae	1	140	0.714
Caprifoliaceae	1	140	0.714	Sapotaceae	1	140	0.7142
Caryophyllaceae	2	140	1.428	Solanaceae	5	140	3.571
Chenopodiaceae	3	140	2.1428	Tiliaceae	1	140	0.714
Convolvulaceae	1	140	0.714	Typhaceae	1	140	0.714
Cucurbitaceae	2	140	1.428	Ulmaceae	1	140	0.714
Ephedraceae	3	140	2.142	Valerianaceae	1	140	0.714
Fabaceae	4	140	2.857	Vitaceae	1	140	0.7142
Geraniaceae	1	140	0.714	-	-	-	-
Grossulariaceae	1	140	0.714	-	-	-	-
Lamiaceae	8	140	5.714	-	-	-	-
Leonticaceae	1	140	0.714	-	-	-	-
Liliaceae	9	140	6.428	-	-	-	-
Menispermaceae	1	140	0.714	-	-	-	-
Moraceae	3	140	2.142	-	-	-	-

Gathering habitats, used categories and recipes

All species were found to be restricted to the particular habitat types. The wild food plant species were gathered from variety of habitats mostly from dry mountain slopes (63 species, 45.7%). The other habitat types like plains areas contributed 30 species, cultivated lands 35 species, wetlands 6 species, rocky slopes 3 species, and 3 species as weed. Some diverse habitats

are shown in Figure 4. The use pattern was classified eight (8) used categories are given in Figure 5. i.e. beverages (8 species), beverages and flavor (1 species), edible fresh (47 species), flavor (7 species), salad (14 species), vegetable (46 species), vegetable and flavor (2 species), vegetable and salad (15 species). The wild edible species were consumed in many ways depending on taste and preference. Several recipes were practiced to for wild vegetables cooking. A large number of leafy vegetables including *Sonchus oleraceus, Cucumis prophetarum, Goldbachia pendula, Polygonum polycnemoides, Lepidium draba, Chenopodium album, Polygonum aviculare, Portulaca oleracea, Erodium cicutarium, Silene Conoidea, Rumex chalepensis, Trigonella foenum-graceum, Descurainia sophia, Sisymbrium altissimum, Lactuca orientalis, Rumex vesicarius, Chenopodium foliosum , Strigosella cabulica* are boiled in water until full vaporization. The materials then fried onion, garlic, tomatoes, green chilies, coriander and cumin depending on their availability. *Ferula oopoda* fresh stem, *Mentha royleana*, fresh leaves and green twigs of *Ferula assa-foetida* are collected roasted and serve as salad. *Allium rubellum, Peucedanum beluchistanicum* and *Peucedanum ferulaefolium* also used in salads. Bulbs of *Fritillaria gibbosa* locally known as *Gagra*, and *Gagea aquettica*, *Gagea Balochistanica* and *Gagea persica* known as Anjuri in Pushto are dug out and used as salad also cooked with vegetables. Many wild plants are used in making beverages *Lallemantia royleana, Thymus linearis, Hymenocrater sessilifolius.* For instance, in summer season *Plantago amplexicaulis* plant is cut into pieces and soaked in cold water for few minutes then taken as drink. *Hymenocrater sessilifolius* leaves are soaked in water over night and the infusion utilize as morning drink. Fresh as well as dried leaves of *Thymus linearis* used in flavoring food and making Qehwa (boiled drink) without milk. Crushed seeds of *Ziziphora tenior, Lallemantia royleana* and leaves are also used in drinks. The fresh fruits of *Cucumis prophetarum* cut into pieces and cooked with onion and tomatoes. Seeds/grain of *Panicum antidotale* ground and used in making bread. In most of the cases it is reported that fresh fruits are directly eaten but *Cordia ghraf* and *Capparis spinosa* cooked fruits are eaten with curd, fruits are also used in making pickle. Fruits *Solanum incanum* and *Withania coagulans* used in making cheese. *Punica granatum* Fruits are dried ground into powder and used as salt. A local sweet dish *Pusa* made by grinding *Pistacia atlantica* fruits with sugar and eaten it with breads.

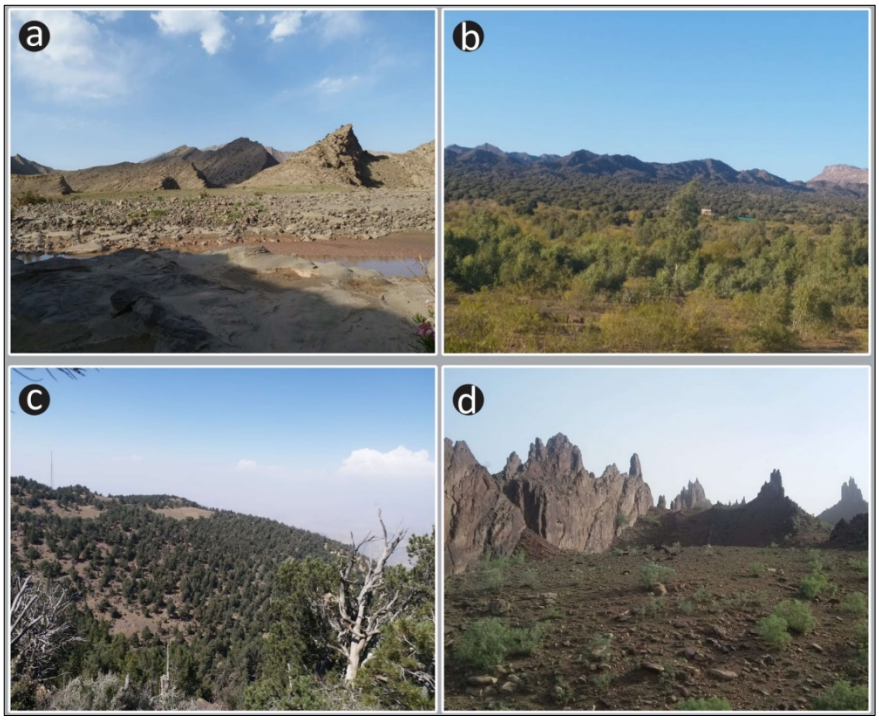

Figure 4. Views of WEPs gathering habitats in the Province.

Used part(s) and marketing of WFPs

The inhabitants of Balochistan province were using 12 different plant parts in their wild edible plants. All the wild vegetables are mainly consumed in young growing stages. Mostly the green leaves or aerial parts of the plant are used. Leaves (54 species) and fruits (44 species) were the frequent using plant part. The utilization of other parts was revealed as tubers (13 species), bulb (11 species), whole plant (8 species), flowers (4 species), seeds (4 species), shoots (3species), young stem (2 species), petiole (1 species), twig (1 species) and inflorescence (1 species). The studied communities were selling only 33 (23.57 %) species of WFPs in the local markets with prizes ranging from 50 to 800 rupees. The major remaining portion 107 (77%) species were in traditional food practices.

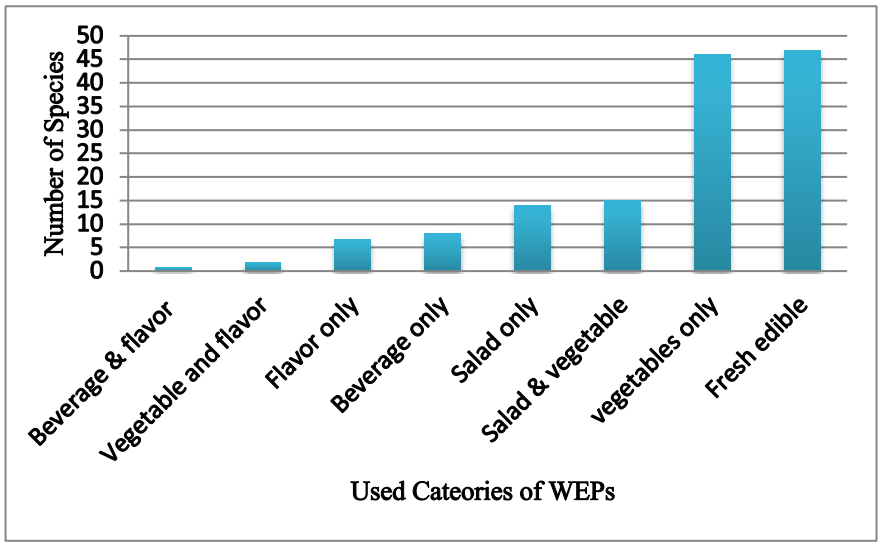

Figure 5. Used categories of wild food plant.

Figure 6. Local dishes a) Pusa; a traditional sweet dish of *Pistacia atlantica* & *Pistacia khinjuk* b) Pakhare Tarkari local dish of *Portulaca oleraceae* c) Chapati (local bread type) and d) Stone grinder.

Cross-cultural comparison – folk nomenclature

The recorded WFPs for local naming for commonness in local nomenclature revealed that the Balochis and Birohis used similar names for nineteen (19) plants. The region is characterized mostly with bilingual society and inter-cast marriages among the aforesaid ethnic groups. Some representatives with similar local names in Balochi and Birohi languages are *Mentha royleana* (local name **Purchinak**), *Lathyrus aphaca* (**Rewari**), *Ixiolirion tataricum* (**Bulah**), *Sisymbrium irio* (**Roosh**), *Sisymbrium brassiciforme* (Shuvaran), *Ziziphus nummularia* (Pins) and *Ziziphus spina-christi* (Konar), *Capparis decidua* (**Kaled**), *Allium umbilicatum* (**Pimalako**), *Perovskia atriplicifolia* (**Pimalako**), *Strigosella cabulica* (Ochrikawa), *Diplotaxis griffithii* (Janbo), *Typha domingensis* (Kull), *Eremurus stenophyllus* (**Sarshako**), *Ferula costata* and *Ferula assa-foetida* (both are *reffered* as **Hing**), *Tulipa lehmanniana* and *Tulipa stellate* (Govarikh, Saidandan). The Pushtoon and Brahvi used same local name for 2 plants only i.e. **Wahu** for *Zaleya pentandra and* **Roosh** for *Sisymbrium altissimum*. Similarly, Pushtoon and Balochi both name **Tagha** for *Celtis australis* and Balochi, Brahvi and Pushtoon only use similar name for *Valerianella oxyrrhyncha* as **Charpuk**. This strengthens the historical and cultural nexus with Balochis and Birohis. Furthermore, the Pushtoons showed many differences in local naming of plants with both Balochis and Birohis. Some collections of WFPs are shown in Figure 7.

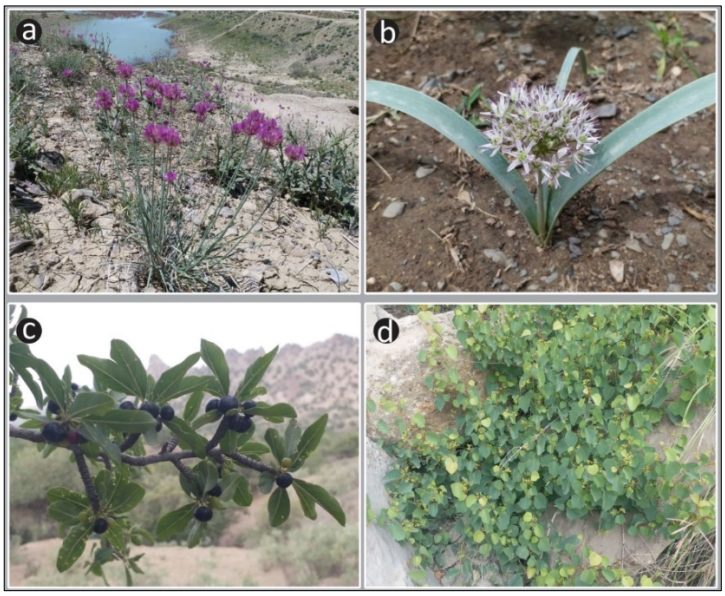

Figure 7. Representatives of WEPs a) *Allium dolichostylum* b) *Allium zhobicum* c) Rhamnus *pentapomica* and d) *Ampelopsis vitifolia*

Comparative selection of WFPs

Comparative assessment for utilization based on three ethnic communities revealed that the Pushtoon community comparatively holds considerable knowledge about WFPs. They utilized 44 (31.42%) plant species out of 140 species. Pushtoon retain wild food plants knowledge as compare to Balochis and Birohis. The Balochi and Birohi groups, on the other hand, have limited selectiveness, employing only two species each. The species of collective utilization of all three communities were 75 (53.57%) in number. Similarly, the Pushtoons and Balochis shared 13 (9.28%), Pushtoon and Birohi, (2 species) and Balochi and Birohi (2 species) are shown in Figure 8.

Quantitative analysis

The documented WFPs were quantitatively analyzed with RFCs to know cultural importance of the recorded species. The RFCs value ranges from 0.30 to 0.01. *Portulaca oleracea*, *Amaranthus viridis Allium umbilicatum*, *Pinus gerardiana* and *Asphodelus tenuifolius* scored high RFC values i.e. 0.30, 0.25, 0.25, 0.17 and 0.15 respectively. The consumption of wild edible plant species was based on five factors: hunger due to paucity of food, spicing staple foods, cultural preservation, therapeutic benefit, and market worth. It is further noted that the herbs are the most important source of wild food (RFC =) while grass are the least (RFC =). Edible species each. The four plant species with the highest RFC were *Portulaca* Oleaceae, *Amaranthus viridis*, *Allium umbilicatum*, *Pinus gerardiana* and *Ximenia americana*. The literature review for all cited plant species discovered that 88% of the reported species have not been report from any parts of Pakistan. The rest 22% of species were already reported as WFPs from different parts of the country for different food uses. The mostly documented species were *Rumex dentatus*, *Chenopodium album*, *Oxalis corniculata*, *Silene conoidea* and *Celtis australis*. The comparison of indigenous knowledge on food plants is helpful to determine the difference between region arising due to ecological (Ladio *et al.* 2007), historical (Meorman 1998) and organoleptic differences. Jaccard index (JI) is a quantitative index used to compare the ethnobotanical data with previous reports, specifically from adjoining areas are given in Table 3. In this study, the data was compared with 37 previously published articles of Pakistan. The similarity percentage with allied areas ranges from 0.51-8.56. The highest JI value (8.56) was with data reported previous from Hindu Kush Mountain Range, KPK. The lowest JI value (0.51) was with data reported previous from Tehsil Timergara, District Dir of KPK. JI values with data reported previous from District Killa Abdullah and Mahal Kohistan of Province Balochistan were very less, because the previous research work in the areas of Balochistan was not specifically on the edible plants which affected the cross-comparison analysis which was mainly with edible plants. While the reason of higher JI similarity with data of Hindu Kush Mountain Range, KPK was the research work which was only on edible plants. From this analysis we can conclude that different factors including cross-marriages, subsistence earning ways, religious believes, social interactions and migration also affect the food consumption within the communities of different provinces. Comparative analysis of present findings with reported literature revealed 92 new plant species, which have rarely been documented so far in the Pakistan. Among these new reports *Ferula costata, F. oopoda, Ferula assa-foetida, Allium zhobicum, Asphodelus tenuifolius, Sonchus oleraceus, Menoicus linifolius Capparis decidua* were mostly reported species from the region Table 4. Consequently, documenting and comparing intensity of knowledge among

local communities, which can provide a novel source of food plants consumption and indicates the high degree of ethnobotanical novelty in the study area. The complete account of reported plants is given in Table 5.

Table 3. Similarity of wild food plants used in the study area with neighboring areas expressed as Jaccard Index.

Author citation	**Study Area**	**Province**	**Total reported plant species=b**	**Total species common in both areas=c**	**c*100**	**a+b**	**(a+b)-c**	**JI**
Ahmad *et al.* 2012	Cholistan Desert	Punjab	90	8	800	230	222	3.60
Iqbal *et al.* 2021	Head Maralla	Punjab	119	8	800	259	251	3.19
Majeed *et al.* 2021	District Jhelum	Punjab	77	14	1400	217	203	6.90
Qureshi *et al.* 2007	District Mianwali	Punjab	26	3	300	166	163	1.84
Shah *et al.* 2020	Central Punjab	Punjab	27	8	800	167	159	5.03
Shaheen *et al.* 2020	Lahore	Punjab	5	4	400	145	141	2.84
Zareen *et al.* 2013	Central Punjab	Punjab	102	3	300	242	239	1.26
Awan *et al.* 2013	Mountainous region	Gilgit Baltistan	49	2	200	189	187	1.07
sAbdullah & Khan 2020	Tribal belt	Pak Afghan Border	63	14	1400	203	189	7.41
Jan *et al.* 2016	District Killa Abdullah	Balochistan	35	3	300	175	172	1.74
Panhwar & Abro 2007	Mahal Kohistan	Sindh & Balochistan	50	6	600	190	184	3.26
Mirani *et al.* 2016	Lower Sindh	Sindh	1	1	100	141	140	0.71
Hamayun	District Buner	KPK	94	5	500	234	229	2.18
Abbas *et al.* 2020	Kurram District	KPK	55	14	1400	195	181	7.73
Abdullah *et al.* 2021	Hindu Kush Mountain Range	KPK	63	16	1600	203	187	8.56
Ibrar *et al.* 2007	Ranyal Hills, District Shangla	KPK	97	6	600	237	231	2.60
Afzal *et al.* 2009	Northren Pakistan	KPK	85	3	300	225	222	1.35
Ahmad *et al.* 2011	Tehsil Kabal, District Swat	KPK	140	14	1400	280	266	5.26
Ahmad *et al.* 2016	Takht-e-Sulaiman Hills	KPK	51	14	1400	191	177	7.91
Ahmad *et al.* 2019	North west Pakistan	KPK	25	4	400	165	161	2.48
Ali *et al.* 2018	Swat Valley	KPK	100	8	800	240	232	3.45
Aziz *et al.* 2020	Chitral	KPK	55	9	900	195	186	4.84
Gulzar *et al.* 2019	District Malakand	KPK	50	4	400	190	186	2.15
Jan *et al.* 2011	Dir Kohastan Valleys	KPK	65	3	300	205	202	1.49
Khan & Musaraf 2014	Sheikh Maltoon, District Mardan	KPK	92	3	300	232	229	1.31

Khan *et al.* 2003	Gokand Valley, District Buner	KPK	138	11	1100	278	267	4.12
Khan *et al.* 2015	Tehsil Charbagh, District Swat	KPK	122	7	700	262	255	2.75
Khan *et al.* 2018	District Charsadda	KPK	40	6	600	180	174	3.45
Marwat *et al.* 2011	D.I. Khan	KPK	11	4	400	151	147	2.72
Murad *et al.* 2013	Banda Daud Shah, District Karak	KPK	58	3	300	198	195	1.54
Nasrullah *et al.* 2012	Jandool Valley, Dir Lower	KPK	67	6	600	207	201	2.99
Naveed *et al.* 2018	District Swabi	KPK	104	4	400	244	240	1.67
Samreen *et al.* 2016	Takht-e-Sulaiman Hills	KPK	203	5	500	343	338	1.48
Shah *et al.* 2019	District Tor Ghar	KPK	38	14	1400	178	164	8.54
Sher and Hussain 2009	Malam Jabba Valley	KPK	50	1	100	190	189	0.53
Shuaib *et al.* 2014	District Dir Lower	KPK	40	4	400	180	176	2.27
Shuaib *et al.* 2018	Tehsil Timergara, Distrcit Dir	KPK	59	1	100	199	198	0.51

Discussion

The present conducted study in the arid province of the Balochistan Pakistan uncovered the rich heritage of the food plants. The food legacy of the region was studied for the first time as a whole. The feudal lord system coupled with pure agro-pastoral societies has their own set norms and conservations. In these transhumant society's men are engaged in outdoor pastoral and agricultural activities while women mostly confined to home deeds. The limited women activities stop them interacting others but also limit access to economic opportunities, education, formal employment and participation in development (Bhasin, 2011). Balochistan region falls in Irano-Turanian floristic sub-regions and contribute 45% Plants in the national Flora of Pakistan. It offers an array of habitat types form coastal sand dunes to sub-alpine belts in western mountains. Due to low precipitation and montane ecological system the region supports considerable herbaceous species as compare to other growth habit. Family Brassicaceae is one of the largest families in Pakistan. Cruciferous species distributed in numerous habitat types. In physical setting, Baluchistan's mountains are semi-arid and display dry and rocky steppe vegetation and support rich plant diversity (Abbas *et al.* 2018). Hence, most of the wild plant gathering takes place in these habitats. These landforms may be effective for WFPs crop development and agricultural diversification. This practice would be effective for easy survival, economic development and food security of the arid province (Aziz *et al.* 2022). These remote communities are traditional and have limited socio-economical perceptions to change their life routines. They are oblivious of possible innovation using the wealth of these advantageous plants. The long-term social activities may underpin to know the worth and effective practice for its sustainability and socioeconomic development. Ethnically, except Pushtoons, Balochis and Birohis both are considered as Baloch clans with different languages. The "Birohi language is believed to be created by Balochis during wars for communication as a defense tactics (Rahman 1996, Durrani 2012). They have same cultural and religious festivals. There are also instances that a particular tribe is speaking Balochi in one place while same tribe is speaking Birohi in another place. The current investigation also recognized the noticing homogeneity in vernacular nomenclature and practices of plants among these groups. On the contrary, Birohis are also considered to be offshoot of South Indian Dravadian origin and Balochis are Iranian Aryan (Durrani 2012).

Table 5. Botanical, vernacular, ecological and ethnobotanical description of wild edible Flora of Balochistan Province, Northwestern Pakistan.

Botanical Taxon/ Family	Vernacular name in Pushto (P), Balochi (B) & Barahvi (V)	Habit/ Gathering area	Use categories	Used part(s)	Gastronomic recipe	Market Price	RFCs	Report status
Zaleya pentandra (L.) C. Jeffrey Aizoaceae/BLP-001	Wahu (P), Lular, Wahu (V)	Ph /Plain areas	Vegetable	Leaves	Leaves are chopped and cooked as vegetable	No	0.01025641	Yes
Amaranthus blitum L. /Amaranthaceae/BLP-002	Mariro (P)	Ah /Grows as weed	Vegetable	Whole plant	Whole plant collected, cut into pieces and cooked with spices	No	0.153846154	No
Amaranthus viridis L./ Amaranthaceae/BLP-003	Saag (P), zahrin kalpir (B)	Ah /Grows as weed	Vegetable	Leaves	Leaves collected, boiled and cooked with onion, tomatoes and spices	No	0.256410256	Yes
Allium umbilicatum Boiss. /Amaryllidaceae/BLP004	Piazan (P), Pimalako (B & V)	Ah /Among cultivated fields	Vegetable, salad	Leaves, bulbs	Fresh leaves used as salad, bulbs used in place of onion in curry	Yes Rs.200 /Kg	0.256410256	No
Allium zhobicum N.Khan, A.Sultan & R.M.Fritsch /Amaryllidaceae/BLP-005	Khatol (P)	Ah /Plain areas	Salad	Whole plant	Whole plant cut into pieces and used as salad	No	0.102564103	No
Allium registanicum Wendelbo/ Amaryllidaceae/BLP-006	piazi, Anjori (P)	Ah /Plain areas	Salad	Leaves	Leaves eaten as salad	No	0.076923077	No
Allium rubellum M.Bieb./ Amaryllidaceae/BLP-007	Anjori (P)	Ah /Mountain slopes	Salad	Leaves, bulbs	leaves collected and bulbs dug out peeled and eaten as salad	No	0.051282051	No
Allium caroli-henrici Wendelbo/ Amaryllidaceae/BLP-008	Sur Khatool (P)	Ah /Plain areas	Vegetable	Bulbs	dug out Bulbs are peeled and cooked with vegetables and spices	No	0.025641026	No
Allium dolichostylum Vved./ Amaryllidaceae/BLP-009	Khokhai (P)	Ah /Plain areas	Salad	Leaves	Leaves chopped and used in salad	No	0.020512821	No
Allium griffithianum Boiss./ Amaryllidaceae/BLP-010	Khokhai, Kokan (P)	Ah /Plain areas	Salad	Leaves	Leaves eaten as salad	No	0.066666667	Yes
Allium roylei Stearn/ Amaryllidaceae/BLP-011	Kokan (P)	Ah /Mountain slopes	Vegetable	Leaves, bulb	leaves and bulb are cooked as vegetables	No	0.051282051	Yes
Pistacia atlantica Desf. /Anacardiaceae/BLP-012	Sharawan Shanay (P), Gwan, Badwar, Yadun, Gir (B), Kasor (V)	Tr /Mountain slopes	Edible	Fruits	Fruits are ground with Sugar (GHUR) for making sweet local recipe known as *Pusa*.	Yes Rs.200/Kg	0.153846154	No
Rhus mysurensis B. Heyne ex Wight & Arn./ Anacardiaceae/BLP-013	Kahira (B), Kasela (V)	Sh /Mountain rocks	Edible	Fruits	Fresh fruits are edible	No	0.01025641	No

Pistacia khinjuk Stocks/ Anacardiaceae/BLP-014	Uzhgai, Shanay (P), Khinjuk (B), Kasur (V)	Tr /Mountain slopes	Edible	Fruits	Fresh fruits are eaten. Local sweet dish i.e. is *Pusa* is made.	Yes Rs.200/Kg	0.153846154	Yes
Ferula assa-foetida L./Apiaceae/BLP-015	Hanja, Raghband (P), Hing (B), Hing (V)	Ah /Among cultivated fields	Edible	Branches	The green twigs are roasted on low flam and used in salad	Yes Rs.800/Kg	0.102564103	No
Ferula oopoda (Boiss. & Buhse) Boiss./ Apiaceae/BLP-016	Lewanai, Raghban, Da Ushenar (P), Hing (B), Hanjir (V)	Ah /Mountain slopes	Salad	Stem	The fresh stem roasted on low flame and used as salad	Yes Rs.800/Kg	0.102564103	No
Ferula costata Korovin ex Nasir/ Apiaceae/BLP-017	Stagh (P), Hing (B), Hing (V)	Ah /Mountain slopes	Salad	Branches	The fresh juicy green stem & branches are used as salad or sucked its juice	Yes Rs.800/Kg	0.102564103	No
Elwendia persica Boiss./ Apiaceae/BLP-018	Tora Zira (P), Hum (B)	Ah /Mountain slopes	Flavour	Seeds	Seeds are collected dried and used flavouring food	Yes Rs.300/Kg	0.051282051	No
Peucedanum aucheri Boiss./ Apiaceae/BLP-019	Raghbolai (P)	Ah /Mountain slopes	Salad	Leaves	Fresh leaves used as Salad	Yes Rs.200/Kg	0.046153846	No
Peucedanum beluchistanicum Wolff/ Apiaceae/BLP-020	Raghbolai (P)	Ah /Mountain slopes	Salad	Leaves	Fresh leaves used as Salad	Yes Rs.200/Kg	0.041025641	No
Peucedanum ferulaefolium Gilli / Apiaceae/BLP-021	Raghbolai (P)	Ah /Mountain slopes	Salad	Leaves	Fresh leaves used as Salad	Yes Rs.200/Kg	0.035897436	No
Schumannia karelinii (Bunge) Korovin/ Apiaceae/BLP-022	Da murghai pushi (P)	Ah /Plain areas	Vegetable	Tuberous roots	dug out Bulbs are peeled and cooked with vegetables and spices	No	0.01025641	No
Foeniculum vulgare Mill./ Apiaceae/BLP-023	khwazawalani (P), Rizeh (B), Raz (V)	Ah /Among cultivated fields	Edible	Fruits	Fresh fruits are edible	Yes Rs.150/Kg	0.061538462	Yes
Nannorrhops ritchiana (Griff.) Aitchison/ Arecaceae/BLP-024	Mazari (P), Daz (B), Pesh (V)	Sh /Mountain slopes	Edible	Fruit	Fresh fruits are edible	No	0.030769231	Yes
Glossonema varians (Stocks) Benth. ex Hook.f./ Asclepiadaceae/BLP-025	Gulloo Khurram (P), Shagoshaq, Guragunduk, Galaon (B), Munga, Khurumb, Khurram (V)	Ah /Along water channels	Edible	Fruits	Fruit are edible	No	0.015384615	No
Caralluma tuberculata N.E.Br./ Asclepiadaceae/BLP-026	Pamanay (P), Marmotak (B), Apitak (V)	Ph /Mountain slopes	Vegetable	Whole plant	Whole plant collected, chopped and cooked as vegetable	Yes Rs.200/Kg	0.102564103	Yes
Asphodelus tenuifolius Cav. /Asphodelaceae/BLP-027	Basri (P), Pimaluk (B)	Ah /Plain areas	Vegetable, salad	Flowers, leaves	Boiled flowers eaten as vegetable, Leaves used as salad or cook as vegetable	No	0.179487179	No

Scorzonera paradoxa Fisch. & C.A.Mey./Asteraceae/BLP-028	Dagham (B), Asguch (V)	Ph /Mountain slopes	Vegetable	Tubers	Tubers dug out, peeled and used in place of onion in curry	No	0.01025641	No
Sonchus oleraceus (L.) L. /Asteraceae/BLP-029	Azghai (P), Kalamo, Gogru (B), Agut (V)	Ah /Along water channels	Vegetable	Leaves	The fresh leaves are collected boil in water and fried.	No	0.102564103	No
Launaea procumbens (Roxb.) Ramayya & Rajagopal/ Asteraceae/BLP-030	Shatrag Bhuttri (P), Shanturrug (B)	Ah /Plain areas	Vegetable	Leaves	Leaves are chopped and cooked as vegetable	No	0.030769231	No
Helianthus annuus L./ Asteraceae/BLP-031	Namar gulai, Zarhgulai (P)	Ah /Among cultivated fields	Edible	Seeds	Seeds are collected and dried to eat	Yes Rs.100/Kg	0.025641026	No
Epilasia acrolasia (Bunge) Lipsch./ Asteraceae/BLP-032	Sarshako (B)	Ah /Among cultivated feilds	Salad	Leaves	Fresh leaves are collected and used in salad	No	0.01025641	No
Cymbolaena griffithii (A.Gray) Wagenitz/ Asteraceae/BLP-033	Da Murghai pusha (P)	Ah /Among cultivated feilds	Vegetable	Whole plant	Young herbaceous plants are mixed with onion and cooked as vegetable	No	0.01025641	No
Lactuca orientalis (Boiss.) Boiss./ Asteraceae/BLP-034	Sandrashai, Sandran (P), Mrialko (B), Aghut (V)	Sh /Among cultivated feilds	Vegetable	Leaves	Young Leaves, shoots used in Salad as well as chopped and cooked as vegetable	No	0.01025641	No
Scorzonera raddeana C.Winkl./ Asteraceae/BLP-035	Arghuch (P), Dagham (B), Asguch (V)	Ph /Mountain slopes	Vegetable	Tubers	Tuberous roots dug out and cooked with other vegetables	No	0.01025641	No
Koelpinia linearis Pall./ Asteraceae/BLP-036	Shawai Rish (P), Murubi, Zimpud, Zampad (B), Rish-buzuk (V)	Ah /Mountain slopes	Vegetable	Leaves	Leaves are cooked as vegetables	No	0.01025641	No
Scorzonera pusilla Pall./ Asteraceae/BLP-037	Paroka (P), Dagham (B), Asguch (V)	Ph /Mountain slopes	Vegetable	Tubers	Tubers are mixed with vegetables and cooked.	No	0.01025641	No
Reichardia tingitana (L.) Roth/ Asteraceae/BLP-038	Dodolak (P)	Ah /Mountain slopes	Vegetable	Leaves	Fresh or dried leaves are chopped and cooked as vegetable	No	0.01025641	No
Scorzonera litwinowii Krasch. & Lipsch./ Asteraceae/BLP-039	Papoka (P), Dagham (B), Asguch (V)	Ph /Plain areas	Vegetable	Tubers	Tuberous roots are dug out and cooked as vegetable	No	0.01025641	No
Tragopogon gracilis D.Don/ Asteraceae/BLP-040	Shabe (P)	Ph /Mountain slopes	Vegetable	Leaves	Leaves are cooked as vegetables	No	0.01025641	Yes
Lactuca dissecta D.Don/ Asteraceae/BLP-041	Poi boti (V)	Ah /Mountain slopes	Vegetable	Whole plant	Whole plant collected chopped and cooked as vegetable	No	0.01025641	Yes
Cordia ghraf (Forssk.) Ehren. Ex Asch/ Boraginaceae/BLP-042	Lasori (P), Jangli Liwar (B)	Sh /Plain areas	Flavor	Fruit	Ripened fruits are edible and used in making pickles	No	0.01025641	Yes

Ehretia obtusifolia Hochst. ex A.DC./ Boraginaceae/BLP-043	Kanero ,sio (P), Kahiro (B), Puzo gowangi (V)	Sh /Plain areas	Edible	Fruits	Fresh fruits are edible	No	0.025641026	No
Menoicus linifolius (Steph. ex Willd.) DC/Brassicaceae/BLP-044	Ghoelera (P)	Ah /Mountain slopes	Vegetable	Whole plant	Whole plant collected cut into pieces and cooked as vegetable	No	0.102564103	No
Alliaria petiolata (M.Bieb.) Cavara & Grande/ Brassicaceae/BLP-045	Sagpanre (P)	Ah /Mountain slopes	Vegetable, flavour	Leaves	Leaves eaten as salad as well as used flavouring food	No	0.061538462	No
Strigosella africana (L.) Botsch. / Brassicaceae/BLP-046	Khatol (P), Chambar, Sochako, Chambrak (B), Bahushok, Chamav (V)	Ah /Among cultivated feilds	Vegetable	Whole plant	Whole parts of plant cooked as vegetable	No	0.051282051	No
Lepidium sativum L./ Brassicaceae/BLP-047	Tartezak (P)	Ah /Among cultivated fields	Salad	Leaves	Fresh leaves are collected and used as salad	No	0.025641026	No
Diplotaxis griffithii (Hook.f. & Thomson) Boiss./ Brassicaceae/BLP-048	Tarikh sag,Sizgai (P), Janbo (B), Janbo (V)	Ah / Mountain slopes	Vegetable, salad	Leaves	Fresh leaves cooked as vegetable as well as used as salad	No	0.020512821	No
Crambe cordifolia Steven/ Brassicaceae/BLP-049	Skharyai (P)	Ph /Mountain slopes	Vegetable	Roots, leaves	Root and leaves both are cooked as vegetable	No	0.01025641	No
Lepidium draba L./ *Cardaria draba/* Brassicaceae/BLP-050	Baska (P), Bushi (B), Halia (V)	Ah /Among cultivated feilds	Vegetable	Leaves, Shoots	Fresh leaves and shoots are collected cut into pieces and cooked as vegetable	No	0.025641026	Yes
Sisymbrium altissimum L./ Brassicaceae/BLP-051	Roosh (p), Guto (B), Roosh (V)	Ah /Among cultivated feilds	Vegetable, salad	Leaves, shoots	Young Leaves, shoots used in Salad as well as chopped and cooked as vegetable	No	0.061538462	No
Strigosella cabulica Boiss./ Brassicaceae/BLP-052	Khatool (P), Ochrikawa (B), Ochrikawa (V)	Ah /Mountain slopes	Vegetable	Leaves	Fresh leaves cooked as vegetable with spices	No	0.051282051	No
Sisymbrium brassiciforme C.A. Mey. / Brassicaceae/BLP-053	Buskai (P), Shuvaran (B), Shuvaran (V)	Ah /Plain areas	Vegetable	Leaves	Young Leaves and shoots chopped and cooked as vegetable as well as used as salad	No	0.046153846	No
Descurainia sophia (L.) Webb ex Prantl/ Brassicaceae/BLP-054	Roosh (P)	Ah /Among cultivated feilds	Vegetable, salad	Leaves	Fresh leaves used as salad as well as cooked as vegetable	No	0.030769231	No
Goldbachia pendula Botsch./ Brassicaceae/BLP-055	Gwapanre (P)	Ah /Among cultivated feilds	Vegetable	Leaves	Fresh leaves are collected chopped and cooked as vegetable	No	0.015384615	No
Goldbachia laevigata (M.Bieb.) DC./ Brassicaceae/BLP-056	Gwapanre (P)	Ah /Among cultivated feilds	Vegetable	Leaves	Leaves are collected, chopped boiled and cooked as vegetable	No	0.015384615	No

Moricandia sinaica (Boiss.) Boiss./ Brassicaceae/BLP-057	Sezgai panre	Ph /Mountain slopes	Vegetable	Leaves	Leaves are cooked as vegetables	No	0.01025641	No
Sisymbrium irio L./Brassicaceae/BLP-058	Shersham (P), Roosh (B), Roosh (V)	Ah /Grows as weed	Salad	Leaves	Young Leaves used as Salad	No	0.051282051	Yes
Capparis decidua (Forssk.) Edgew./ Capparaceae/BLP-059	Kirha (P), Kaled (B & V)	Sh /Plain areas	Edible	Fruits	Fresh fruits are edible	No	0.117948718	Yes
Capparis spinosa L./ Capparaceae/BLP-060	Kirof (P), Khawarg (B), Pahinro (V)	Sh /Mountain rocks	Flavor	Fruits	Cooked fruits are eaten with curd; fruits are also used in making pickle	No	0.076923077	Yes
Viburnum cotinifolium D. Don./ Caprifoliaceae/BLP-061	Thorayi (P)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.01025641	Yes
Acanthophyllum squarrosum Boiss./ Caryophyllaceae/BLP-062	Khah Aghagzai, Shalwar-Dirr (P), Shah-verdar, Kucha-ghazi (B), Kanda Bagh (V)	Sh /Mountain slopes	Edible	Root, flower	Roots are dug out, dried and ground into fine powder mixed with flower and eaten in the form of pastry	No	0.051282051	No
Silene conoidea L./ Caryophyllaceae/BLP-063	Gardi (P), Dardiri (V)	Ah /Among cultivated feilds	Vegetable	Leaves	Fresh leaves used as salad as well as cooked as Vegetable	No	0.015384615	Yes
Haloxylon griffithii (Moq.) Boiss./ Chenopodiaceae/BLP-064	Shorai (P), Traht, Kaal (B), Sadagh, Lana, Bundi (V)	Sh /Plain areas	Edible	Seeds	Dry seeds are edible	No	0.01025641	No
Chenopodium foliosum Asch./ Chenopodiaceae/BLP-065	Sag (P)	Ah /Mountain slopes	Vegetable	Leaves, inflorescence	Fresh leaves and Inflorescence chopped and cooked as vegetable	No	0.01025641	No
Chenopodium album L./ Chenopodiaceae/BLP-066	Torsag (P), Lullar, Kalpir, Maliro (B), Maler (V)	Ah /Among cultivated feilds	Vegetable	Leaves	Fresh leaves are collected, boiled and cooked	No	0.102564103	Yes
Convolvulus spinosus Burm. f./ Convolvulaceae/BLP-067	Lawanar (P), Dolko, Ritachak (B), Delankur, Titok, Sahsa (V)	Sh /Mountain slopes	Vegetable	Flowers	Fresh flowers are boiled and cooked with spices and onion	No	0.020512821	No
Cucumis prophetarum L./ Cucurbitaceae/BLP-068	Zaran chibit (B)	Ph /Among cultivated feilds	Flavor	Leaf	The fresh fruits are collected, cut into pieces and cooked with onion and tomato	No	0.01025641	No
Cucumis melo var agrestis Naudin/ Cucurbitaceae/BLP-069	Gidra wal (P), Golaro (B), Chibarwal (V)	Ah /Among cultivated feilds	Vegetable	Fruit	Fresh fruit collected, boiled and cooked as vegetable	Yes Rs. 50/Kg	0.025641026	Yes
Ephedra intermedia Schrenk & C.A.Mey. Ephedraceae/BLP-070	Ghat oman (P), Sarshako (B), Hum (B), Narom (V)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	Yes Rs.400/Kg	0.076923077	No

Ephedra procera C.A.Mey. /Ephedraceae/BLP-071	Narai Oman (P), Hum (B), Narom (V)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	Yes Rs.400/Kg	0.076923077	No
Ephedra gerardiana Wall. ex Stapf. Ephedraceae/BLP-072	Narai Oman (P), Hum (B), Narom (V)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	Yes Rs. 400/Kg	0.076923077	Yes
Prosopis cineraria (L.) Druce/ Fabaceae/BLP-073	Kikar (P), Mer (B), Hajero (V)	Tr /Plain areas	Vegetable	Seeds, Pods	Seeds are edible, Immature pods cooked as vegetable	No	0.01025641	Yes
Erodium cicutarium (L.) L'Hér./ Geraniaceae/BLP-074	Sagdandan, /Wazai (P), Saidandan (B), Saidandan (V)	Ah /Among cultivated feilds	Vegetable	Leaves	Leaves boiled and cooked with spices	No	0.01025641	No
Ribes heterotrichum C.A. Mey/ Geraniaceae/BLP-075	Sre nane (P)	Sh /Mountain rocks	Edible	Fruits	Fresh fruits are edible	No	0.01025641	No
Lallemantia royleana (Benth.) Benth./ Lamiaceae/BLP-076	Malangian (P)	Ah /Among cultivated feilds	Beverage	Seeds	Seeds are crushed and used in making drinks	Yes Rs. 200/Kg	0.041025641	No
Ziziphora tenior L./ Lamiaceae/BLP-077	Mori (P), , Indarkah (B)	Ah /Among cultivated feilds	Beverage	Seeds, leaves	Seeds are crushed and leaves are chopped and used as local drink	No	0.015384615	No
Nepeta bracteata Benth./ Lamiaceae/BLP-078	Zufa Sugarai (P), Simsok (B), Chingum boti (V)	Ah /Mountain slopes	Beverage	Leaves	Fresh leaves are collected, crushed and used in making drinks	No	0.01025641	No
Perovskia abrotanoides Kar./ Lamiaceae/BLP-079	Gwaree ,Tirkh (P), Torik (B), Purchenk (V)	Sh /Mountain slopes	Beverage	Leaves	Fresh leaves are collected, chopped and used in making local drinks	No	0.01025641	No
Hymenocrater sessilifolius Benth./ Lamiaceae/BLP-080	Sarsanda v	Ph /Mountain slopes	Beverage	Leaves	Leaves are soaked in water over night, and the infusion utilize as morning drink	No	0.01025641	No
Perovskia atriplicifolia Benth./ Lamiaceae /BLP-081	Gwari (P), Gowaridarna (B), Gowaridarna (V)	Ph /Mountain slopes	Vegetable, salad	Flower	Fresh flowers are used as salad or cooked as vegetable	No	0.01025641	No
Mentha royleana Wall. ex Benth. / Lamiaceae/BLP-082	Shinshobai (P), Purchinak (B), Purchinak (V)	Ph /Along water channels	Salad	Leaves	The fresh leaves are collected roasted and used as salad. Sometimes used fresh leaves are used without roasting.	Yes Rs.200/Kg	0.051282051	Yes
Thymus linearis Benth./ Lamiaceae/BLP-083	Marvai (P)	Ah /Mountain slopes	Beverage, flavour	Leaves	Fresh as well as dried leaves used in flavouring food and making tea	No	0.01025641	Yes

Bongardia chrysogonum (L.) Spach/ Lamiaceae/BLP-084	Pucca Tutucka (P), Pashmook-i-talkh (B)	Ph /Mountain slopes	Vegetable, salad	Root	Roots are eaten as salad and cooked with jawari (corn) flour in making pastries	No	0.025641026	No
Eremurus stenophyllus (Boiss. & Buhse) Baker/ Lilliaceae/BLP-085	Shaze (P), Sarshako (B), Sarshako (V)	Ph /Mounatin slopes	Vegetable	Leaves	Leaves collected chopped and cooked with meat	Yes Rs.70/Kg	0.056410256	No
Eremurus persicus (Jaub. & Spach) Boiss./ Lilliaceae BLP-086	Da khara shazay (P), Sarshako (V)	Ah /Plain areas	Vegetable	Leaves	Leaves are cooked as vegetable	Yes Rs.70/Kg	0.056410256	No
Tulipa stellata Hook./ Lilliaceae/BLP-087	Khatol, sindai (P), Govarikh (B), Govarikh (V)	Ph /Mountain slopes	Vegetable	Bulbs	Bulbs are dug out peeled and used as salad or cooked with vegetables	No	0.051282051	No
Ixiolirion tataricum (Pall.) Schult. & Schult.f./ Lilliaceae/BLP-088	Ghunyaray, Charasakay (P), Bulah (B), Bulah (V)	Ah /Among cultivated fields	Vegetable, salad	Bulbs	Bulbs are dug out, peeled and used as salad as well as cook as vegetable	No	0.030769231	No
Gagea quettica Levichev & Ali/ Lilliaceae/BLP-089	Unjorai,Da mala, ghanrakai (P)	Ah /Plain areas	Vegetable, salad	Bulb	Bulb are dug out used as salad and cooked with vegetables	No	0.01025641	No
Gagea Balochistanica Levichev & Ali /BLP-090	Unjorai (P)	Ah /Plain areas	Vegetable, salad	Bulb	Bulb are dug out used as salad and cooked with vegetables	No	0.01025641	No
Gagea persica Boiss./ Lilliaceae/BLP-091	Unjorai (P)	Ah /Plain areas	Vegetable, salad	Bulb	Bulb are dug out used as salad and cooked with vegetables	No	0.01025641	No
Fritillaria gibbosa Boiss./ Lilliaceae/BLP-092	Gagara (P)	Ph /Plain areas	Vegetable, salad	Bulb	Bulb are dug out used as salad and cooked with vegetables	No	0.01025641	No
Tulipa lehmanniana Merckl/ Lilliaceae/BLP-093	Sur sindai, Sindai (P), Govarikh (B), Govarikh (V)	/Mountain slopes	Vegetable, salad	Bulbs	Bulbs are dug out peeled and used as salad or cooked with vegetables	No	0.051282051	Yes
Cocculus pendulus (J.R.Forst. & G.Forst.) Diels/ Menispermaceae/BLP-094	Zamor, Parwatki (P), Zahmur (B), Zamur (V)	Sh /Mountain slopes	Vegetable	Root, leaves	Roots and leaves both are cooked as vegetable	No	0.01025641	No
Ficus johannis Boiss./ Moraceae/BLP-095	Inzar ,Injeer (P), Anjir (B), Hanjir (V)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.01025641	No
Ficus carica sub/spp carica L./Moraceae/BLP-096	Inzar (P), Anjir (B), Hanjir (V)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	Yes Rs.200/Kg	0.102564103	Yes
Ficus palmata Forssk./ Moraceae/BLP-097	Inzar (P), Anjir (B), Hanjir (V)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.025641026	Yes
Boerhavia procumbens Banks ex Roxb./ Nyctaginaceae/BLP-098	Khurhchaka (P) Pathri (B)	Ph /Plain areas	Vegetable	Tuberous roots	Tuberous roots are dug out and cooked as vegetable	No	0.128205128	Yes

Olea ferruginea (Aiton) Steud./ Oleaceae/BLP-099	Showan, Shananai (P), Khat (B), Kato, Khot (V)	Tr /Mountain slopes	Edible	Fruits	Fresh fruits are edible	Yes Rs.80/Kg	0.076923077	Yes
Oxalis corniculata L./ Oxalidaceae/BLP-100	Lewnai booti (P)	Ah /Among cultivated fields	Edible	Leaves	The fresh leaves are collected and chew by children	No	0.01025641	Yes
Trigonella foenum-graceum L./ Fabaceae/BLP-101	Mulkhuzay (P)	Ah /Among cultivated fields	Vegetable, flavour	Leaves	Leaves are cooked with vegetables to flavour the curry	Yes Rs.100/Kg	0.051282051	No
Vicia monantha Retz./Fabaceae/BLP-102	Matar (P)	Ah /Among cultivated fields	Edible	Seeds	Fresh seeds are edible	No	0.020512821	No
Lathyrus aphaca L./ Fabaceae/BLP-103	Zanghli matar (P), Rewari (B), Rewari (V)	Ah /Among cultivated fields	Edible	Fruits, seeds	Used as fruit/ Seeds collected and dried to eat	No	0.025641026	Yes
Caragana ambigua Stocks / Fabaceae/BLP-104	Makhai (P), Chairraj, Chitik (B), Chidrig (V)	Sh /Mountain slopes	Vegetable, salad	Flowers, fruits	yellow flowers eaten as salad as well as Fruits are cooked with meat	No	0.025641026	Yes
Pinus gerardiana Wall. ex D.Don/ Pinaceae/BLP-105	Zanrghozai,Chalghoza (P)	Tr /Mountain slopes	Edible	Seeds	Fresh fruits are edible	Yes Rs.5000/Kg	0.256410256	
Plantago amplexicaulis Cav./ Plantaginaceae/BLP-106	Spaghol, Shingpara, Danich (P), Danchik (B)	Ah /Along water channels	Beverage	Whole plant	The whole plants are cut and soaked in cold water. Kept in shade for some time then taken as cold drink	No	0.01025641	No
Panicum miliaceum L./ Poaceae/BLP-107	Azbhan, China (P), Azhdum (B), Azhdun (V)	Ah /Plain areas	Edible	Seeds	Seeds/grain ground into flour and used in making bread	No	0.015384615	No
Panicum antidotale Retz./ Poaceae/BLP-108	Washa (P), Gharam (B), Gomaz (V)	Ah /Among cultivated fields	Edible	Seeds	Seeds are ground into flour and used in making bread	No	0.015384615	Yes
Rheum ribes L./ Polygonaceae/BLP-109	Pushai (P), Rawash (B), Filgoosh (V)	Ph /Mountain slopes	Salad	Petiole	Petiole cut into pieces and used as Salad	Yes Rs.100/Kg	0.092307692	No
Rumex vesicarius L./ Polygonaceae/BLP-110	Tarwashkai (P), Hari Gosh (B), Homaz (V)	Ah /Mountain slopes	Vegetable, salad	Leaves	Leaves used as Salad or cooked with spices and potatoes as vegetable	No	0.020512821	No
Polygonum polycnemoides Jaub. & Spach/ Polygonaceae/BLP-111	Sag (P)	Ah /Among cultivated fields	Vegetable	Leaves	Frsh leaves are boiled and cooked with onion	No	0.01025641	No
Rumex dentatus L./ Polygonaceae/BLP-112	Parpanray, Torpanray (P), Hari Gosh (B), Homaz (V)	Ah /Among cultivated fields	Vegetable	Leaves	Young Leaves chopped and cooked as vegetable	No	0.020512821	Yes
Rumex chalepensis Mill. / Polygonaceae. /BLP-113	Parpanray (P), Hari Gosh (B), Homaz (V)	Ph /Among cultivated fields	Vegetable	Leaves	Fresh leaves are boiled cooked as vegetable while juicy petiole peeled and used to chew	No	0.015384615	Yes

Polygonum aviculare L. Polygonaceae. /BLP-114	Seresh, Banduke, Bannali, Kesru (P), Seresh (B), Soeris (V)	Ah /Among cultivated fields	Vegetable	Leaves	boiled Leaves are used as vegetable and eaten with bread	No	0.01025641	Yes
Portulaca oleracea L. /Portulacaceae/BLP-115	Pakharay (P), Pichlo, Shurdako (B), Mirri (V)	Ah /Among cultivated fields	Vegetable	Leaves	Leaves are collected chopped and cooked with onion and tomatos. A local dish *Pakhari Tarkari* is also made.	No	0.307692308	Yes
Punica granatum L./ Lythraceae/BLP-116	Nargosa Aningai (P), Hanor (B), Dahrun (V)	Tr /Mountain slopes	Edible	Fruits	Fruits are dried ground into powder and used as salt	Yes Rs.150/Kg	0.076923077	Yes
Ziziphus spina-christi (L.) Desf./ Rhamnaceae/BLP-117	Beray/ karkanrha (P), Konar (B), Konar (V)	Tr /Plain areas	Edible	Fruits	Fresh fruits are edible	Yes Rs. 50/Kg	0.102564103	No
Rhamnus persica P. Lawson/ Rhamnaceae/BLP-118	Sarawan (P), Toruno (B), Birori (V)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.025641026	No
Sageretia thea (Osbeck) M.C. Johnst./ Rhamnaceae/BLP-119	Manray (P), Hari Gosh (B)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.025641026	No
Rhamnus pentapomica R. Parker/ Rhamnaceae/BLP-120	Sarawan (P), Toruno (B), Birori (V)	Tr /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.025641026	No
Ziziphus oxyphylla Edgew./ Rhamnaceae/BLP-121	Haynanay, Gurgula (P)	Sh /Plain areas	Edible	Fruits	Fresh fruits are edible	No	0.01025641	No
Ziziphus nummularia (Burm.f.) Wight & Arn./ Rhamnaceae/BLP-122	Beray (P), Pins (B & V), Pins (V)	Sh /Plain areas	Edible	Fruits	Fresh fruits are edible	Yes Rs.50/Kg	0.102564103	Yes
Prunus rechingeri (Browicz) R.R.Stewart/ Rosaceae/BLP-123	Zanghli Charay (P)	Tr /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.051282051	No
Rosa beggeriana Schrenk ex Fisch. & C.A.Mey. /R. lacerans/ Rosaceae/BLP-124	Sirai (P), Surai (B)	Sh /Mountain slopes	Edible	Fruits, petals	Fresh fruits are edible	Yes Rs. 500/Kg	0.051282051	No
Cotoneaster persicus Pojark./ Rosaceae/BLP-125	Sharu,sharawai,Tora Sharu (P)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.015384615	No
Crataegus wattiana Hemsl. & Lace/ Rosaceae/BLP-126	Naghuncha, Ghunza (P)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are eaten.	No	0.01025641	No
Rubus sanctus Schreb./ Rosaceae/BLP-127	korharay (P)	Sh /Along water channels	Flavor	Fruits	Fruit are collected dried and used in flavouring food	No	0.025641026	Yes
Cotoneaster nummularius Fisch. & C.A.Mey./ Rosaceae/BLP-128	Sharawai (P)	Sh /Among cultivated fields	Edible	Fruits	Fresh fruits are edible	No	0.01025641	Yes

Salvadora oleoides Decne./ Salvadoraceae/BLP-129	Pilu ,kater (P), Peer, Khabbar, Karuch (B), Kator (V)	Sh /Plain areas	Edible	Fruits	Fresh fruits are edible	No	0.051282051	Yes
Monotheca buxifolia (Falc.) A. DC./ Sapotaceae/BLP-130	Gurguray (P)	Plain areas	Edible	Fruits	Fresh fruits are edible	Yes Rs.150/Kg	0.102564103	Yes
Lycium ruthenicum Murray/ Solanaceae/BLP-131	Zargulan (P), Jarik (B), Jarak (V)	Sh /Plain areas	Beverage	Fruits	Fresh fruits are edible as well as used in making tea	No	0.030769231	No
Lycium depressum Stocks/ Solanaceae/BLP-132	Ziruk, Rinzuk (P), Garathi, Zirok (B)	Sh /Among cultivated fields	Edible	Fruits	Fresh fruits are edible	No	0.030769231	No
Solanum nigrum var. nigrum L./ Solanaceae/BLP-133	Mangobai (P), Kach mach (B), Lillan Balokk (V)	Ah /Among cultivated fields	Edible	Fruits	Fresh fruits are edible	No	0.076923077	Yes
Withania coagulans Stocks./ Solanaceae/BLP-134	Khamazur (P), Panirbad (B), Pareyband (V)	Sh /Mountain slopes	Flavor	Seeds	Seeds are used for making cheese	Yes Rs.100/Kg	0.051282051	Yes
Solanum incanum L./ Solanaceae/BLP-135	Bahar Didi (P), Batag (B), Bhaer (V)	Sh /Mountain slopes	Flavor	Fruits	Fruits are used in making cheese/ juice used in making curd	No	0.01025641	Yes
Grewia tenax (Forssk.) Fiori/ Tiliaceae/BLP-136	Kango (P), Liwaar, Ganghi, Potronk (B), Catarch, Gangi, Kango (V)	Sh /Plain areas	Edible	Fruits	Fresh fruits are edible	Yes Rs. 150/Kg	0.01025641	Yes
Typha domingensis Pers./ Typhaceae/BLP-137	Lukha, Shokhan (P), Kull (B), Kull (V)	Ph /Along water channels	Edible	Rhizome	The rhizomes are dug out, peeled, chewed and sucked its juice.	No	0.061538462	No
Celtis australis L./ Ulmaceae/BLP-138	Tagha (P), Tagas (B)	Tr /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.015384615	Yes
Valerianella oxyrrhyncha Fisch. & C.A.Mey/ Valerianaceae/BLP-139	Charpuk (P), Charpuk (B), Charpuk (V)	Ph /Mountain slopes	Vegetable	Whole plant	Whole plant collected cut into pieces an cooked as vegetable	No	0.015384615	No
Ampelopsis vitifolia (Boiss.) Planch. /Vitaceae/BLP-140	Mar Malue (P)	Sh /Mountain slopes	Edible	Fruits	Fresh fruits are edible	No	0.153846154	No

Comparative assessment for utilization revealed the Pushtoon community comparatively is more knowledgeable about WFPs. They retain wild food plants knowledge as compare to Balochis and Birohis. They are the second largest ethnic group and constitute 36% of the population mainly inhabit the northern Balochistan. Pushtoon was extremely well-presented in interview process. However, the traditional practice of gathering wild plants for food is vividly alive among all considered locals in Balochistan. Because, there are also great regional disparities within the province as northern Balochistan shows the districts with the highest prevalence of under-nutrition. The Balochis and Birohis groups, on the other hand, they have limited selectiveness, employing only two species each. This pattern is linked to the fact that Pushtoon and Balochis are still traditionally engaged in many similar activities as they are more populated as compare to Birohi community. The cross-cultural ethnobotanical analysis has shown that remarkable commonalities were observed among the selected studied groups. The indigenous knowledge of Balochis and Pushtoons indicated the overlapping pattern of wild plant uses confirms some form of cross interaction among these communities, which shared the same environmental and sociocultural space for a few centuries. Birohi gather less wild food plants and share only a few plants with Pushtoon which may have limited the exchange of plant knowledge and practices with Pushtoon, while share more plants with Balochi. This may be due to the fact that these ethno-religious groups live together in more areas as compare to Pushtoon. They also have followed endogamic marriage patterns for centuries. However, study participants confirmed their narratives that knowledge on WFPs goes beyond linguistic and religious boundaries and they have the perception that they all follow the same food patterns. A significant volume of traditional knowledge associated with food ethnobotany exists in the province and presented by all ethnic communities. But it is being limited to the aged people and cause low intergenerational transmission as reported in various studies (Aziz *et al.* 2022, Bibi *et al.* 2022). In the marginalized human societies the utilization and business of WFPs are perceived as laborious practice with low profit (Arshad *et al.* 2022). Hence, the young people abandon to traditional practices and prefer modern businesses. Moreover, cultural modernization, fashioned life pattern and food trend also contribute to lessen the worth of these knowledge. The events such as special day celebration to promote the value and transmission could be effective to invigorate the local traditional knowledge. The inclusion of ethnobotany/local ecological knowledge in the syllabus at school level could also be fruitful for the retention and practice of the available indigenous knowledge. The cross-cultural intermarriages between different cultural groups may lead to the homogenization of traditional knowledge. Similarly, remoteness, drought, accessibility, poor infrastructure, socio-political uncertainty and feudalism social set up trigger the mass outmigration that direct cause the traditional knowledge fragmentation. The botanists hesitate to conduct the research in the province due to endemic and harsh geo-political uncertainty.

Conclusion

The study validates the existence of substantial WFPs variability in the arid-land of Balochistan. WFPs play a central role in regional biological diversity and practices of food selection and utilization. The associated local ecological knowledge with these food plants is present in all relegated societies of all ethnic groups. However, distinct difference in the knowledge volume was observed among the ethnic communities. On the other hand, folk knowledge is not being transmitted effectively due to modern market, social and food trends.

Deleterious geo-ecological processes, mass displacement, outmigration and human factors strikingly affected the retention and transmission and of the folklore. These factors include persistent drought, flood hits, political uncertainty, resource scarcity, outmigration and mass displacement due to mega developmental projects. The establishment of these wild edible as crops in the region would be a game changer for food security, socioeconomic development and nutritional supplements for agro-pastoral people and far flung people. The majority of the interviewers lacked formal schooling. As illiteracy has always been a serious problem in Balochistan. Male and females are denied access to education, and literacy is low, particularly among females. The dominated illiteracy particularly in women seems to be factor for their confidence and reclusiveness in addition to feudal social setup.

Declarations

List of abbreviations: P: Pushto**;** B: Balochi**;** V: Barahvi**;** KPK: Khyber Pakhtunkhwa**;** Ah: Annual herb**;** Bh: Biennial herb**;** Ph: Perennial herb**;** Sh: Shrub**;** Tr: Tree

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Author's Contribution: SK collected the data, compiled the data and helped in the manuscript write up. NK, KI, TK collected the data, photographed and gathered specimens, plant identification. ZA wrote the manuscript, developed graphics, and tabulation. NH improved the manuscript, worked on graphics and analyzed the data. EAE, AH, GDAQ, EFAA edited and improved the manuscript.

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