aPlant Diversity and Its Role in Generating Seasonal Employment Opportunities for Local Communities in Balekayeti-Choman, Kurdistan Region, Iraq

Ali Mala Khedir Galalaey [1,2]
[1] Field Crops and Medicinal Plant Department, College of Agricultural Engineering Science, Salahaddin University-Erbil, Kurdistan Region, Iraq.
[2] College of Medicine Veterinary, Salahaddin University-Erbil, Kurdistan Region, Iraq.
* Corresponding authors E-mail: ali.galalaey@su.edu.krd

Abstract

The main objective of this study is to identify and characterize plant genera and species that contribute to local livelihoods in the Balekayati region of the Kurdistan Region of Iraq. Economic plants are broadly defined as species that provide direct or indirect benefits to human activities, including food, animal feed, fuel, ornamental uses, and raw materials for industry. In contrast, plants that negatively affect human activities such as weeds reducing crop productivity, toxic species harmful to livestock, or plants obstructing water systems are also considered economically significant. This study includes native wild flora as well as cultivated, garden, and introduced plant species present in the region. Owing to the high plant diversity, local vegetation plays a crucial role in sustaining livelihoods throughout the year, with peak economic importance during spring, summer, and autumn. Data was collected through structured interviews with local collectors, traders, elders, and shopkeepers conducted periodically over one year to assess seasonal income sources and market dynamics. This approach provided insights into collection practices, trade patterns, and associated socioeconomic factors. A total of 78 plant species belonging to 36 families were documented, including their scientific classification and seasonal availability. The findings highlight the rich phytodiversity of the Balekayati region and emphasize its significance in supporting rural livelihoods and regional economic sustainability.

Keywords: Edible food, Ethnobotany, Wild plant, Seasonal employment, Balekayati.

1. Introduction

Plants constitute the foundation of terrestrial life and the primary source of human sustenance. The natural vegetation of numerous nations harbours a diverse assemblage of useful plant species that have served as a valuable supply of essential commodities for millennia [10]. Millions of people in developing nations lack sufficient food to meet their daily nutritional requirements, and many more suffer from deficiencies in one or more micronutrients [11,12]. The diversity of wild food plants contributes significantly to household food security and dietary diversification. In addition to their nutritional value, several species can be marketed, thereby providing a supplementary source of household income [13,14]. Plants fulfil a multiplicity of functions in human life, ranging from providing reliable food sources through agriculture to their application in medicine, industry, and aesthetics [15]. The discipline of ethnobotany examines how indigenous peoples utilise plants, while economic botany focuses on their contemporary applications. Numerous pharmaceutical agents are plant-derived, and this practice has deep historical roots extending to the earliest civilisations

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[16,17]. Industrial products, including paper, timber, and various chemical compounds, are likewise sourced from plant materials [18,19].

The rural communities of Iraq, like those in many other regions of the world, possess a rich repository of plant folklore that has been transmitted orally across generations. Despite never encountering a Latin binomial name, nomadic shepherds and camel herders are remarkably familiar with their native flora. The majority of plant species found in desert and steppe environments have their own traditional vernacular names, and local populations can distinguish between species that are beneficial for grazing and those that pose a threat to their livestock [1,2]. Furthermore, these communities can identify plants that yield medicines, dyes, soaps, and other commercially or culturally valuable products [3]. Although marketed medicines and manufactured goods sold in village shops are gradually supplanting traditional herbal remedies, farmers in rural districts continue to retain a remarkable breadth of knowledge regarding the commercial applications of their native plants [4,5].

In pursuit of this comprehensive documentation, the current *Flora of Iraq* aims to transcend the limitations of a conventional illustrated taxonomic inventory accessible only to professional botanists [6]. For each plant family, genus, or species of major or minor economic significance, accompanying paragraphs provide accessible information on common names and customary uses within the country, supplemented, where relevant, by ethnobotanical practices documented in other nations [7,8]. This approach is intended to give the work a substantially broader scope than many conventional floras, rendering it useful not only to taxonomists but also to researchers, educators, students in allied scientific fields, veterinary officers, irrigation engineers, farmers, industrialists, and agriculturists [7,9].

The mountainous, rugged landscape of the Balekayati area (encompassing Choman District and a Werte portion of Ruwandz District) is a unique example of human–nature interaction spanning thousands of years. This area qualifies as a rich repository for indigenous traditional knowledge regarding the use and significance of wild plants. Such traditional ecological knowledge is profoundly insightful and holds considerable potential as a foundation for integrating contemporary strategies for the sustainable development and management of natural resources [20–24]. The majority of residents are engaged in agriculture and animal husbandry, partly due to the area's remoteness from major urban centres and the scarcity of private-sector employment opportunities such as businesses and supermarkets. Seasonal wild plants, including kangaroo, rhubarb, and mushrooms, are a valuable source of income for local residents during spring. Additionally, farmers cultivate and trade a variety of horticultural products, including apples, grapes, cucumbers, tomatoes, potatoes, onions, and apricots [25,26]. These plant-based products contribute substantially to the local economy, both through direct household consumption and through commercial exchange within the community. Furthermore, plants serve as the primary feed source for draft and pack animals, particularly horses, which facilitate agricultural labour, transportation, and trade in mountainous terrain, thereby further enhancing the community's economic well-being.

The materials examined in this study were gathered from wild populations; however, prior investigations suggest that collectors often lack adequate awareness of the potential value of the plants they harvest or the long-term ecological consequences of their collection activities on native plant communities [27–29]. Accordingly, a thorough analysis of current methods for

gathering and managing high-value secondary crops from the research areas has been conducted. The study focused on the trend of collecting wild plants for commercial purposes in rural areas, as well as the potential markets for these products in both domestic and international settings. The moderate climate and improved accessibility in most locations, facilitated by the construction of highways during the eight-year war between Iraq and Iran in the 1980s, offer a substantial opportunity for economic diversification. However, several constraints remain, including high business costs, limited demand, insufficient financial resources, inadequate physical infrastructure, and deficiencies in technical and decision-making capacity [30–34].

This study aims to examine the financial benefits of specific wild plants for residents of the Balekayati region by analyzing the entire supply chain, from sustainable harvesting to processing and marketing. The research is part of a larger effort to manage natural resources and boost economic opportunities for local communities. It highlights the growing trend of wild plant gathering as a source of income in rural areas and identifies potential markets, both domestically and internationally, for these products. The study also stresses the importance of training to ensure adherence to international standards for natural resource conservation [35,36].

2. Materials and Methods

2.1 Study Area

The Hallgord–Sakran National Park (HSNP) is the only officially designated national park in the Kurdistan Region of Iraq. It is located within the Zagros Mountains near the biogeographic junction where the borders of Iraq, Iran, and Turkey converge. The park covers approximately 1,100 km², making it one of the largest protected mountainous areas within the Irano-Anatolian biodiversity hotspot [34]. It lies about 120 km northeast of Erbil and spans an elevation range from roughly 700 m to 3,607 m above sea level, including the highest peak in Iraq. The summit of Hallgord Mountain remains snow-covered throughout the year. This wide altitudinal gradient creates diverse ecological niches and microclimates, supporting a broad spectrum of vegetation types ranging from lowland steppe to alpine meadows [37].

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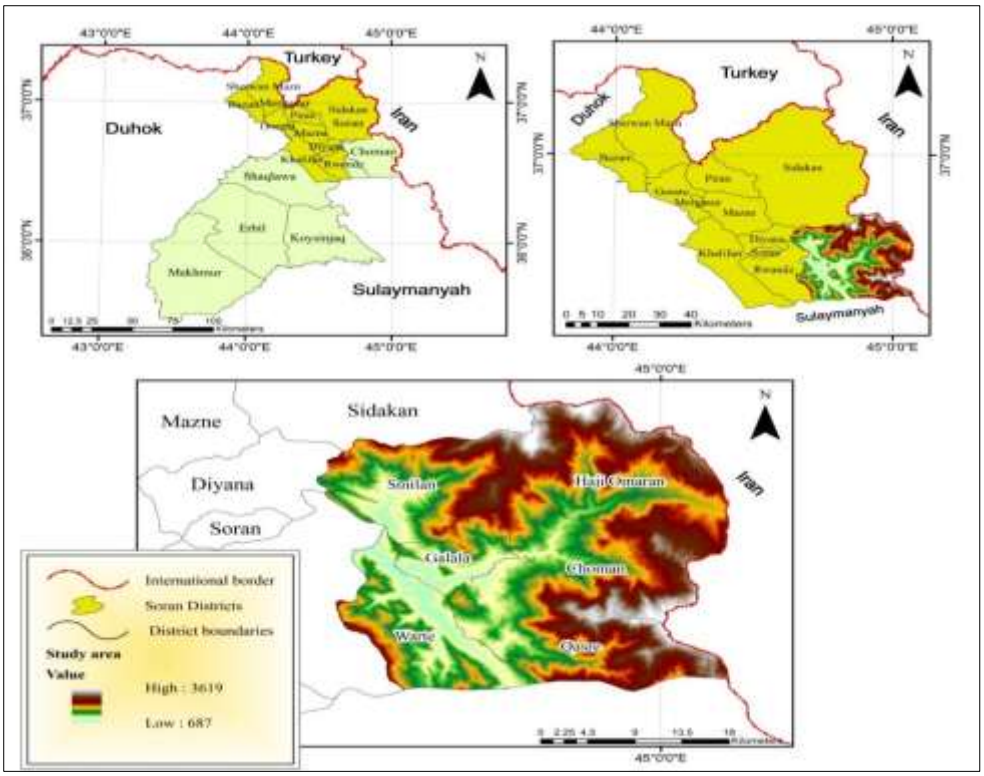

Figure 1: Map of the study location

2.2 Study Procedures

Data collection was carried out using a combination of semi-structured interviews, direct field observations, plant specimen collection, group discussions, and traditional market surveys. A detailed investigation of the collection and trade patterns of high-value wild plant species was conducted during the summer season. Interviews with plant collectors were performed at multiple production sites across Choman District. Additional interviews were conducted in regional markets, including Gallala, Haji Omaran, Similan, Qasrei, and Choman, to document procurement and distribution pathways. Shopkeepers were also consulted to identify sources of plant materials supplied to markets. Participants estimated the quantities of each species collected, and these values were aggregated to represent total village-level harvests. All data were obtained through collector and trader surveys as well as focus group discussions [38]. Voucher specimens were collected for all recorded species and identified using standard floristic references. Taxonomic nomenclature followed the accepted classifications provided by the World Flora Online database, ensuring consistency with current international standards [39].

2.3 Survey of Collectors

A semi-structured ethnobotanical questionnaire was used to document traditional knowledge. Interviews were conducted face-to-face with local residents, primarily from rural communities, beginning in 2017 and continuing to the present. The survey focused on local plant names, plant parts used, harvesting practices, and methods of preparation [40]. To better understand the economic role of wild plant collection, data were gathered on harvesting methods, seasonal timing, market destinations, and trade dynamics. Participants included collectors, farmers, and traders aged between 30 and 85 years. They were asked about harvesting locations, sales channels, annual income, and labor investment associated with wild plant collection. The study followed a comparative qualitative case study approach based on long-term field observations and interviews. Data collection included repeated visits and continuous engagement with community members, particularly elders with extensive ethnobotanical knowledge. Selected study sites represented different plant groups based on criteria such as cultural importance, frequency of use, and economic potential. Participants also described consumption patterns and harvesting schedules. Market surveys were conducted to evaluate product availability and pricing [41,42].

2.4 Wild Plant Taxonomic Identification

Wild edible plant species were identified through field observations, specimen collection, and photographic documentation. Identification was primarily based on the *Flora of Iraq* [9,43–45]. Additional references included *Flora Iranica* [46] and *Flora of Turkey* [47–49]. Supporting literature used for verification included works by Rawi [50], Rashed [51], Shahbaz [52], Galalaey [53], Vela et al. [54], Youssef et al. [55], and Hamad et al. [56]. Collected plant samples were preserved using a standard wooden plant press and subsequently identified using these authoritative sources.

3. Results

3.1 Floristic Inventory and Seasonal Collection Patterns

Table 1 presents a comprehensive botanical inventory of 78 plant species identified in the study area, detailing their respective families, binomial scientific names, and seasonal collection periods. This floristic inventory encompasses 36 plant families and reflects the rich phytodiversity of the Balekayati region within the Kurdistan Region of Iraq. The documented collection periods—spanning spring, summer, and autumn—correspond to the peak phenological stages of numerous herbaceous, woody, and medicinal plant species, highlighting the seasonal nature of wild plant harvesting and its alignment with local livelihood patterns [57,58].

Table 1: Botanical inventory and seasonal collection periods of identified plant species.

Collection times	Scientific names	Families	No.
Summer	*Acer monspessulanum L. subsp.*	Aceraceae	1
Spring and Summer	*Adiantum capillus-veneris L.*	Adianthaceae	2
Spring	*Allium akaka Gmelin*	Alliaceae	3
Spring	*Allium jesdianum Boiss.&Buhse*	Alliaceae	4
Spring and Autumn	*Pistacia eurycarpa Yalt.*	Anacardiaceae	5
Spring and Autumn	*Pistacia khinjuk Stocks*	Anacardiaceae	6
Autumn	*Rhus coriaria L.*	Anacardiaceae	7
Summer	*Ammi majus L.*	Apiaceae	8
Late Spring	*Anthriscus cerefolium (L.) Hoffm.*	Apiaceae	9
Spring	*Smyrnium cordifolium Boiss.*	Apiaceae	10
Spring	*Heracleum lasiopetalum Boiss.*	Apiaceae	11
Spring	*Arum conophalloides Kotschy ex Schott*	Araceae	12
Spring and Summer	*Gundelia rosea M.Hossain & Al-Taey*	Asteraceae	13
Spring	*Helichrysum armenium*	Asteraceae	14
Spring	*Anchusa azurea Mill.*	Boraginaceae	15
Spring	*Anchusa strigosa Labill.*	Boraginaceae	16
Spring and Summer	*Nasturtium officinale R.Br.*	Brassicaceae	17
Spring	*Brassica nigra (L.) W.D.J.Koch*	Brassicaceae	18
Autumn	*Elaeagnus angustifolia L.*	Elaeagnaceae	19
Summer	*Astragalus spp.*	Fabaceae	20
Summer	*Glycyrrhiza glabra L.*	Fabaceae	21
Summer and Autumn	*Medicago sativa L.*	Fabaceae	22
Summer	*Prosopis farcta (Banks & Sol.)*	Fabaceae	23

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Spring	*Vicia ervilia (L.) Willd.*	Fabaceae	24
Spring	*Vicia sativa L.*	Fabaceae	25
Autumn	*Quercus aegilops L.*	Fagaceae	26
Spring and Autumn	*Quercus infectoria G. Olivier*	Fagaceae	27
Spring	*Crocus biflorus Miller*	Iridaceae	28
Spring	*Crocus cancellatus Herb.*	Iridaceae	29
Summer and Autumn	*Juglans regia L.*	Juglandiaceae	30
Spring and Summer	*Mentha longifolia (L.) L.*	Lamiaceae	31
Spring	*Origanum vulgare L.*	Lamiaceae	32
Spring	*Ziziphora clinopodioides M.Bieb.*	Lamiaceae	33
Autumn	*Punica granatum L.*	Lythraceae	34
Spring	*Alcea arbelensis Boiss. et Hausskn.*	Malvaceae	35
Spring	*Malva neglecta Wallr.*	Malvaceae	36
Spring	*Malva nicaeensis All.*	Malvaceae	37
Summer	*Ficus carica var. carica*	Moraceae	38
Summer	*Morus alba L.*	Moraceae	39
Summer	*Morus nigra L.*	Moraceae	40
Summer	*Fraxinus syriaca Tom.*	Oleaceae	41
Spring	*Cephalanthera kurdica Bornm. ex Krae.*	Orchidaceae	42
Spring	*Himantoglossum comperianum (Steven) P.Delforge*	Orchidaceae	43
Spring	*Ophrys mammosa Desf.*	Orchidaceae	44
Spring	*Ophrys umbilicata Desf.*	Orchidaceae	45
Spring	*Orchis simia Lam.*	Orchidaceae	46

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Spring	*Anacamptis collina (Banks & Sol.)*	Orchidaceae	47
Autumn	*Platanus orientalis L.*	Platanaceae	48
Summer	*Phragmites australis Trin. ex Steud.*	Poaceae	49
Spring	*Rumex crispus L.*	Polygonaceae	50
Spring	*Rheum ribes L.*	Polygonaceae	51
Spring	*Rumex scutatus L.*	Polygonaceae	52
Summer	*Portulaca oleracea L.*	Portulacaceae	53
Summer	*Nigella arvensis L.*	Ranunculaceae	54
Autumn	*Crataegus azarolus L.*	Rosaceae	55
Spring and Summer	*Prunus microcarpa C.A.Mey.*	Rosaceae	56
Spring and Autumn	*Prunus arabica (Oliv.) Meikle*	Rosaceae	57
Spring	*Prunus argentea (Lam.) Rehd.*	Rosaceae	58
Spring and Summer	*Prunus dulcis (Mill.) Webb.*	Rosaceae	59
Summer	*Prunus mahaleb (L.) Mill.*	Rosaceae	60
Autumn	*Pyrus syriaca Boiss.*	Rosaceae	61
Summer and Autumn	*Rosa canina L.*	Rosaceae	62
Summer	*Rubus sanctus Schreber*	Rosaceae	63
Summer	*Rubia tinctorum L.*	Rubiaceae	64
Summer	*Populus alba var. alba*	Salicaceae	65
Summer	*Populus alba var. pyramidalis Bunge*	Salicaceae	66
Summer	*Populus nigra L. var. nigra*	Salicaceae	67
Summer	*Salix acmophylla Boiss.*	Salicaceae	68
Summer	*Salix aegyptiaca L.*	Salicaceae	69
Summer	*Salix alba L.*	Salicaceae	70
Summer	*Salix purpurea L.*	Salicaceae	71

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Summer	*Scrophularia deserti Delile*	Scrophulariaceae	72
Summer	*Physalis divaricata D.Don*	Solanaceae	73
Autumn	*Celtis tournefortii Lam.*	Ulmaceae	74
Spring	*Urtica dioica L.*	Urticaceae	75
Spring	*Urtica pilulifera L.*	Urticaceae	76
Spring, Summer, and Autumn	*Vitis vinifera L.*	Vitaceae	77
Spring	*Morchella esculenta (L.) Pers.*	Morchellaceae	78

3.2 Seasonal Distribution of Collected Plants

The analysis of seasonal distribution (as illustrated in the figures) indicates that the highest species diversity and collection intensity occurred during spring and summer. This pattern is consistent with the phenological behavior of temperate montane ecosystems, where herbaceous and early-flowering species reach peak growth during warmer periods [19]. Spring alone accounted for the collection of more than 56 species, primarily used for food and medicinal purposes. Summer showed comparable diversity, with additional emphasis on species used for construction materials, tools, and firewood. In contrast, autumn collections focused mainly on fruit-bearing species and those producing economically valuable by-products such as galls and tannins. The seasonal analysis further indicates that food and beverage plants (FOD) dominated collection patterns, followed by wild medicinal plants (WMP). This reflects the strong dependence of local communities on wild edible resources for nutrition and dietary diversity, a trend widely reported in ethnobotanical studies [59–61]. The high proportion of medicinal plants also emphasizes the continued importance of traditional healthcare systems in areas with limited access to modern medical services [25,62]. In combined seasonal analyses (spring and autumn), food and medicinal plants remained dominant, while cosmetic and bee-related plants were least collected. Similar patterns were observed during summer and autumn, with slight increases in medicinal and genetic resource categories. Autumn collections were primarily focused on food species and plant materials used for daily tools, with secondary contributions from ornamental, medicinal, and material-use plants. Cosmetic, genetic, and dye plants remained the least represented categories.

3.3 Ethnobotanical Use Categories and Quantitative Indices

Table 2 presents the calculated ethnobotanical indices, including Use Value (UV), Citation Frequency (FC), and Relative Importance (RI), for the recorded plant species. These indices provide a standardized framework for evaluating cultural significance and usage intensity across plant categories [63].

Table 2: Use Value (UV), Citation Frequency (FC), and Relative Importance (RI) of ethnobotanical use categories.

RI (Relative Importance)	FC (Citation Frequency)	UV (Usage Value)	Ethno Botanical uses	NO.
0.48	57	0.7308	Food and Beverage (FOD)	1
0.2523	30	0.3846	Wild Ornamental Plants (WOP)	2
0.0925	11	0.141	Wild Fodder Plants (WFP)	3
0.4121	49	0.6282	Wild Medicinal Plants (WMP)	4
0.1766	21	0.2692	Materials (MIT)	5
0.1935	23	0.2949	Firewood and Charcoal (FWACH)	6
0.0336	4	0.0513	Cosmetics (COS)	7
0.0757	9	0.1154	Bee Plants (BPs)	8
0.1178	14	0.1795	Genetic Resource Plants (GENP)	9
0.0421	5	0.0641	Dye Plants (DYP)	10
0.2271	27	0.3462	Plant Tools (PTs)	11

The results indicate that food and beverage plants (FOD) had the highest values (UV = 0.7308, FC = 57, RI = 0.48), highlighting their essential role in sustaining local diets. Wild medicinal plants (WMP) also showed high values (UV = 0.6282, FC = 49, RI = 0.4121), confirming their importance in traditional healthcare practices. Other categories such as ornamental plants (WOP), plant tools (PTs), and firewood (FWACH) demonstrated moderate importance, while cosmetic (COS) and dye plants (DYP) exhibited the lowest usage levels.

These findings are consistent with ethnobotanical studies conducted in the Kurdistan Region and broader Mediterranean and Middle Eastern areas, where food and medicinal plant use dominate traditional plant utilization patterns [64–66]. Documenting these usage patterns is essential for biodiversity conservation, preservation of indigenous knowledge, and the development of sustainable resource management strategies.

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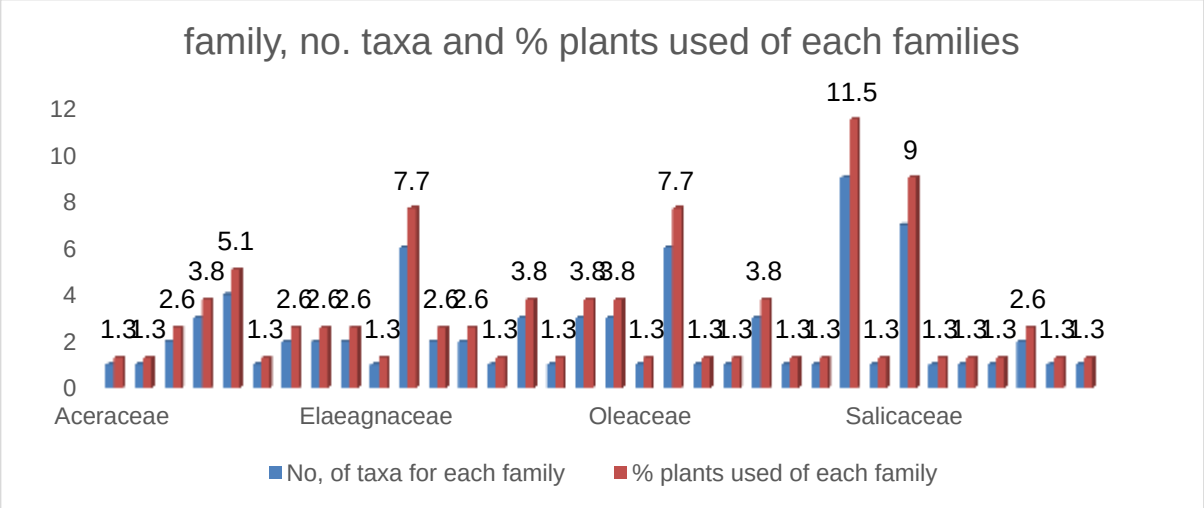

Figure 2: distribution of plant families by number of taxa and percentage of utilization.

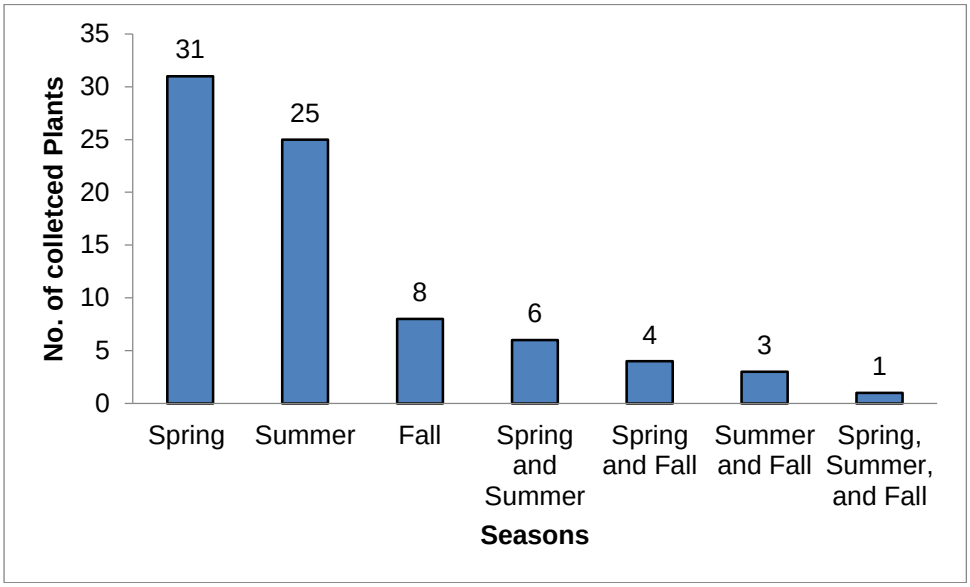

Figure 3: number of collected plants in different seasons.

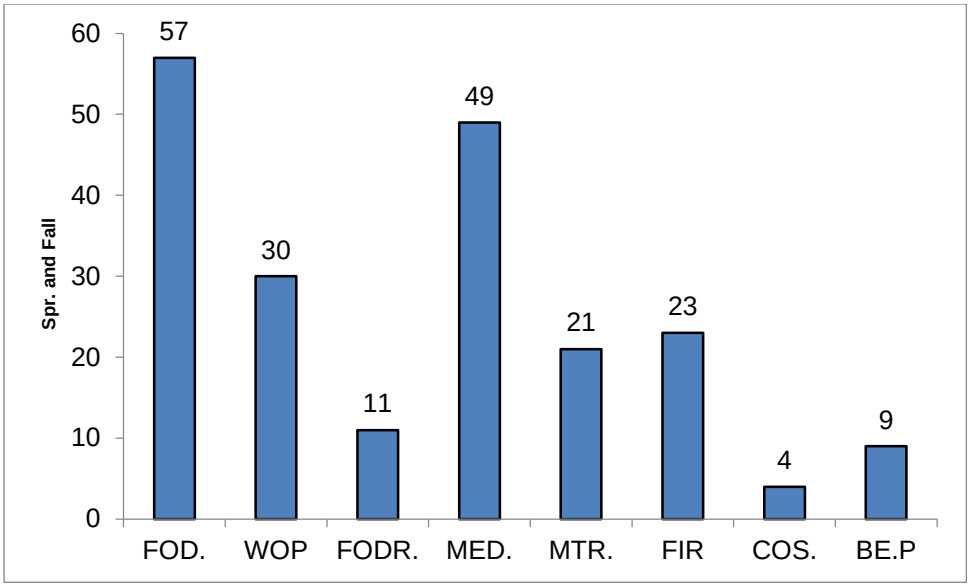

Figure 4: No. of collected plants in spring and fall season for different uses.

The maximum values were recorded for FOD with a slight decreasing for Med. It is indicated that the lowest values were recorded for both COS and Be.P , and also there was a variation in the rest of using collected plants. In addition, in summer and fall season the uses of plants were the same for all different uses and only was high in for both MED and GEN purposes (2 and 2) respectively (Figure 5). Figure 6 shows number of plants that are collected in fall season. It is found that the majority of the people was collected both FOD. and used as Tools for their daily life in Fall season. On the other hand, it is found that Wop, MED, MTR and BE. P were categorized into second stage in terms of uses. While the lowest plant was used for the purpose of COS. GEN and Dyes.

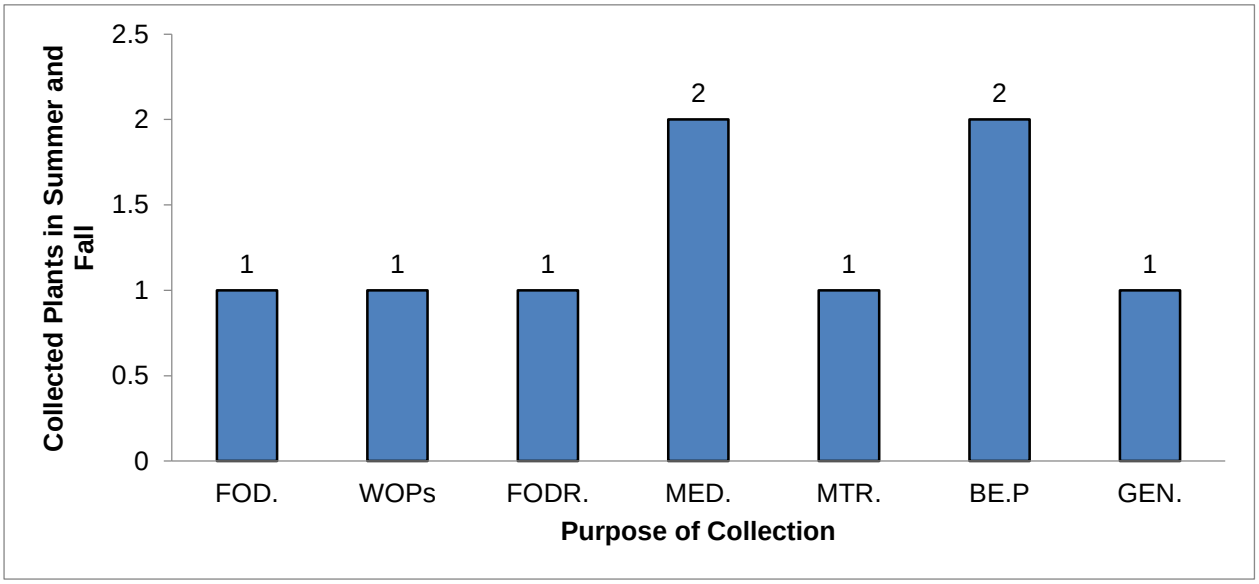

Figure 5. No. of collected plants in Summer and fall seasons for different uses.

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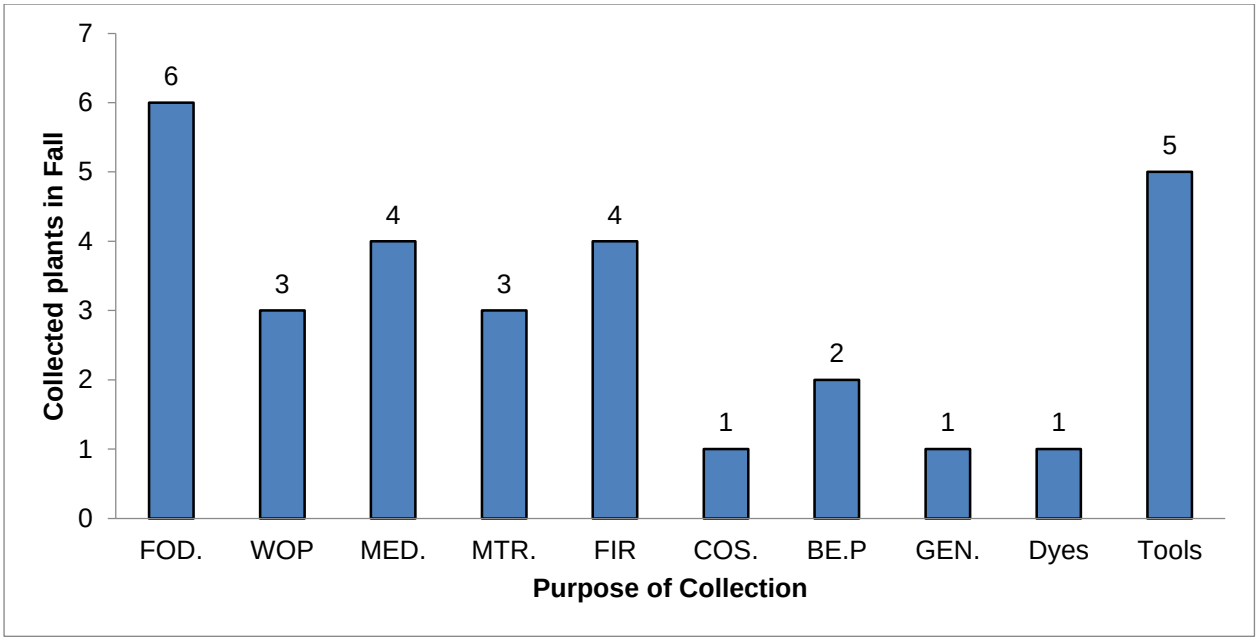

Figure 6: collected plants in Fall season for different uses.

Figure (7) shows number of collected plants for different purposes in Spr. and Summer seasons. It is found that FOD. and Med. Are the main [purpose in these two seasons? However, minimum number was recorded for the purpose of WOP, FIR. And BE. P uses in their daily life.

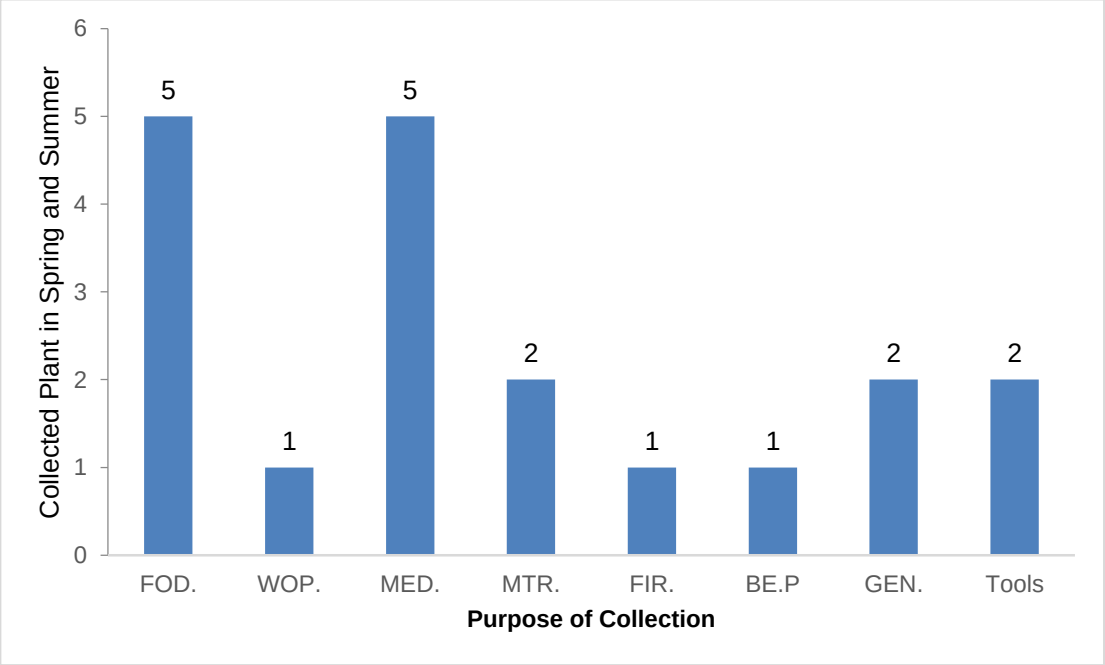

Figure 7: collected plants in Spring and Summer season for different uses.

In addition, it is found that the highest collected plants were recorded in summer months are used for Tools for their daily life, while the lowest values were recorded for Dyes as indicated in figure (8). On the other hand, in Spring months FOD. was classified in the first aim with the mean of (56), and the second

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highest mean was recorded for Med. However, the lowest mean was found for COS. and Dyes (2) (Figure, 8).

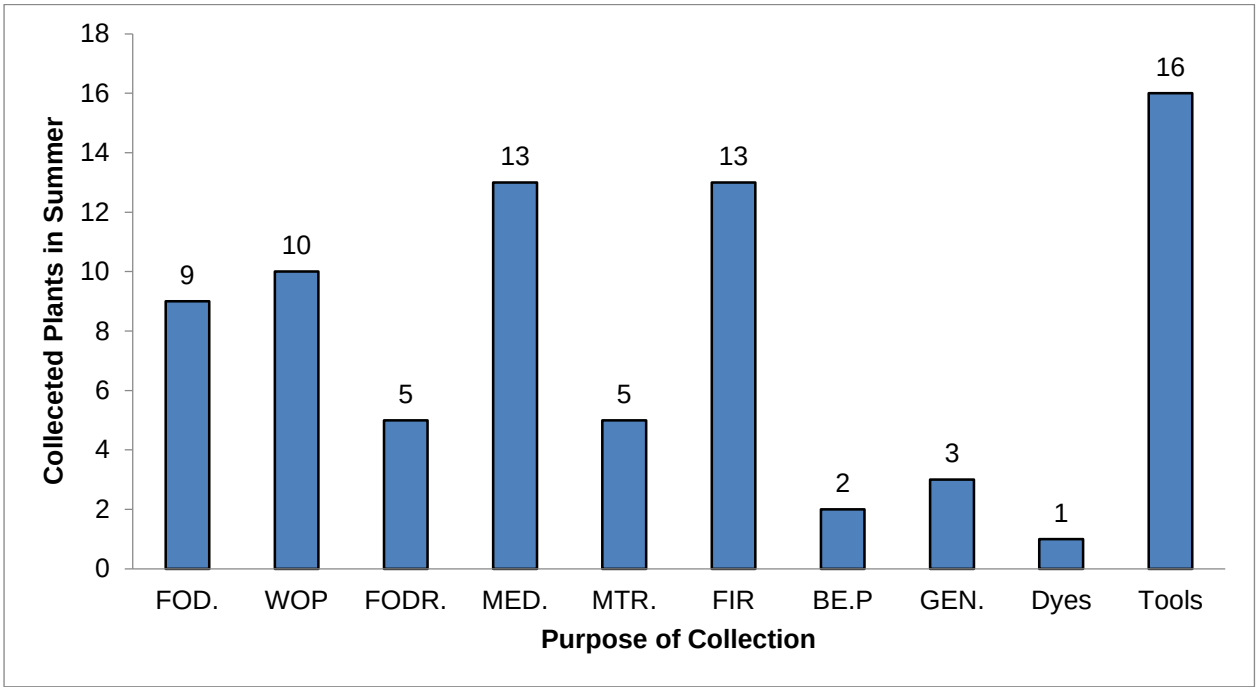

Figure 8: No. of collected plants in Summer season for different uses.

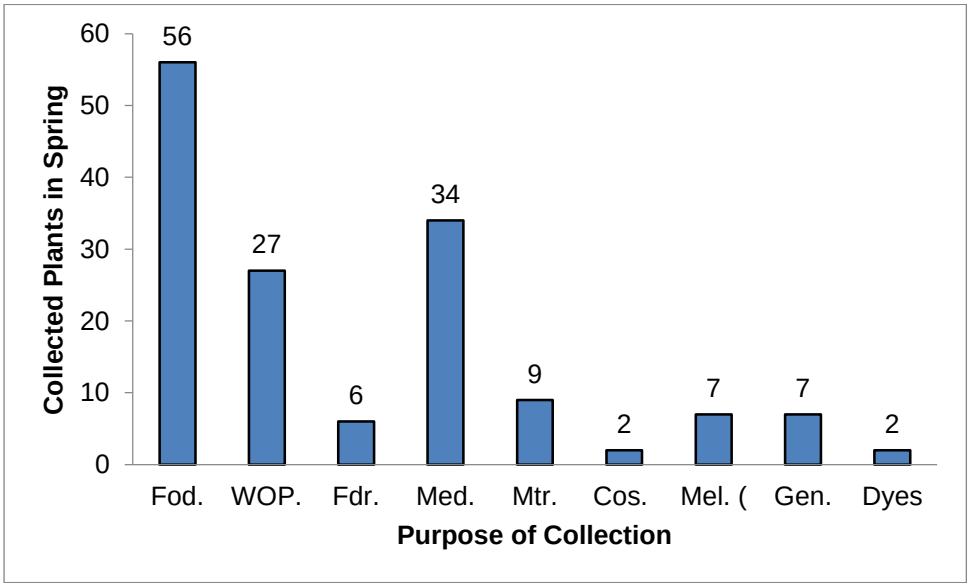

Figure9: No. of collected plants in Spring season for different uses.

Overall, it was found that all collected plants in different seasons of the year the highest number was recorded for FOD. with the mean value of (57), and the second higher number of plants was used for Med. However, it is indicated that the lowest mean was obtained for COS. as shown in figure (10). Table (2) shows UV (Usage Value), FC (Citation Frequency) and RI (Relative Importance) with Ethno Botanical uses of collected plants. It is found that *Food and beverage (FOD.)was*

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classified in the first class the highest mean of UV (0.7308) and RI (0.48). While the lower mean value was recorded for the purpose of COS. in terms of (*of* UV (0.0513) and RI (0.0336).

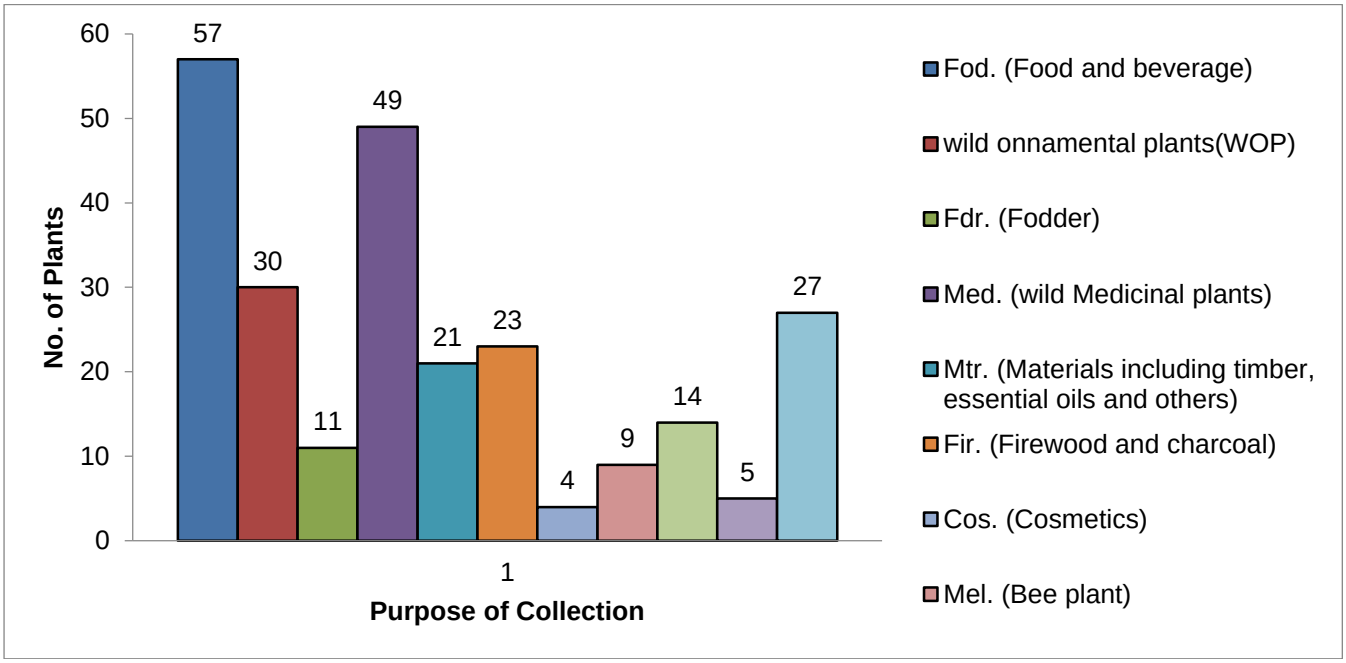

Figure 10: No. of collected plants for different uses.

4. Discussion

4.1 Wild Plants and Traditional Healthcare

In developing countries, herbal medicine remains the primary source of healthcare for nearly 80% of the population, and demand for plant-based therapeutics has increased significantly in recent decades [25,67]. National regulatory authorities in many regions permit the continued use of herbal medicines due to their long history and the widespread belief in their safety and effectiveness. Even during periods of major medical advancement, such as in ancient Egypt, the therapeutic knowledge of Babylonian practitioners was highly valued [68]. This traditional system of healing is complex and varies depending on regional plant diversity, cultural traditions, and geographical conditions [5,8,69].

4.2 Community Organisation and Market Dynamics

Residents of the study communities exhibit strong social cohesion, supporting one another during wild plant harvesting and other labor-intensive activities. Each village operates under a local governance system led by a mukhtar (village leader), who plays a central role in coordination and conflict resolution. Such social structures are crucial for organizing sustainable harvesting practices [25,35]. Wild plant collectors must better understand market demands to maximize economic returns. This includes improving knowledge of quality standards, post-

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harvest handling, and storage practices. The present study identified several gaps including fragmented information systems, lack of training, unstructured collection practices, and poorly developed market networks. These findings are consistent with previous studies highlighting similar challenges [32,30].

4.3 Economic and Medicinal Significance of Regional Flora

The diversity of economically and medicinally important plant species in the Balekayati area significantly enhances the economic potential of Choman District and Werte sub-district. Local communities utilize a wide range of plant resources, including wild foods, medicinal plants, forage species, gum-producing trees, dye plants, and fuelwood. The ethnobotanical importance of these resources has been widely documented in regional studies [20,70,71]. Several plant species, including *Origanum* spp., wild *Pistacia* spp., *Allium* spp., *Arum* spp., and *Juglans regia*, are traditionally used to treat ailments such as fever, cough, respiratory infections, skin diseases, and gastrointestinal disorders [72,2]. Information regarding these uses was obtained directly from local collectors. Important multipurpose species include timber-producing trees (*Quercus* spp.), resin-producing plants (*Astragalus* spp.), dye-producing species (*Rubia tinctorum*), and edible plants such as *Gundelia* spp. and *Rheum ribes*. However, intensive harvesting of key species, including endangered taxa such as *Fritillaria* spp., poses serious conservation challenges [33].

4.4 Conservation Concerns and Anthropogenic Pressures

The sustainability and population stability of these plant species are increasingly threatened by anthropogenic pressures such as illegal logging, overgrazing, and unsustainable harvesting. Field observations, supported by previous studies, confirm the presence of illegal deforestation activities in the region [73,74]. Continued disturbances may lead to irreversible losses in biodiversity [7]. Comprehensive assessments of both biotic and abiotic stress factors are therefore essential to understand their impact on species diversity and ecosystem stability [36,6].

Phytochemicals derived from medicinal plants are often preferred over synthetic drugs due to their perceived safety, affordability, and accessibility. The commercialization of these resources could significantly improve local livelihoods. Despite limited ethnobotanical documentation in the Kurdistan Region, wild plants remain central to Kurdish culture and traditional practices [5,4,75].

4.5 Ecological and Economic Potential of the Study Region

The Balekayati region supports a rich diversity of wild plant species due to its varied topography, including mountain ranges such as Hisarost and Sakran, Mount Karokh, and valleys such as Rust, Khanqa, and Balayan. These diverse habitats create ideal conditions for plant growth. During spring, local communities collect wild plants for food, medicinal use, and trade. Recent agricultural data indicate an expansion of cultivated land across elevations ranging from 1,000 m to 3,600 m. As in many parts of the world, communities in Soran, Choman, Ruwandz, and surrounding areas rely on plants for multiple purposes, including food, medicine, fodder, fuel, construction, and tools [76,77].

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4.6SWOT (Strengths, Weaknesses, Opportunities, and Threats) Analysis

A SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis indicates that the wild plant utilization system in the Balekayati region is supported by high plant diversity, strong traditional ecological knowledge, and community cohesion. However, its effectiveness is limited by weak supply chain and value chain structures, poor post-harvest practices, and limited technical capacity. Despite these constraints, there are significant opportunities for value addition, market development, and cultivation of high-value species. At the same time, the system faces serious threats from overexploitation, overgrazing, deforestation, and environmental changes, which may compromise long-term sustainability.

4.7 Conclusion

This study highlights the critical role of wild economic plants in supporting rural livelihoods in the Balekayati region of the Kurdistan Region of Iraq. The identification of 78 plant species belonging to 36 families demonstrates the region's rich phytodiversity and its strong contribution to seasonal employment, food security, and traditional healthcare systems . The findings confirm that food and beverage plants and medicinal species are the most dominant categories, reflecting the high dependence of local communities on natural plant resources.

The results also reveal clear seasonal patterns in plant collection, with peak activity during spring and summer. However, despite their economic importance, the current system remains largely informal and underdeveloped, particularly in terms of post-harvest handling, value addition, and organized supply chain and value chain structures. This limits the full economic potential of these resources. While the region benefits from strong traditional ecological knowledge, community cohesion, and biodiversity richness, several challenges threaten sustainability. Unsustainable harvesting, overgrazing, deforestation, and increasing anthropogenic pressures pose serious risks to plant diversity and long-term resource availability. Many economically valuable species are particularly vulnerable due to slow regeneration and continuous exploitation. To address these challenges, a shift toward an integrated and sustainable management approach is essential. This includes improving harvesting practices, developing post-harvest processing and value addition, and strengthening market linkages. Capacity-building programs and technical training should be implemented to enhance local knowledge and economic returns. In addition, promoting the cultivation of high-value species and establishing community-based resource management systems will help reduce pressure on wild populations. In conclusion, sustainable utilization of wild plant resources in the Balekayati region requires a balanced approach that integrates conservation, economic development, and value chain strengthening. Effective collaboration between local communities, governmental institutions, and other stakeholders will be crucial to ensure long-term environmental sustainability and improved rural livelihoods.

5. Achknowledgments

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6. Ethical Statement

Since this study only comprised the collecting and analysis of plant materials and ethnobotanical surveys with no human subjects, it did not require ethical approval from a human ethics council.

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I did not receive any financial support; it was all my own personal effort.

8. References

[1] Borchardt, J.K. (2002). The beginnings of drug therapy: ancient Mesopotamian medicine. *Drug News Perspect.*, 15, pp. 187–192.

[2] Mandaville, J.P. (2011). *Bedouin ethnobotany: plant concepts and uses in a desert pastoral world*. Tucson: University of Arizona Press.

[3] Dafni, A., and Böck, B. (2019). Medicinal plants of the Bible revisited. *J Ethnobiol Ethnomed.*, 15, p. 57.

[4] Lobab, A.S., and Musawi, H.A. (2025). Traditional plant-based knowledge in Iraqi rural communities. *Iraqi J Agric Sci.*, 56(1), pp. 88–99.

[5] Ahmed, H.M. (2016). Ethnopharmacobotanical study on medicinal plants used by herbalists in Sulaymaniyah Province, Kurdistan, Iraq. *J Ethnobiol Ethnomed.*, 12(1), p. 8.

[6] Alsalahi, A. (2024). Cultivating health: advancing medicinal plant management strategies in Iraq. *Preprints*.

[7] Pei, S., Huai, H., and Hamilton, A. (2020). Ethnobotanical approaches of traditional medicine studies. In: *Ethnobotany of Mountain Regions*. Springer.

[8] Ghazanfar, S.A., and Thorogood, C.J. (2023). *A herbal of Iraq*. London: Royal Botanic Gardens, Kew.

[9] Townsend, C.C., and Guest, E. (1966–1985). *Flora of Iraq*. Baghdad: Ministry of Agriculture.

[10] Schulp, C.J., Thuiller, W., and Verburg, P.H. (2014). Wild food in Europe: ecosystem services. *Ecol Econ.*, 105, pp. 292–305.

[11] Garibaldi, A. (2012). Moving from model to application: cultural keystone species and reclamation. *J Ethnobiol.*, 32(1), pp. 84–101.

[12] FAO (2004). *The state of food insecurity in the world*. Rome: Food and Agriculture Organization.

[13] Duguma, H.T. (2020). Wild edible plant nutritional contribution and consumer perception. *Int J Food Sci.*, 2020, art. no. 2958623.

[14] Kumar, B.M., et al. (2025). Wild edible plants for food security and dietary diversity: a global overview. *Front Sustain Food Syst.*, 9, art. no. 1686446.

[15] Amer, W.M., et al. (2024). Economic botany and ethnobotanical perspectives on food security. *J Appl Bot.*, 48(2), pp. 112–128.

[16] Hamilton, A., Pei, S., and Kessy, J. (2003). *The purposes and teaching of applied ethnobotany*. Paris: UNESCO.

[17] Cheikhyoussef, A., et al. (2011). Ethnobotanical study of indigenous knowledge on medicinal plant use. *J Ethnobiol Ethnomed.*, 7, p. 10.

[18] Mathur, R. (2018). Industrial applications of plant-derived products. In: *Plant Biology and Biotechnology*. Springer.

[19] Brooker, R.W., et al. (2023). Plant diversity and ecological intensification in

crop production systems. *J Plant Ecol.*, 16(6), art. no. rtad015.

[20] Galalaey, A.M., Shaban, M.A., Rasul, K.M., et al. (2021). Ethnobotanical study of some wild edible plants in Kurdistan Region of Iraq. *Zanco J Pure Appl Sci.*, 33(s1), pp. 19–30.

[21] Mohammed, A.A., and Al-Dahash, S.M. (2023). Traditional ecological knowledge and plant utilisation in northern Iraq. *Environ Sci Pollut Res.*, 30(18), pp. 52301–52315.

[22] Pieroni, A., Ahmed, H.M., and Zahir, H. (2018). The use of wild food plants in the Hawraman region of Iraqi Kurdistan. *Genet Resour Crop Evol.*, 65(5), pp. 1491–1506.

[23] Lele, S., et al. (2017). Sustainable development goals and the use of traditional ecological knowledge. *Sustain Sci.*, 12(4), pp. 543–556.

[24] Carvalho, A.M., and Frazão-Moreira, A. (2011). Importance of local knowledge in plant resource management and conservation. *J Ethnobiol Ethnomed.*, 7, p. 36.

[25] Scoones, I., Melnyk, M., and Pretty, J.N. (1992). *The hidden harvest: wild foods and agricultural systems*. London: IIED.

[26] De Cortes Sánchez-Mata, M., and Tardío, J. (2016). *Mediterranean wild edible plants: ethnobotany and food composition tables*. New York: Springer.

[27] Sulaiman, M.A., et al. (2023). Assessment of wild plant collection practices in Kurdistan Region.

[28] Vorstenbosch, T., et al. (2017). The impact of wild plant collection on biodiversity: a review. *Conserv Biol.*, 31(1), pp. 45–56.

[29] Sulaiman, M.A., et al. (2022). Sustainable harvesting practices and biodiversity conservation.

[30] Madsen, S.H., and Smith-Hall, C. (2023). Market access and livelihoods from wild products in developing countries. *World Dev.*, 162, art. no. 106138.

[31] Broegaard, R.B., et al. (2017). Wild food collection and nutrition under commercial agriculture expansion. *For Policy Econ.*, 84, pp. 92–101.

[32] Mahdi, H.S., et al. (2025). Socioeconomic constraints in rural agricultural development.

[33] Kawarty, A.M.A., Behçet, L., and Çakilcioğlu, U. (2020). An ethnobotanical survey of medicinal plants in Ballakayati (Erbil, North Iraq). *Turk J Bot.*, 44(3), pp. 345–357.

[34] Mittermeier, R.A., et al. (2005). *Hotspots revisited: Earth's biologically richest and most endangered terrestrial ecoregions*. Mexico City: Cemex.

[35] Cunningham, A.B. (2014). *Applied ethnobotany: people, wild plant use and conservation*. London: Routledge.

[36] Schippmann, U., Leaman, D.J., and Cunningham, A.B. (2002). *Impact of cultivation and gathering of medicinal plants on biodiversity*. Rome: FAO.

[37] Gaznayee, H.A.A., et al. (2024). Integrating terrain variables and satellite vegetation indices for forest cover analysis in Kurdistan Region. *Passer J Basic Appl Sci.*

[38] Alexiades, M.N. (2003). Ethnobotany in the third millennium: expectations and unresolved issues. *Delpinoa*, 45, pp. 15–28.

[39] The Plant List (2013). Version 1.1. Available at: http://www.theplantlist.org.

[40] Kunwar, R.M., and Bussmann, R.W. (2008). Ethnobotany in the Nepal Himalaya. *J Ethnobiol Ethnomed.*, 4, p. 24.

[41] Amiri, M.S., and Joharchi, M.R. (2013). Ethnobotanical investigation of medicinal plants in Iranian markets. *Avicenna J Phytomed.*, 3(3), pp. 254–271.

[42] Pardo-de-Santayana, M., et al. (2007). Traditional knowledge of wild edible plants in the Iberian Peninsula. *J Ethnobiol Ethnomed.*, 3, p. 27.

ISSN 2072-3857

[43] Ghazanfar, S.A., and Edmondson, J.R. (2013). *Flora of Iraq*. Kew: Royal Botanic Gardens.

[44] Ghazanfar, S.A., and McDaniel, T. (2016). Floras of the Middle East: flora of Iraq. *Edinburgh J Bot.*, 73(1), pp. 1–34.

[45] Bor, N.L., and Guest, E. (1968). *Flora of Iraq*, Vol. 9. Baghdad: Ministry of Agriculture.

[46] Rechinger, K.H. (1963–2012). *Flora Iranica*. Graz: Akademische Druck.

[47] Davis, P.H. (1965–1985). *Flora of Turkey and the East Aegean Islands*. Edinburgh: Edinburgh University Press.

[48] Davis, P.H., Mill, R.R., and Tan, K. (1988). *Flora of Turkey*, Vol. 10. Edinburgh: Edinburgh University Press.

[49] Güner, A., et al. (2000). *Flora of Turkey*, Vol. 11. Edinburgh: Edinburgh University Press.

[50] Rawi, A. (1964). *The wild growing plants of Iraq*. Baghdad: Ministry of Agriculture.

[51] Rashed, K.N. (1990). *Medicinal plants of Iraq: a bibliographic survey*. Baghdad: National Centre for Consultancy.

[52] Shahbaz, S.E. (2007). *Trees and shrubs of Kurdistan Region of Iraq*. Duhok: Spirez Press.

[53] Galalaey, A.M. (2021). *Plant diversity of Sakran Area in Northern Iraq*. PhD Thesis.

[54] Vela, E., et al. (2013). Biodiversity and plant ecology studies in Middle East regions.

[55] Youssef, S., et al. (2019). *Wild orchids of Kurdistan Region*. Société Méditerranéenne d'Orchidologie.

[56] Hamad, S., et al. (2019). Plant identification and ecological studies in Kurdistan Region.

[57] Sundriyal, M., and Sundriyal, R.C. (2004). Wild edible plants of the Sikkim Himalaya: nutritive values of selected species. *Econ Bot.*, 58(2), pp. 286–299.

[58] Balemie, K., and Kebebew, F. (2006). Ethnobotanical study of wild edible plants in Derashe and Kucha districts, South Ethiopia. *J Ethnobiol Ethnomed.*, 2, p. 53.

[59] Ju, Y., Zhuo, J., Liu, B., and Long, C. (2013). Eating from the wild: diversity of wild edible plants used by Tibetans in Shangri-La region. *J Ethnobiol Ethnomed.*, 9, p. 28.

[60] Kallas, J. (1996). *Edible wild plants: from neighborhood to wilderness*. Utah: Gibbs Smith.

[61] Tag, H., Tsering, J., Hui, P.K., Gogoi, B.J., and Veer, V. (2014). Nutritional potential and traditional uses of wild edible plants in Eastern Himalaya. *Int J Biol Biomol Agric Food Biotechnol Eng.*, 8(3), pp. 238–243.

[62] Teklehaymanot, T., and Giday, M. (2007). Ethnobotanical study of medicinal plants used by people in Zegie Peninsula, Ethiopia. *J Ethnobiol Ethnomed.*, 3, p. 12.

[63] Tugume, P., Kakudidi, E.K., Buyinza, M., et al. (2016). Ethnobotanical survey of medicinal plant species used by communities around Mabira Forest Reserve, Uganda. *J Ethnobiol Ethnomed.*, 12, p. 5.

[64] Anywar, G., Kakudidi, E.K., Byamukama, R., et al. (2020). Indigenous knowledge of medicinal plants among communities in Uganda. *J Ethnopharmacol.*, 246, art. no. 112188.

[65] Rivera, D., Obón, C., Inocencio, C., et al. (2005). The ethnobotanical study of local Mediterranean food plants as medicinal resources. *J Ethnopharmacol.*, 97(1), pp. 5–13.

[66] Blamey, M., and Grey-Wilson, C. (2004). *Wild flowers of the Mediterranean*. London: A&C Black.

[67] Al-Snafi, A.E. (2018). Medicinal plants with central nervous effects in Iraq: a review. *Int J Pharm Sci Res.*, 9(3), pp. 895–904.

[68] Teall, E.J. (2014). Medicine and society in ancient Egypt. In: *The healing arts of ancient civilizations*. Oxford: Oxford University Press.

ISSN 2072-3857

[69] Naqishbandi, A.M. (2014). *Traditional herbal medicine practices in Kurdistan Region*. Erbil: Local Press.

[70] Balaky, H.H., Galalaey, A.M., et al. (2021). Ethnobotanical survey of medicinal plants in Kurdistan Region of Iraq. *Zanco J Pure Appl Sci.*, 33(2), pp. 45–60.

[71] Bapir, T.O., and Galalaey, A.M. (2023). Wild plant use and economic importance in Northern Iraq. *Kurdistan J Appl Res.*, 8(1), pp. 77–89.

[72] Al-Rawi, A., and Chakravarty, H.L. (1988). *Medicinal plants of Iraq*. Baghdad: Ministry of Agriculture.

[73] Darweish, D.A. (2016). Assessment of forest degradation in northern Iraq.

[74] Kawarty, A.M.A. (2018). Environmental impacts on forest ecosystems in Kurdistan Region.

[75] Youssef, S., et al. (2017). Ethnobotanical uses of wild plants in Kurdistan Region. *J Ethnobiol Ethnomed.*, 13, p. 33.

[76] Tomkins, J.P., et al. (2019). Ethnobotany and sustainable livelihoods in mountainous regions. *Sustain Dev.*, 27(4), pp. 567–578.

[77] Chakravarty, H.L. (1976). *Plant wealth of Iraq: a dictionary of economic plants*. Baghdad: Ministry of Agriculture.

ISSN 2072-3857