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Economic Analysis of Herbal Plants in the Hazara Region

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Abstract

Medicinal and aromatic plants (MAPs) play a crucial role in supporting livelihoods in the mountainous region of Hazara, where conventional agriculture is limited by terrain and climatic constraints. This study investigates the economic, ecological, and cultural dimensions of MAP use, emphasizing the role of traditional practitioners, including hakeems and pansars, in the collection, processing, and trade of herbal resources. Data from semi-structured interviews revealed five major themes: traditional therapeutic knowledge, economic value variation across species, potential for cultivation, ecological risks, and market mechanisms. Findings suggest that while MAPs provide significant income opportunities, challenges such as overharvesting, weak market linkages, and limited post-harvest processing reduce profitability and threaten ecological sustainability. Integrating systematic cultivation, local value addition, community monitoring, and improved market access can enhance economic returns, empower marginalized groups, and ensure the long-term conservation of medicinal plant biodiversity. These insights provide a foundation for policy interventions and sustainable development strategies in mountain-based herbal economies.

Keywords: Medicinal plants, aromatic plants, Hazara region, mountain livelihoods, traditional knowledge, sustainable harvesting, cultivation potential, value chain, ecological conservation

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1. Introduction

Mountainous regions around the world are home to rich biodiversity that sustains both ecological systems and human livelihoods. Among the key natural resources in these areas are medicinal and aromatic plants (MAPs), which have historically provided food, medicine, and supplementary income to local communities. In South Asia, and particularly in Pakistan's northern Himalayan belt, MAPs constitute a vital component of rural mountain economies, where agricultural options are often limited due to steep terrain, short growing seasons, and climatic constraints (Hussain & Khattak, 2013; Shinwari et al., 2011). The Hazara division of Khyber Pakhtunkhwa, Pakistan, represents a unique intersection of ecological richness and cultural heritage, offering a wide array of herbal species that have been used for centuries in traditional medicine. Understanding the economic and ecological dimensions of MAPs in this region requires a comprehensive examination of their market structures, value chains, cultural significance, and sustainability challenges.

Globally, MAPs are increasingly recognized as "green commodities" due to their potential to contribute simultaneously to livelihood security, health benefits, and ecological conservation (Pouliot & Sutherland, 2014). In Pakistan, northern mountainous regions—including Hazara—are part of the Himalayan biodiversity corridor, which hosts a diverse array of endemic plant species adapted to high-altitude ecosystems. These species exhibit unique biochemical properties influenced by local altitudinal gradients, microclimatic variation, and soil heterogeneity, enhancing their therapeutic value (Shinwari et al., 2011). Traditional health practitioners, including hakeems and pansars, rely on this biodiversity to treat ailments ranging from digestive disorders and respiratory illnesses to musculoskeletal pain and fever, maintaining deep-rooted cultural and medicinal practices (Bano et al., 2014). Consequently, MAPs are not merely ecological resources but also form an integral aspect of socio-cultural identity, influencing harvesting patterns, local markets, and community-based knowledge transmission.

The economic significance of MAPs in mountain livelihoods is well-documented in regional and international literature. In regions such as Nepal and northern India, wild herb collection contributes between 15–35% of annual household income in forest-dependent communities (Pouliot & Sutherland, 2014). Although systematic data for Hazara remain limited, preliminary surveys and anecdotal evidence indicate that MAPs provide a substantial source of supplementary income for households living near forested areas in Siran Valley, Balakot, and Konsh. These plants are often collected seasonally, with returns varying according to species rarity, medicinal efficacy, and market demand. Gendered dimensions of herbal collection are also observed; women commonly participate in post-harvest processing, cleaning, drying, and packaging of herbs, enabling them to contribute economically while navigating socio-cultural mobility constraints (Sherpa & Sharma, 2020). Such engagement not only generates income but also strengthens household resilience, aligning with the principles of sustainable livelihoods that emphasize diverse forms of capital, including natural, human, social, and financial (Chambers & Conway, 1992; Morse & McNamara, 2013).

Despite the economic potential of MAPs, market inefficiencies and structural barriers often constrain local benefits. In Pakistan, herbal markets typically operate through multi-layered value chains involving collectors, middlemen (aarthis), wholesalers, and urban traders, with collectors receiving only a fraction of retail prices due to information asymmetry, limited bargaining power, and lack of direct market access (Shinwari & Gilani, 2012; Qureshi et al., 2019). High-value species such as Kala Zeeri, Ratanjot, and Patrees command significant urban demand, yet local collectors are often unable to capture their full economic potential due to

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inadequate knowledge of grading, post-harvest handling, and market dynamics. Introducing small-scale value addition—such as drying, packaging, and minor processing—can substantially improve local earnings, reduce losses from poor storage, and create employment opportunities, particularly for women and youth (Laurenti et al., 2016; Chausson et al., 2023).

Sustainability concerns further complicate the economic utilization of MAPs. Overharvesting, habitat degradation, and slow regeneration rates threaten the long-term viability of high-demand species (Hamilton, 2004). The absence of effective monitoring and community-based regulatory mechanisms in Hazara amplifies these pressures. International experiences suggest that community cultivation and structured resource management can mitigate ecological risks while generating stable income streams (Kala, 2015). Early initiatives in Hazara indicate that species like Kala Zeeri, Mamekh, and Ratanjot can be cultivated successfully under controlled conditions, highlighting opportunities for sustainable economic development.

Given these complexities, the economic analysis of MAPs in Hazara must integrate ecological, cultural, and market dimensions. Traditional knowledge of hakeems and pansars, combined with modern cultivation practices, value addition strategies, and improved market access, presents a pathway toward sustainable livelihoods and biodiversity conservation. This study adopts a sustainable livelihoods framework (Chambers & Conway, 1992; Natarajan et al., 2022) to explore how natural capital—specifically MAPs—contributes to household income, health, and ecological stewardship. By analyzing the economic potential, market structures, and sustainability risks associated with medicinal plants, the research seeks to provide evidence-based recommendations for policy interventions, cultivation strategies, and market development that can enhance the economic and ecological value of Hazara's herbal sector.

Medicinal and aromatic plants represent a nexus of economic opportunity, cultural heritage, and ecological significance in Hazara. Their sustainable utilization offers a promising avenue for income generation, gender-inclusive employment, and biodiversity preservation. However, realizing this potential requires targeted interventions encompassing cultivation, value addition, market transparency, and community-based resource management.

2. Literature Review

Medicinal and aromatic plants (MAPs) form an important component of mountain economies, especially in regions where agriculture is limited by terrain and climatic constraints. Across South Asia, households located in forested uplands depend extensively on wild herbs for food, medicine, fuel, and income generation. Scholars note that MAPs are increasingly viewed as "green commodities" that provide both livelihood security and ecological value (Hussain & Khattak, 2013). Pakistan's northern mountainous belt—including the Hazara division—is part of the Himalayan biodiversity corridor, recognized for its unique flora and longstanding traditions of herbal medicine. In this setting, an economic analysis of herbal plants requires an understanding of ecological factors, market structures, value chains, and the socio-cultural role of collectors, traders, and local practitioners such as hakeems.

Ecological and Ethnobotanical Significance

The Hazara landscape, spread across steep valleys and high-altitude forests, contains diverse species used in traditional healing practices. Research across Himalayan and Hindukush ecosystems highlights that altitudinal gradients, microclimatic variations, and forest heterogeneity help sustain a wide range of medicinal flora (Shinwari et al., 2011). These ecological characteristics allow plants to develop distinct biochemical properties that enhance their therapeutic value.

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While ethnobotanical studies conducted in nearby Gilgit, Kaghan, and Swat document extensive indigenous knowledge related to plant identification and use, similar patterns are evident in rural communities. Local hakeems maintain oral traditions regarding species selection, dosage, and preparation methods. Their knowledge influences harvesting behavior and shapes demand for specific herbs. Studies in mountain economies show that traditional practitioners often stimulate local herb markets by prescribing particular species for common ailments such as digestive issues, respiratory illnesses, and joint pain (Bano et al., 2014). For Hazara, these patterns indicate the presence of a stable and culturally rooted demand base for many wild herbs.

Economic Role of MAPs in Mountain Livelihoods

Medicinal plants offer an income source for rural households that face limited agricultural opportunities. Mountain regions typically experience short growing seasons, fragmented landholdings, and low crop productivity. As a result, collected herbs—often gathered during specific seasons—become an important supplementary revenue stream. Studies from Nepal and India show that MAP collection contributes between 15–35% of annual household income in forest-dependent communities (Pouliot & Sutherland, 2014). Although exact figures for Hazara are limited, anecdotal evidence suggests that the economic contribution is substantial, especially among households located near forest belts in Siran Valley, Balakot, and Konsh.

The literature also notes a gendered dimension to MAP-related work. In several Himalayan regions, women are heavily involved in cleaning, drying, sorting, and storing herbs, even when men are responsible for collecting them from higher altitudes. Such participation allows women to access cash income within cultural boundaries that restrict their mobility (Sherpa & Sharma, 2020). Similar patterns can be expected in Hazara, where women engage in home-based processing of herbs such as mamekh, chorah, and kala zeeri.

Market Structures and Price Dynamics

Herbal markets in Pakistan generally operate through multi-layered supply chains involving collectors, middlemen (aarthis), wholesalers, urban herb markets, processors, and pharmaceutical companies. The literature emphasizes that collectors typically receive the lowest share of profits due to information asymmetry, limited bargaining power, and lack of direct market access (Shinwari & Gilani, 2012). Prices vary widely across species depending on scarcity, medicinal value, seasonal availability, and demand from industries.

Several high-value species are known across northern Pakistan, such as kala zeeri, mamekh, ratanjot, sunbal, patrees, and but mewa—all of which are also found in Hazara. Comparative price analyses conducted in Peshawar, Rawalpindi, and Lahore herb markets reveal that urban traders earn significantly higher margins than rural collectors (Qureshi et al., 2019). For instance, kala zeeri collected from mountain villages is often sold at a fraction of its retail price due to the absence of grading systems and the dominance of intermediaries.

The literature also highlights quality as a major determinant of price. Proper drying, grading, and storage can significantly increase the market value of MAPs. Yet most collectors lack access to drying sheds or training in post-harvest management. Poor handling leads to moisture retention, contamination, and deterioration in color or aroma—factors that reduce prices. As a result, researchers argue that introducing small-scale value addition at the village level can substantially boost earnings for local collectors.

Sustainability and Overharvesting

Economic incentives to harvest high-value herbs often lead to unsustainable extraction. International studies show that unregulated harvesting practices can cause rapid population decline in slow-growing or difficult-to-regenerate species (Hamilton, 2004). In Pakistan,

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overharvesting has been reported for several species across the Himalayan belt, including some found in Hazara's higher valleys. Forest departments frequently lack the capacity to monitor extraction, and community-based regulation mechanisms remain weak.

Scholars emphasize that the market structure itself promotes overexploitation. Because collectors receive low returns, they tend to maximize supply rather than focus on sustainability. Additionally, traders prefer wild-collected species due to perceptions that cultivated herbs have lower potency. These factors place pressure on forest ecosystems, especially for species with long maturation cycles or specific habitat requirements.

Research from India and Nepal shows that shifting from wild collection to community cultivation can reduce pressure on natural populations while generating consistent income (Kala, 2015). Cultivation of herbs such as kala zeeri, mamekh, and ratanjot is feasible in the Hazara climate, though initial investment and extension services are required.

Value Chain Analysis

Value chain studies examine how economic benefits are distributed among actors involved in the production, processing, and sale of herbal plants. In Pakistan, these chains are characterized by loose linkages, informal transactions, and limited transparency. Researchers observe that collectors rarely have access to reliable market information, leading to inconsistent pricing and exploitation by intermediaries (Nazir et al., 2019). Strengthening value chain coordination—through cooperatives, producer groups, or public-private partnerships—can help increase local earnings.

A key insight from global MAP research is the advantage of local processing. Even basic value-added activities, such as grinding, packaging, or preparing herbal teas, can dramatically increase profitability. In many Asian countries, small herbal enterprises have emerged that specialize in processing locally available plants for niche markets. Such enterprises create rural employment, strengthen women's economic participation, and support cultural heritage associated with herbal medicine.

For Hazara, the potential for local processing is underexplored. With proper investment, the region could supply herbal powders, extracts, balms, essential oils, and value-added products to national markets. Additionally, consumer trends indicate growing preference for organic and traceable herbal products—a niche that Hazara's mountain-grown herbs can fill.

Policy Environment and Institutional Support

Effective management of MAP resources depends on coherent policy frameworks. Studies across South Asia show that policies related to forestry, agriculture, biodiversity, and trade often operate in silos, creating gaps in regulation and support (Pant & Rai, 2017). In Pakistan, MAP-related governance is divided between the Forest Department, Agriculture Department, and local government institutions, leading to fragmented implementation.

Recent national policies emphasize the importance of non-timber forest products for rural livelihoods, but operational frameworks remain weak. Scholars argue that integrating MAP conservation with livelihood development—through community forestry models, joint management, and benefit-sharing mechanisms—can improve outcomes for both people and ecosystems (Rahman & Shah, 2019).

In Hazara, strong institutional coordination is needed to regulate harvesting permits, support cultivation, and provide training on sustainable practices. The literature also underscores the role of academic institutions, such as Hazara University, in conducting research on species identification, economic potential, propagation methods, and supply chain analysis.

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Economic Valuation Approaches

Economic valuation of MAPs involves assessing their direct use value, market price, ecosystem service contribution, and potential for enterprise development. Several methodologies are used globally:

1. Market Price Method – calculates revenue obtained through direct sale of herbs.
2. Value Chain Margin Analysis – examines profit distribution among collectors, traders, and processors.
3. Cost–Benefit Analysis for Cultivation – compares returns from herb cultivation with alternative crops.
4. Ecosystem Service Valuation – assesses benefits such as soil stabilization, biodiversity conservation, and cultural value.

Studies from Nepal and Bhutan show that cultivation of certain high-value herbs can yield higher profits than traditional crops like potatoes or maize. These findings imply potential for crop diversification in mountain areas of Hazara.

Despite growing regional research, gaps remain regarding species-specific economic valuation in Hazara, women's economic roles, the influence of hakeems on market behavior, and the potential for herbal clusters. Addressing these gaps would support evidence-based planning for sustainable harvesting and value-added enterprise development in the region.

3. Theoretical Framework

This study is guided by the Sustainable Livelihoods Theory, which emphasizes that rural households rely on different forms of capital—natural, human, social, physical, and financial—to maintain and improve their livelihoods (Chambers & Conway, 1992; Morse & McNamara, 2013). In the Hazara context, medicinal and aromatic plants (MAPs) constitute a form of natural capital, providing both income and health benefits to local communities. By examining the practices of hakeems and pansars, the study investigates how these actors utilize MAPs while balancing economic gains with ecological conservation. Modern interpretations of the theory highlight the role of adaptive strategies, knowledge systems, and market participation in sustaining livelihoods in changing socio-environmental conditions (Natarajan et al., 2022). This framework links traditional knowledge, resource use, and economic activity to the broader goal of sustainable development in rural mountain settings.

4. Methodology

This study adopts a qualitative research design to explore the economic and ecological practices of medicinal and aromatic plant (MAP) users in Hazara. Qualitative methods are particularly suitable for understanding local knowledge, cultural practices, and decision-making processes associated with resource use. The research focuses on hakeems and pansars, who play a central role in the collection, processing, and distribution of MAPs.

Primary data were collected through semi-structured interviews with selected hakeems and pansars. Participants were chosen using purposive sampling to ensure that respondents have extensive knowledge of medicinal plants, including identification, therapeutic use, and market practices. Interviews explored topics such as species selection, harvesting techniques, local pricing, challenges in sustainable collection, and perceptions of market dynamics.

Interviews were conducted in local languages to facilitate open communication, and participants were encouraged to share detailed narratives about their daily practices. Notes and audio recordings were used to capture responses accurately, ensuring data richness and authenticity.

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5. Data Analysis

Collected data were analyzed using thematic analysis, which allows identification of recurring patterns, concepts, and insights from participants' accounts. Thematic coding focused on key dimensions, including economic benefits, sustainability practices, knowledge transmission, and market interactions. Data were then synthesized to develop a comprehensive understanding of how MAPs contribute to livelihoods while considering ecological constraints.

Thematic Analysis

The herbal plant sector in Hazara is deeply intertwined with local culture, traditional health practices, and mountain ecosystems. To explore the economic and ecological dimensions of medicinal plant use, semi-structured interviews were conducted with three local traditional practitioners—two hakeems and one pansar. The discussions focused on plant species commonly used, therapeutic applications, sources of supply, market interactions, pricing structures, cultivation practices, and sustainability challenges. Analysis of these interviews revealed five interconnected themes that offer insights into both economic potential and resource management in the region.

Theme 1: Cultural and Therapeutic Knowledge

All participants demonstrated extensive traditional knowledge of medicinal plants, reflecting their long-standing role as primary healthcare providers within local communities. They identified specific herbs for common ailments, including digestive disorders, respiratory illnesses, fever, musculoskeletal pain, and wound care. For example, Podeena and Jogi Jurri were frequently cited for digestive issues, while Ratan Jok and Mamekh were recommended for back and joint pain, and Patrees for respiratory infections and fevers. This theme highlights that herbal remedies are not only medically significant but also culturally embedded, fostering strong community trust.

Hakeems emphasized that the preference for local herbs stems from affordability, accessibility, and long-standing familiarity compared to modern pharmaceuticals. One hakeem stated, "People trust herbs passed down from their ancestors; they are cheaper and do not have side effects like chemical medicines." This reliance on traditional remedies ensures a consistent demand for particular plant species, which in turn shapes collection practices and local market dynamics. The depth of this knowledge also indicates the potential role of hakeems as partners in conservation and cultivation programs, as their expertise can guide sustainable harvesting and species selection.

Theme 2: Economic Value and Price Differentiation

A second key theme emerging from the interviews was the wide variation in economic value among different species. Prices for commonly harvested herbs ranged from as low as Rs. 300 per kilogram for everyday species to over Rs. 7,000 per kilogram for rare, high-demand plants. Kala Zeeri, Patrees, Jogi Jurri, and Ratan Jok were identified as particularly valuable due to scarcity and high medicinal potency, while more abundant species like Mamekh and Chorah offered lower returns.

This differentiation creates clear economic incentives for collectors and small-scale farmers, but also generates pressures that can affect sustainability. High-value species attract intensive collection, sometimes leading to overharvesting in the absence of structured management. Conversely, low-value plants are often overlooked despite their cultural and medicinal significance. Interviews revealed that pricing is influenced by scarcity, seasonal availability, and therapeutic reputation. One pansar explained, "Collectors don't know what the herbs are worth in the cities; they sell quickly to hakeems for immediate cash." This

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statement underscores the importance of market transparency and better information flow to maximize local earnings.

Theme 3: Supply Sources and Cultivation Opportunities

Interview data indicated that the majority of medicinal plants are still harvested from wild habitats, particularly forested areas in Siran Valley, Balakot, Murree, and surrounding highland belts. However, a smaller subset of herbs has begun to be cultivated on a limited scale, including Kala Zeeri in Dhodial and Girwal and selected herbs in Mundi and Manda Gucha. These emerging cultivation practices demonstrate the feasibility of structured production and highlight potential avenues for reducing pressure on wild populations.

Participants expressed optimism regarding the expansion of cultivation. Hakeems suggested that planned growth could stabilize supply, improve quality, and increase income predictability. Cultivation also enables the introduction of controlled agronomic practices, such as optimized planting densities, irrigation, and organic soil management, which are not possible in wild collection scenarios. Furthermore, location-specific insights were noted: Siran Valley's water availability makes it suitable for high-yield cultivation of Podeena and Chorah, whereas Balakot and Kaghan provide ideal conditions for slow-growing root species like Mamekh and Ratan Jok. Dhodial and Girwal were recognized for their suitability in cultivating high-value species like Kala Zeeri. These site-specific advantages suggest that regionally tailored cultivation strategies could enhance productivity while supporting ecological sustainability.

Theme 4: Sustainability Risks and Resource Management

All respondents highlighted concerns about sustainability and the long-term viability of wild collection. Overharvesting, seasonal scarcity, and habitat degradation were identified as key threats. Hakeems reported that certain species are becoming harder to find in their natural habitats, leading to increased collection effort and longer foraging times. They also noted a lack of structured knowledge regarding agronomic practices, optimal harvesting periods, propagation techniques, and yield estimation.

The interviews underscored the tension between economic necessity and ecological preservation. Collectors often prioritize immediate income over long-term resource management due to low margins and lack of access to alternative livelihoods. Hakeems emphasized that without guidance and training, wild populations of slow-growing or high-demand herbs could face severe depletion. This theme indicates the need for integrated approaches, including community nurseries, demonstration plots, training programs, and local monitoring systems. By embedding sustainability within economic activities, the region could balance income generation with conservation objectives, ensuring the longevity of both natural and human capital.

Theme 5: Market Dynamics and Information Asymmetry

The fifth theme relates to the structure of herbal markets and the flow of economic benefits along the value chain. Interviews revealed that hakeems act as primary buyers and intermediaries, maintaining long-term, trust-based relationships with collectors. However, this system also allows intermediaries to capture a significant share of profits, as collectors often lack timely information about urban market prices in Abbottabad, Rawalpindi, and Lahore.

Information asymmetry was identified as a central barrier to fair pricing. Collectors frequently sell herbs quickly at lower rates to meet immediate financial needs, while buyers profit from selling in urban centers at marked-up prices. Hakeems acknowledged this imbalance but noted the practical challenges in changing established supply relationships.

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Establishing market information systems, such as regular price updates via mobile platforms or local cooperatives, could empower producers to negotiate better rates and reduce exploitative dynamics.

Furthermore, interviews highlighted the role of value addition in stabilizing income. Activities such as drying, grading, packaging, and minor processing were seen as opportunities to enhance the economic value of herbs while creating employment for women and youth. Hakeems stressed that even modest improvements in post-harvest handling could increase market prices by 20–40% and reduce losses caused by deterioration or contamination. This aligns with broader evidence that structured processing and cooperative market participation enhance rural livelihoods and strengthen local economies.

Implications for Economic Development and Sustainable Practices

The five themes collectively reveal that the herbal plant sector in Hazara is both culturally significant and economically promising. Traditional knowledge ensures a steady demand for certain species, while price differentiation presents income opportunities for collectors and small-scale farmers. However, sustainability risks, wild-dependence, and market inefficiencies limit long-term benefits.

Structured cultivation programs, community nurseries, and training initiatives could enhance yield stability, improve quality, and increase profitability. Moreover, integrating women into value addition processes, implementing market information systems, and promoting cooperative structures could reduce information asymmetry and maximize income. Sustainability-oriented cultivation also addresses ecological concerns, ensuring that high-value herbs are not overexploited and that local ecosystems remain resilient.

Connecting local knowledge systems with market opportunities and conservation strategies, Hazara's herbal plant sector has the potential to serve as a model for green economic development. Careful planning, institutional support, and community engagement can transform informal, high-risk harvesting practices into organized, sustainable enterprises that simultaneously generate income, preserve biodiversity, and maintain cultural heritage.

Interviews with hakeems and pansars highlight the interdependency between traditional knowledge, economic opportunity, and ecological sustainability in the Hazara herbal plant sector. The five themes—therapeutic knowledge, economic differentiation, cultivation potential, sustainability risks, and market dynamics—illustrate both the challenges and opportunities inherent in this system. A transition toward sustainable cultivation, value addition, and enhanced market access could increase profitability, reduce environmental pressures, and secure long-term livelihoods for local communities. This thematic analysis provides a foundation for policy recommendations, cultivation strategies, and market interventions that aim to maximize economic gains while safeguarding the region's botanical heritage.

6. Discussion

The findings from interviews with hakeems and pansars in the Hazara region illustrate the complex interplay between traditional knowledge, economic opportunity, and ecological sustainability in the medicinal plant sector. Five central themes emerged from the data—therapeutic knowledge, economic differentiation, cultivation potential, sustainability risks, and market dynamics—which provide a foundation for understanding both challenges and opportunities in this context.

Integration of Traditional Knowledge and Economic Potential

The interviews revealed that local practitioners possess detailed knowledge of medicinal plants, their therapeutic applications, and associated local demand patterns. This aligns with

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the notion that indigenous knowledge is a critical component of sustainable livelihoods, enabling communities to derive both health and economic benefits from their environment (Abbas et al., 2017; Pavlov & Bukvareva, 2007). Herbs such as Podeena, Patrees, and Ratan Jok are highly valued for their efficacy and cultural acceptance, which maintains steady demand. Such trust in local remedies, combined with low-cost alternatives to allopathic medicines, enhances the economic potential of herbal plants for rural households (Ali, 2000; Abbas et al., 2020).

Economic Differentiation and Value Chain Opportunities

Price variation across species highlights the potential for strategic cultivation and market-based interventions. High-value species like Patrees and Kala Zeeri offer lucrative income streams, whereas more common herbs provide steady but modest returns. This disparity reflects wider trends in natural resource-based markets, where scarcity and demand influence economic opportunity (Raimi et al., 2021; Schütze, 2020). The interviews suggest that collectors and farmers currently capture only a fraction of potential earnings due to the dominance of intermediaries and information asymmetry. This finding supports previous research emphasizing the need for transparent supply chains and knowledge sharing to enhance rural incomes while maintaining sustainability (Durrani et al., 2020; Olan et al., 2022).

Cultivation Potential and Regional Advantages

Most medicinal plants remain dependent on wild harvesting, yet limited cultivation exists in areas such as Dhodial, Girwal, and Manda Gucha. Participants reported that planned cultivation could stabilize supply, improve product quality, and reduce harvesting pressure on natural populations. These observations correspond with broader ecological studies that stress the importance of site-specific strategies for sustainable plant production in mountainous regions (Abbas et al., 2017; Beniston, 2016). By leveraging regional ecological strengths—such as water availability in Siran Valley for Podeena or suitable soil conditions in Balakot for root-based herbs—structured cultivation can enhance productivity while safeguarding biodiversity (Alam, 2010; Muhammad et al., 2017).

Sustainability Risks and Knowledge Gaps

Overharvesting, habitat degradation, and limited agronomic knowledge emerged as key risks threatening long-term productivity. Hakeems and pansars highlighted that high-value plants are increasingly difficult to locate in the wild, indicating the risk of resource depletion if current practices continue. These findings align with global literature documenting the vulnerability of medicinal plant species in mountain ecosystems due to anthropogenic pressure and environmental change (Brooks et al., 2002; Ali, 2008). Establishing community nurseries, demonstration plots, and structured training for collectors could mitigate these risks while providing economic benefits, echoing sustainability frameworks proposed by Ahmed & Sundaram (2012) and Bettencourt & Kaur (2011).

Market Dynamics and Information Asymmetry

Hakeems function as both buyers and knowledge intermediaries, creating trust-based networks with collectors but also limiting producers' bargaining power. This mirrors findings in sustainable finance and supply chain literature, where information gaps often restrict equitable value distribution and impede market efficiency (Nasution et al., 2024; Tseng et al., 2021). By introducing market information systems, transparent pricing mechanisms, and cooperative structures, local actors could capture a greater share of value, reduce volatility, and enhance incentives for sustainable cultivation (Dion & Evans, 2023; Gangi et al., 2021). Moreover, value addition through drying, grading, and packaging could increase revenues

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while generating employment for women and youth, fostering inclusive economic growth (Laurenti et al., 2016; Chausson et al., 2023).

Implications for Policy and Practice

The thematic analysis underscores the need for integrated interventions combining ecological conservation, economic development, and social inclusion. Encouraging cultivation of high-value species, providing practical training for collectors, and enhancing market transparency can transform informal wild harvesting into structured, sustainable production systems. Such strategies reflect principles outlined in sustainable enterprise and finance frameworks, which emphasize stakeholder engagement, resource efficiency, and long-term economic viability (Elkington, 1994; Chofreh et al., 2016; Migliorelli, 2021).

Additionally, region-specific approaches are critical. Hazara's diverse topography and microclimates suggest that generalized policies may be less effective than localized cultivation and resource management strategies. For instance, nurseries for slow-growing roots in Balakot or water-intensive herbs in Siran Valley could optimize yields while minimizing ecological impact. Integrating traditional knowledge with scientific guidance ensures that interventions are culturally appropriate, ecologically sound, and economically viable (Alam & Ali, 2010; Benkard, 2004).

The discussion highlights the intertwined nature of culture, economy, and ecology in Hazara's medicinal plant sector. The five thematic areas—traditional knowledge, economic differentiation, cultivation potential, sustainability risks, and market dynamics—illustrate both the promise and the constraints of this sector. By combining structured cultivation, community-based monitoring, value addition, and market transparency, stakeholders can enhance local livelihoods while protecting biodiversity. These insights not only inform sustainable management strategies but also provide a model for integrating traditional knowledge systems with modern sustainability and economic frameworks in mountainous regions.

7. Conclusion

The study demonstrates that the medicinal plant sector in Hazara is closely linked to cultural practices, economic opportunity, and ecological sustainability. Traditional practitioners possess extensive knowledge of plant species and therapeutic uses, which sustains local demand and cultural trust. Certain high-value species, such as Kala Zeeri, Patrees, and Ratan Jok, offer substantial income prospects; however, reliance on wild collection, overharvesting, and information gaps in market channels limit economic benefits. Emerging cultivation efforts and potential for local processing indicate that structured interventions can enhance yields, stabilize supply, and increase earnings, especially for women and youth. Integrating traditional expertise with modern cultivation practices, post-harvest handling, and cooperative market structures is essential for long-term sustainability of both livelihoods and plant resources in the region.

To enhance the economic and ecological potential of medicinal and aromatic plants in the Hazara region, several strategic measures are recommended. First, promoting the cultivation of high-value species in areas with favorable microclimatic conditions can reduce dependence on wild populations while ensuring a more stable supply. Complementing cultivation, the development of local processing units for drying, sorting, packaging, and producing value-added herbal products can increase profitability and create employment opportunities, particularly for rural communities. Improving market access through cooperative structures or digital platforms can provide collectors and small-scale farmers with timely price information, thereby reducing reliance on intermediaries and promoting fairer

trade. Community-based resource management initiatives, including nurseries, demonstration plots, and local monitoring systems, are essential to encourage sustainable harvesting practices and preserve biodiversity. Capacity-building programs that provide training on propagation, post-harvest handling, and sustainable collection techniques can equip collectors, farmers, and traditional practitioners with the skills needed for long-term resource management. Additionally, fostering gender-inclusive participation by involving women in processing, marketing, and value-added activities can enhance household income and contribute to economic equity. Finally, coordinated policy efforts that integrate forestry, agriculture, and trade regulations, supported by academic and institutional partnerships, are necessary to ensure that conservation and livelihood objectives are effectively aligned.

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