

A REVIEW ON PRODUCTION AND MARKETING OF SATAVARI (*Asparagus Racemosus*) IN THE TARAI AREA OF KUMAUN REGION OF UTTARAKHAND

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ABSTRACT

The Tarai region of Kumaun in Uttarakhand stands out as one of the important centres for cultivating medicinal plants and producing traditional medicines. This prominence is largely due to the area's unique climate and soil, as well as its abundance of plant biodiversity, which together support both cultivation and the continuation of traditional healing practices. Satavari (*Asparagus racemosus*), known locally as Shatavari, is an important medicinal plant used extensively in Ayurvedic medicine systems and has substantial market potential. Understanding the production dynamics and marketing challenges of this medicinal herb requires examining broader contextual frameworks related to medicinal plant cultivation, value chain management and the Ayurvedic pharmaceutical industry in the region.

Satavari (*Asparagus racemosus*) belongs to family Liliaceae, commonly known as 'Queen of herbs' in Ayurveda, because it is used as a main constituent of female reproductive tonic. This amazing herb is highly effective in diseases related to female reproductive system. Satavari is also a high-value medicinal plant widely used in Ayurvedic formulations, because it prevent ageing, increase longevity, impart immunity, improve mental function, vigor and addvitality to the body and it is also used in nervous disorders, dyspepsia, tumors, inflammation, neuropathy, hepatopathy. Dried roots of Satavari plant have main therapeutic value as a drug, due to the presence of pharmaceutical active compound steroidal saponins and Asparagamine, a polycyclic alkaloid.

The main objective of this review paper is to understand the traditional production practices of Satavari in the Tarai area, marketing channels and value addition with specific micro-climate of foothills area of Kumaun region and overall its impact on rural economics, because increasing demand of Satavari from domestic and export herbal markets has incentivized farmers to shift from traditional crops to Satavari cultivation.

Keywords: Satavari, *Asparagus racemosus*, Saponins, Kumaun region, Uttarakhand

INTRODUCTION

Asparagus racemosus, commonly known as Shatavari, is a highly valued medicinal plant recognized for its diverse therapeutic properties and

substantial economic potential in the global pharmaceutical market ([Kumar & Yadav, 2013](#)).

Owing to its intensive utilization in traditional systems like Ayurveda and Unani, the species faces significant pressure, leading to its endangered status

by the IUCN due to habitat degradation and overexploitation ([Sharma & Singh, 2021](#)). To address these challenges, cultivating high-yielding accessions offers a sustainable alternative to wild harvesting while providing farmers with a viable economic substitute for traditional agricultural crops ([Saran et al., 2020](#)). The Tarai region of Kumaun, characterized by its fertile alluvial soil and sub-tropical climate, provides an ideal ecological niche for the commercial-scale cultivation of *Shatavari*. Despite this suitability, the sector remains hindered by fragmented value chains and a lack of market transparency for primary producers ([Kala et al., 2006](#)). Consequently, this study aims to examine the prevailing production constraints and marketing bottlenecks that impede the economic viability of *Shatavari* cultivation in the region ([Sharma & Chen, 2020](#)). Specifically, this research evaluates the existing supply chain architecture to identify the roles of various stakeholders and the influence of intermediaries on farmer profitability ([Chandra & Kumar, 2021](#)). By assessing these infrastructural and economic impediments, this research establishes a strategic framework for improving livelihood security through the commercialization of medicinal plants in Himalayan rural societies ([Phondani et al., 2011](#)). This assessment is particularly urgent given that current medicinal plant businesses in Uttarakhand often lack the necessary integration to ensure long-term resource and economic sustainability ([Chandra, 2020](#)).

MEDICINAL PLANT RESOURCES AND UTTARAKHAND'S BIODIVERSITY

The Indian Himalayan Region constitutes a unique ecosystem with exceptional biodiversity ([Gupta et al., 2023](#)). Uttarakhand, being home to a diverse range of wildlife and fragrant plants, has subtropical to tropical soils and agro-climatic conditions, with the Alpine region serving as a biodiversity hotspot with diverse wildlife populations ([Rawat et al., 2023](#)). The Almora forest division of the Kumaun Himalayan region in Uttarakhand contains a rich medicinal plant flora, with 204 medicinal plant

species having been documented during medico-ethnobotanical exploration. Among these, six species are found under endangered and threatened categories, indicating the urgent need for conservation of medicinal plants and their natural habitat for perpetual existence.

The significance of medicinal plants in the Uttarakhand region extends beyond ecological importance ([Tripathi et al., 2019](#)). India is considered "Herbarium of the world" due to its varied agro-climatic conditions and is among the biggest repositories of herbal wealth globally, with Uttarakhand being a native place for different medicinal and aromatic plants due to its subtropical to cold arid climate. With ever-increasing demand of natural products in pharmaceutical industries, cultivation of medicinal plants is now becoming popular and economically feasible. However, the challenge of maintaining quality while scaling production has become critical, as inorganic fertilizers and chemicals, while enhancing productivity, hamper the composition of secondary metabolites, which are active ingredients in medicinal plants.

TRADITIONAL MEDICINE SYSTEMS AND MARKET DEMAND

Ayurveda represents one of the oldest and most comprehensive traditional medicinal systems in India, with deep cultural and therapeutic significance ([Nath et al., 2022](#)). Ayurveda is an ancient traditional medical care system with a major aim of preventing unnecessary suffering and aiding healthy long life, incorporating natural constituents to make potential medicines that are believed to eliminate the root cause of diseases. India alone reports 15,000 medicinal plant species, of which 7,500 species are used by communities to cure different diseases. Ayurveda uses single or polyherbal formulations for treatment, with various formulations including fermented preparations known as arishtas and asavas.

The global herbal medicine market has experienced substantial growth in recent decades (Ravi & Bharadvaja, 2019). There has been a significant growth in the herbal drugs market around the world over the last few decades due to growing awareness among people about the rising cost and side effects related to the use of synthetic drugs. Herbal medicine has been used in traditional medicinal systems around the world, especially India where the oldest systems of medicine namely Ayurveda, Siddha, and Unani make use of more than 90% plant-based formulations. India is rich in medicinal and herbal plant resources that provide for both the health care needs of rural India and the source of raw material for therapeutic agents required in the production of traditional and modern medicine.

The market dynamics of medicinal plants in India reflect both domestic and international demand patterns. India's domestic herb market is represented by a very wide range of users from pharmaceutical industries, folk practitioners to household users (Pujari *et al.*, 2020). The domestic market of Indian system of medicines and Homeopathy (ISM&H) is of the order of Rs 4000 Crore with total consumption of all botanicals to the figure of 17,700 MT which is expanding day by day, with annual turnover of the Ayurvedic drug manufacturing industry estimated around Rs 3,500 Crore. Due to high demand all over the world, the genuinity of drugs and natural resources are threatened. To overcome this issue, the Government of India has taken several measures to promote the cultivation of medicinal plants for conservation of natural resources and to meet the demand of the herb market with genuine articles.

PRODUCTION CHALLENGES IN HILLY REGIONS

The Tarai and hilly regions of Uttarakhand face specific agricultural challenges that impact medicinal plant cultivation. The mid-hills of Uttarakhand constitute a major part of agricultural land in north-west Himalaya, with the region having a unique

advantage of off-seasonality in vegetable production (Singh *et al.*, 2013). However, sub-optimal temperature during winter months is a major limitation in vegetable production in the region. Understanding production constraints is essential for developing viable cultivation strategies for medicinal plants including Satavari.

Agricultural productivity in hilly regions is significantly influenced by climatic and infrastructural factors. A study conducted in districts of Tehri-Garhwal and Almora under the hill state of Uttarakhand examined the economics of major crops grown under organic farming systems and identified constraints of production in the hilly region compared to inorganic farming approaches (Narain and Tripathi, 2024). The results based on interviews with 120 farmers (60 organic and 60 inorganic) revealed that gross and net income or profit of different crops increased significantly by two to three times under organic farming systems, whereas they remained stagnant and even declined under inorganic farming systems over the years. The costs of production of crops per hectare and per quintal under organic farming systems are lower than under inorganic farming systems, with gross and net incomes nearly 2 times higher under organic farming systems. Overall, organic farming systems produce more sustainable agricultural output with less energy, low cost and fewer resources, though constraints remain.

ORGANIC CULTIVATION OF MEDICINAL PLANTS

Organic farming practices have emerged as a preferred approach for medicinal plant cultivation, offering both environmental and economic benefits (Tripathi *et al.*, 2019). Under circumstances where inorganic fertilizers and chemicals cause environmental problems and hamper the composition of secondary metabolites, organic cultivation of medicinal plants provides more viable options. Organically grown medicinal plants have not only appropriate composition but also enhance the opportunity for their export, as medicinal plant

products constitute less than 1% of the \$70 billion Indian share of world trade. The organic movement has received institutional support through various policy changes, recognizing the need to promote organic farming of medicinal and aromatic plants for making production systems sustainable and export-oriented.

The profitability of organic farming in medicinal and aromatic plant production extends beyond conventional measures. A sustainable and environmentally friendly agriculture program in a medicinal plant producing region focused on family medicinal plant and organic rice cultivation, demonstrating positive outcomes such as organic compost production, diverse organic crops, and the formation of local farmer groups (Behera & Mishra, 2021). The program included activities such as organic rice cultivation training, MOL and organic pesticide preparation training, herbal basic and advanced training, and facility and infrastructure procurement. The results demonstrated that organic approaches could be effectively combined with training and community support to enhance production capabilities.

VALUE CHAIN AND SUPPLY CHAIN MANAGEMENT

Effective production and marketing of medicinal plants require sophisticated value chain and supply chain management systems. The production process of formulated products of medicinal plants follows a five-actor value chain structure. Raw material is provided by harvesters who collect medicinal plants from the wild (Laird, 2002). Processing is conducted by wholesalers and formulators, with wholesalers adding value by drying, milling and bulk packaging of individual medicinal plants. Formulators mix different medicinal plants to create ready-made products for specified diseases, while distribution is done by retailers and healers. There are six regulating and two supporting organizations in the value chain, with private supporters including millers and transporters. Governance structure tends to be

relational as a result of lack of official standards along the value chain.

The economic implications of value chain structure are significant for producers. A study of three important medicinal plants documented supply and value chains covering primary producers, market traders, and processors (Pyakurel and Chapagain, 2014). The analysis revealed that three species were mostly extracted from the wild, with two species facing depletion. There was an unfair margin to traders, with producers' shares ranging between 35-50%, which is considerably low. This disparity highlights the need for better linkages between producers and end-users to improve farmer incomes.

A comprehensive framework for understanding medicinal plant value chains in the Indian context reveals systemic issues requiring attention. Value chains and effective supply chain management systems are essential tools for establishing a network of farm produce until it is end-use as a value-added processed product (Hegde, 2015). This necessarily requires policy initiatives for bridging raw produce to grassroots innovative practices for value addition. Through extensive literature analysis of value chain management of medicinal plants in India, multiple gaps were identified in ethnopharmacological studies and a need was recognized to re-route the value chain involving institutional settings and NGOs. Different policy initiatives have been executed by government support systems to establish cohesive approaches between producers and consumers, with an impetus to innovative technology development followed by its transfer to industrial counterparts. This integrative concept would lead to value proposition in the medicinal plant sector and establishment of special-purpose vehicles leading to financial sustenance, promoting a probabilistic gateway to the circular economy.

MARKETING AND MARKET INTEGRATION

The marketing of medicinal plants faces multiple challenges related to market organization, price discovery, and consumer awareness. A study of medicinal and aromatic plants in mountainous areas with large pure stands of forest containing economically important medicinal and aromatic plants revealed that the trade of medicinal and aromatic plants is highly uncoordinated and complex, involving many players (Olsen and Helles, 2009). Of 30 medicinal and aromatic plants surveyed, only ten species were collected mainly for sale purposes, most collected by children and women for supplementary income. Rare and threatened species were collected in a highly unsustainable manner, causing biodiversity loss and depletion of populations with about 10% reduction claimed on both parameters. The study made recommendations for training in plant identification, sustainable collection, processing, value addition, equitable sharing of benefits of medicinal and aromatic plants, trade monitoring and cooperative systems of marketing.

The global market for medicinal and aromatic plants demonstrates significant growth potential. The total trade in medicinal and aromatic plants has increased from 2.4 billion USD in 1996 to 6.2 billion USD in 2013 with an annual growth rate of 5.4% over 18 years, with recent growth rates of 10.7%. By 2023, the herbal medicine market was expected to develop at a compound annual growth rate (CAGR) of 5.88% and reach USD 1,29,689.3 million (Katiyar and Chandra, 2016). China, India, Hong Kong, USA, Germany, Republic of Korea, Canada and Poland are the top export countries while major destinations include USA, Hong Kong, Japan, Germany, France, Republic of Korea, China and Singapore. A number of Non-Governmental Organizations and Governmental Organizations have been working on improvement and expansion of commodity-wise value chains for selected medicinal and aromatic plants throughout the world.

SUSTAINABLE HARVESTING AND CONSERVATION

Sustainable management of medicinal plant resources presents a critical challenge for the medicinal plant sector, particularly for wild-collected species. A study combining qualitative and quantitative methods to survey traders and local harvesters from nine Tibetan townships elucidated the local value chain of medicinal plant trade and harvest of *Nardostachys jatamansi* and *Fritillaria cirrhosa* (Zhang and Wang, 2022). The results revealed that trade characteristics of the two species were contrasting, with sustainability of one species largely dependent on the other. Importantly, traders' practices were affected by supply, while harvesters' willingness to harvest was mainly influenced by harvest incomes, past harvesting experience, and grassland tenure. The harvesters' ecological worldview indirectly affected their harvesting behavior, particularly through the mediation of the level of compliance with village rules and customs.

Conservation urgency is particularly acute for medicinal plants facing extinction threats. The Indian Himalayan Region, which forms part of one of 36 global biodiversity hotspots, is known for its rich and unique biodiversity elements (Gupta and Singh, 2021). Increased demand for plant-based medicinal products has caused over-harvesting, unmonitored trade, habitat destruction and anthropogenic pressure on medicinal and aromatic plants. In a comprehensive study of threatened plants in the Indian Himalayan Region, 112 plant species were documented of which 19 species were found to be in high-risk categories according to IUCN classification: seven critically endangered, seven endangered and five vulnerable. Distribution, life-forms, medicinal values, plant parts used, threat categories, population trends, market value and conservation approaches of the species are presented, with strong recommendations for prohibition of unmanaged extraction of medicinally important threatened plants from the wild and encouragement of their cultivation.

QUALITY STANDARDIZATION AND PHARMACEUTICAL DEVELOPMENT

The standardization and quality control of herbal medicines represents a fundamental challenge for the Ayurvedic pharmaceutical industry. Standardization of herbal formulations is a process of setting standard parameters essential for assuring the quality of herbal formulations and ensuring reproducibility at any time during the stability period of formulations (Jyoti *et al.*, 2023). Today, many people experiencing side effects of modern medicine are shifting towards traditional medical systems, among them most widely accepted is Ayurveda. Increased demand of herbal medicines, along with disparity in demand and supply of raw materials and profit mindedness of pharmaceutical agencies, has resulted in substandard and unsafe products. The adulteration and substitution of drugs, methods of collection, storage and preservation of raw drugs, controversial opinions regarding formulations in classical texts, addition of preservatives and improper purification of toxic herbal and mineral drugs are main problems leading to production of substandard and unsafe products. Authorities like WHO and the Government of India have taken steps to standardize individual drugs and formulations.

The regulatory framework for herbal medicines has evolved to address these quality concerns. Standardization of herbal formulation is important for assessing the standard, purity, safety and efficacy of drugs. The procedure for developing preparations safe for consumption needs modification from traditional methods (Kumar and Singh, 2019). The World Health Organization has estimated that approximately 80% of the population in developing countries relies almost exclusively on traditional medicine for primary health care needs, with Ayurveda covering most community care in India as both a preventive and curative system of medicine.

AGRICULTURAL PRACTICES AND PRODUCTIVITY ENHANCEMENT

Enhancing agricultural productivity for medicinal plants, while maintaining quality requires specific agronomic interventions and practices. Medicinal plant trade has grown by 100% to over 0.6 million tons per year in India over the past two decades, mainly due to growth in consumption of cultivated herbs such as Mint, Holy Basil, Indian Ginseng and spices (Kumar and Sharma, 2017). Various eco-agri-techniques have been identified to increase polyphenol content (emerging bioactive principles) in herbs, including varietal breeding, organic inputs, mycorrhiza/bio-fertilizers, micronutrients, cultural/agronomic practices and elicitors. Such agri-techniques can improve the active ingredient particularly polyphenol content by 50% to 100% and are profitable for the manufacturing industry and farmers. The Indian Government has supported medicinal plant cultivation for the last two decades, especially of threatened herbs, but needs improvement through natural farming techniques and labeling of ingredient content and safety parameters with industry partnership.

INSTITUTIONAL SUPPORT AND POLICY FRAMEWORK

Government support systems and institutional frameworks play crucial roles in promoting sustainable medicinal plant cultivation. India is one of the mega biodiversity countries in the world with massive forests as a hub for indigenous medicinal plant resources. Pharmaceutical industries are fundamentally dependent on conventional supply of medicinal and aromatic plant-based substances (Sharma and Singh, 2020). Overexploitation of plants for manufacturing herbal pharmaceuticals and illegal harvesting has caused wild habitat degradation. Biotechnological approaches encompassing in vitro methods like micropropagation, molecular characterization, molecular docking studies, and

chemo-profiling can be employed to conserve plant species from further exploitation and overcome the burden on wild populations. These approaches help in higher-scale propagation and encourage sustainable consumption, with appropriate agro techniques and ample marketing opportunities encouraging cultivation.

MEDICINAL AND AROMATIC PLANT SUPPLY CHAIN CHALLENGES

The medicinal and aromatic plant sector faces multiple supply chain management challenges. There is increasing evidence for the significant value and potential of medicinal and aromatic plants worldwide. Among other non-wood forest products, these plants are considered key elements of sustainable forest management and economic development (Taghouti *et al.*, 2022). Despite their prominent contribution to local development, conservation of biodiversity and the development of traditional food systems, many challenges and knowledge gaps could potentially place the sector's development at risk. A supply chain analysis of medicinal and aromatic plants in Mediterranean countries identified five groups of challenges related mainly to certification and labelling, life quality and wellbeing, market development, research development, and transforming and processing. Validation by interviewed experts aimed at improving marketing strategies and including various innovations related to political, legal, organisational and institutional frameworks.

REGIONAL PRODUCTION DYNAMICS AND OFF-SEASON CULTIVATION

The Tarai region's capacity for off-season production represents a significant advantage for medicinal plant cultivation. The Vegetable Research Centre of G. B. Pant University of Agriculture and Technology, Pantnagar in Uttarakhand conducted investigations during the rabi season of 2019-20 on protective cultivation methods (Verma *et al.*, 2021). Results demonstrated that considering the prevalent

climatic conditions of the Tarai region of Uttarakhand, specific cultivation techniques can be recommended for obtaining higher yields. The region's unique agro-climatic conditions and favourable off-season characteristics make it particularly suitable for high-value medicinal plant production with proper management practices.

FARMER INCOME AND PROFITABILITY

The economic viability of medicinal plant cultivation for farmers depends on multiple factors including production efficiency, market access and pricing mechanisms. Studies comparing organic farming systems with conventional approaches in Uttarakhand's hilly regions demonstrated that both costs of production and profitability profiles differ significantly between systems (Narain and Tripathi, 2024). Farmers operating under organic systems achieved gross and net incomes nearly 2 times higher compared to inorganic systems, though organic farming faces various constraints including market challenges, supply of certified inputs, and access to extension services. Understanding these economic dynamics is essential for promoting sustainable medicinal plant cultivation that provides adequate income to farming communities.

CONCLUSION

The production and marketing of medicinal plants like Satavari in the Tarai area of Kumaun region, Uttarakhand operates within a complex framework involving ecological, agronomic, economic and institutional factors (Tripathi *et al.*, 2019). The need of the hour is to promote organic farming of medicinal and aromatic plants for making production systems sustainable and export-oriented by developing necessary strategies, putting institutional support for organic movement and making necessary policy changes. Success in this sector requires addressing multiple interconnected challenges: ensuring sustainable harvesting practices to conserve biodiversity, maintaining quality through

standardized cultivation and processing methods, developing efficient value chain structures that provide equitable returns to farmers, and integrating traditional knowledge with modern agricultural techniques. The substantial global market demand for medicinal plants combined with Uttarakhand's rich biodiversity and favorable agro-climatic conditions presents significant opportunities for the development of sustainable medicinal plant production systems, particularly for high-value crops like Satavari, provided that appropriate policy support, institutional mechanisms, and research-backed agricultural practices are put in place to guide sectoral development.

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