

## Kalmegh (*Andrographis paniculata*) The Next Miracle Crop in the Medicinal and Aromatic Plants (MAPs) Ecosystem – A Farm-to-Fork Value Chain Perspective

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### SUMMARY

Kalmegh (*Andrographis paniculata*), widely known as the “King of Bitters,” is an important medicinal plant extensively used in traditional and contemporary healthcare systems owing to its potent bioactive constituent andrographolide. In recent years, Kalmegh has gained renewed attention as a strategic medicinal and aromatic plant (MAP) crop, particularly in the context of immunity enhancement, liver health, anti-inflammatory, and antiviral applications. Following the global success trajectory of Ashwagandha, Kalmegh is increasingly being recognized as a potential next-generation miracle crop within the MAPs ecosystem. India, being a primary center of origin and traditional usage, holds a strong comparative advantage in Kalmegh cultivation, processing, and global supply. However, despite growing demand, the Kalmegh sector continues to face challenges related to non-standardized production, post-harvest losses, limited value addition, and weak farm–industry–market linkages. This article presents a comprehensive farm-to-fork analysis of Kalmegh, covering production systems, post-harvest management, processing, market dynamics, bottlenecks, and future prospects. It emphasizes the need for a post-Ashwagandha-style mission-mode approach to unlock Kalmegh’s full potential as a globally competitive medicinal crop.

### INTRODUCTION

Medicinal and aromatic plants form a critical pillar of India’s agrobiodiversity, traditional knowledge systems, and emerging bioeconomy. India is home to more than 7,000 medicinal plant species and serves as a major supplier of raw herbal materials to domestic AYUSH industries and international markets. Within this vast repository, *Andrographis paniculata* occupies a distinctive position due to its wide therapeutic spectrum, whole-plant utility, and strong scientific validation. Kalmegh is an annual herb belonging to the family Acanthaceae, native to India and Southeast Asia, and deeply embedded in Ayurveda, Siddha, Unani, and folk medicine traditions. Classical texts and traditional practices describe its use in fever, liver disorders, malaria, dysentery, respiratory infections, and metabolic ailments. Modern pharmacological research has corroborated many of these uses, attributing them primarily to diterpenoid lactones such as andrographolide, neo-andrographolide, and deoxyandrographolide, which exhibit antiviral, hepatoprotective, immunomodulatory, anti-inflammatory, and antidiabetic activities. From an agricultural perspective, Kalmegh is cultivated across several Indian states including Madhya Pradesh, Chhattisgarh, Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Odisha, and parts of Uttar Pradesh. The crop is usually grown during the kharif season, matures within 90–120 days, and requires relatively low external inputs. Average dry herbage yields range from 2 to 3 tonnes per hectare, with andrographolide content varying between 1–4%, depending on genotype, agro-climatic conditions, and management practices. Globally, demand for Kalmegh has increased significantly in the post-pandemic period due to rising consumer preference for plant-based immunity boosters and herbal therapeutics. Markets in Europe, the United States, and Southeast Asia increasingly prefer standardized Kalmegh extracts over raw herb. Despite India’s strong production base, its share in value-added exports remains limited, highlighting structural gaps across the value chain. In this context, Kalmegh is increasingly viewed as the next strategic MAP crop after Ashwagandha, with the potential to replicate and expand India’s success in the global herbal sector.

### Farm-To-Fork Value Chain of Kalmegh

#### 1 Farm-Level Production: Agronomy, Adaptability and Yield Dynamics

The farm-to-fork journey of Kalmegh begins at the production stage, where the crop demonstrates considerable adaptability and farmer-friendly characteristics. Kalmegh thrives under tropical and subtropical climates, preferring warm and humid conditions with moderate rainfall. It grows well on a wide range of soils, including marginal and light-textured soils, provided adequate drainage is ensured. This ecological flexibility makes it particularly suitable for rainfed regions, tribal belts, and diversification of existing farming systems.

Kalmegh is propagated primarily through seeds, sown by broadcasting or line sowing at the onset of the monsoon. The crop's short duration of 3–4 months allows its integration into multiple cropping systems and intercropping models. Low fertilizer and pesticide requirements, along with compatibility with organic and natural farming, further enhance its sustainability credentials.

However, a major production-level challenge is the high variability in biomass yield and andrographolide content, largely due to the use of non-uniform seed material and lack of standardized agronomic practices. This variability directly influences market acceptability and pricing. Experiences from Ashwagandha cultivation clearly demonstrate that genotype-led cultivation, quality planting material, and cluster-based production models are essential for transforming Kalmegh from a low-value medicinal herb into a commercially robust crop.

## **2 Harvesting and Post-Harvest Handling: The Critical Value-Determining Stage**

Harvesting and post-harvest management represent the most critical stages in the Kalmegh value chain, with a direct bearing on quality, efficacy, and market value. Scientific studies indicate that andrographolide concentration in the aerial parts peaks at the pre-flowering to early flowering stage. Accordingly, the entire plant is harvested close to ground level during this window to maximize bioactive yield.

Post-harvest handling practices, however, remain largely traditional and unscientific. Sun drying, which is still commonly practiced, often results in degradation of thermo- and photo-sensitive compounds. Shade drying or controlled low-temperature drying is recommended to preserve phytochemical integrity. Maintaining moisture content below 10% is essential to prevent fungal contamination and loss of bitterness during storage. The absence of standardized post-harvest protocols, limited availability of decentralized drying and grading infrastructure, and lack of quality-linked procurement mechanisms result in substantial value loss at this stage. The Ashwagandha success story illustrates that institutionalized post-harvest SOPs, chemical profiling, and traceability systems are indispensable for ensuring consistent quality and improving farmer remuneration.

## **3 Primary Processing, Value Addition and Industrial Utilization**

Primary processing of Kalmegh involves cleaning, cutting, drying, powdering, and packaging of the dried herb. At the industrial level, value addition is achieved through solvent extraction and standardization of andrographolide content. Globally, the market is increasingly oriented towards standardized extracts containing 10%, 30%, 50%, or higher andrographolide levels, which are preferred for nutraceuticals, phytopharmaceuticals, and functional food formulations.

In India, however, limited access to extraction facilities, quality testing laboratories, and MSME-scale processing technologies restrict farmer groups and FPOs from entering higher-value segments. Consequently, most producers sell Kalmegh as raw or minimally processed dried herb, while the bulk of value addition occurs downstream. Strengthening domestic extraction capacity and promoting API-grade production can significantly enhance India's competitiveness in global herbal markets.

## **4 Distribution, Markets and the Consumer (Fork-End)**

At the consumer end, Kalmegh is used in a wide range of products including Ayurvedic formulations, proprietary herbal medicines, immunity boosters, liver tonics, and nutraceutical capsules. Domestic demand is largely driven by the AYUSH sector and public health programs, while international demand focuses on standardized extracts and evidence-backed formulations.

Despite growing demand, India's Kalmegh exports face challenges due to inconsistent quality, lack of harmonized standards, weak branding, and limited traceability. Strengthening farm-to-fork linkages through contract farming, cluster development, digital traceability, and quality certification is essential for improving market access and value realization.

## **Bottlenecks and the Need For A Post-Ashwagandha Revolution**

Several structural bottlenecks prevent Kalmegh from achieving Ashwagandha-like success. These include non-availability of certified high-yielding varieties, weak extension support, inadequate post-harvest infrastructure, limited industry–farmer integration, and insufficient clinical validation. Additionally, the absence of strong global branding and regulatory alignment restricts Kalmegh's entry into high-value regulated markets.

The transformation of Ashwagandha from a traditional herb to a globally recognized nutraceutical ingredient offers valuable lessons. A similar mission-mode approach for Kalmegh—encompassing varietal

improvement, standardized cultivation, decentralized post-harvest infrastructure, extract-focused industrialization, and evidence-driven marketing—is urgently required.

## CONCLUSION

Kalmegh stands at a critical juncture in the evolution of India's medicinal and aromatic plants sector. Its wide therapeutic relevance, whole-plant usability, short crop duration, and adaptability to marginal environments make it a strong candidate for large-scale adoption by small and marginal farmers. At the same time, its growing relevance in immunity and liver health positions it well within the global herbal and phytopharmaceutical markets. If supported by coordinated research, policy, and market interventions, Kalmegh can emerge as a flagship Indian medicinal crop in the global bioeconomy. A post-Ashwagandha revolution in Kalmegh is not only possible but essential for strengthening farmer livelihoods, enhancing value addition, and reinforcing India's leadership in the MAPs ecosystem.

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