



Plant Archives

Journal homepage: <http://www.plantarchives.org>

DOI Url : <https://doi.org/10.51470/PLANTARCHIVES.2025.v25.no.2.185>

FROM FIELDS TO FAME: A CURIOUS CASE OF GI TAGS IN CHILLI VARIETIES OF INDIA

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(Date of Receiving-07-07-2025; Date of Acceptance-21-09-2025)

ABSTRACT

Geographical Indication (GI) is a form of intellectual property right (IPR) that safeguards products possessing unique qualities, reputation, and characteristics attributed to their geographical origin. In agriculture, GI tags enhance marketability, preserve traditional knowledge, and protect farmers from unfair competition. India, with its diverse agro-climatic zones, has a rich repository of GI-tagged crops, including several iconic chilli varieties. This review comprehensively explores the history, legal framework, and importance of GI in agriculture, with a special focus on chilli varieties in India such as Guntur Sannam, Byadgi, Bhiwapur, and Khola. This paper discusses the evolution of GI registration in India since the enactment of the Geographical Indications of Goods (Registration and Protection) Act, 1999, its role in rural development, and challenges in enforcement. Furthermore, it highlights the socio-economic impact of GI certification, recent advancements, global trade implications, and the way forward for sustainable management of chilli biodiversity under the GI regime.

Key words: Geographical Indication, Agriculture, Intellectual Property Rights, Chilli, India, Rural development.

Introduction

Agriculture has historically been more than a source of livelihood; it has been an expression of culture, identity, and tradition. Across civilizations, communities have cultivated crops that were inherently linked to specific regions, climates, and cultural practices. Such products, whose uniqueness stems from geographical origin, later came to be formally recognized under the concept of Geographical Indications (GIs). A GI serves as a form of intellectual property right (IPR) that identifies a good as originating in a particular place, where a given quality, reputation, or other characteristic is essentially attributable to its geographic origin. Geographical Indication (GI)

highlights the origin and excellence of products unique to various locations (WIPO, 2023; Rangnekar, 2004).

Geographical Indication (GI) products represent a significant category of industrial property, as they establish a strong link between a product and its place of origin (Devi *et al.*, 2021). The use of a GI label not only identifies the geographical source but also guarantees the product's unique qualities and superior characteristics (Lukose, 2022). These distinctive attributes arise directly from their association with a specific region, locality, or country. As a form of Intellectual Property Rights (IPRs), Geographical Indications are safeguarded under international agreements such as the Paris Convention

and the Lisbon Agreement.

Certain products possess distinctive qualities, characteristics, or reputations that arise from their geographical origin. These unique features often stem from natural factors like soil, climate and topography, or from the traditional skills and craftsmanship of the local community (Rangnekar, 2004). The connection between a product and its specific place of origin is what the Geographical Indications (GI) law seeks to recognize and protect (Das, 2010).

For example, Assam Orthodox Tea, registered as a GI from Assam, is celebrated for its rich flavour and aroma, which are shaped by the state's unique climatic conditions. Because of this geographical link, consumers are willing to pay a premium for it, associating the tea with authenticity and superior quality (Basu, 2017). While orthodox tea is also produced in other tea-growing regions of the world, only tea originating from Assam can legally carry the GI tag of "Assam Orthodox Tea" (Tea Board of India, 2020).

Similar cases can be found across India. Darjeeling Tea from West Bengal, often referred to as the "champagne of teas," owes its muscatel flavour to the region's specific soil and high-altitude climate (Chakraborty and Sarangi, 2018). Mysore Silk from Karnataka is famous for its traditional weaving techniques and lustrous texture (Reddy, 2015), while Nagpur Oranges from Maharashtra are prized for their distinctive sweetness and juiciness shaped by the local agro-climatic conditions (Lukose, 2022). In handicrafts, Kanchipuram Silk Sarees of Tamil Nadu and Banarasi Sarees of Uttar Pradesh are iconic GIs that highlight regional artistry (Devi *et al.*, 2021).

Thus, the GI framework serves a dual function: it protects consumers from misleading claims by ensuring authenticity, and it safeguards producers by preventing outsiders from unfairly capitalizing on the reputation and value built by local communities over generations (World Intellectual Property Organization [WIPO], 2019).

Historical Background of Geographical Indications

The roots of GI protection can be traced to Europe, where regional products such as Champagne (France), Parma ham (Italy) and Roquefort cheese (France) were historically associated with quality and exclusivity. Early forms of legal protection appeared in France during the 19th century, particularly with the Law on Appellations of Origin (1919), which became a cornerstone for protecting region-specific products (Rangnekar, 2004). Over time, international recognition of GI grew, culminating in the Paris Convention for the Protection of

Industrial Property (1883) and the Lisbon Agreement on Appellations of Origin (1958).

Globally, the most significant milestone was the establishment of the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS) under the World Trade Organization (WTO) in 1995, which mandated member countries to provide legal frameworks for the protection of GIs (Das, 2010). This transformed GIs from a European-centric system into a global mechanism for protecting agricultural and cultural heritage.

Evolution of G.I. Protection in India

India, being one of the world's largest agrarian economies with immense crop diversity, quickly realized the importance of protecting its traditional agricultural products. Initially, Indian farmers relied on community reputation and local trade networks to market products like Darjeeling tea, Malabar pepper, and Mysore silk. However, globalization and imitation of these products necessitated legal safeguards. The motto for Geographical Indications (GI) in India is "Invaluable Treasures of Incredible India" (Fig. 1).

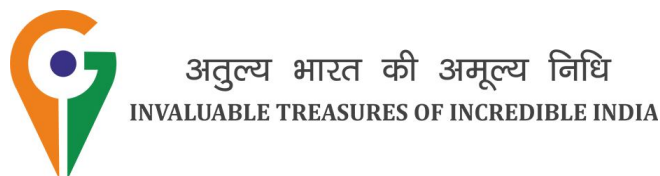


Fig. 1 : The motto for Geographical Indications (GI) in India.

Consequently, India enacted the Geographical Indications of Goods (Registration and Protection) Act, 1999, which came into force in 2003, aligning with TRIPS obligations (Ministry of Commerce & Industry, 2003). The first registered GI in India was Darjeeling Tea (2004), marking a historic moment in agricultural branding (Chaturvedi, 2018). Since then, India has registered more than 400 GI products, of which a significant portion belongs to the agriculture and horticulture sectors (GI Registry of India, 2023).

The registration Process for Geographical indications

In December 1999, the Geographical Indications of Goods (Registration and Protection) Act was passed by the Indian Parliament with the primary objective of providing a framework for the registration and protection of geographical indications (GIs) within the country (Lukose, 2022). The Act is administered by the Controller General of Patents, Designs, and Trademarks, who also functions as the Registrar of Geographical Indications (Nurlani *et al.*, 2023).

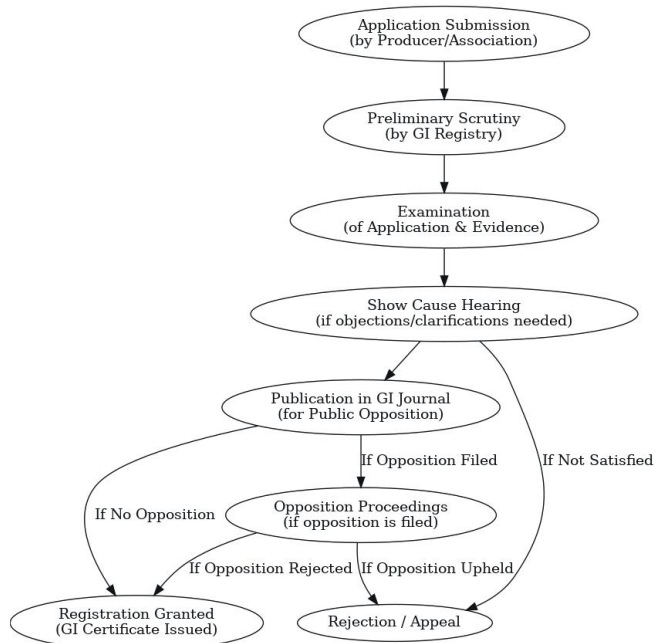


Fig. 2 : A schematic representation of the GI registration process.

The Geographical Indications Registry, located in Chennai, maintains all official records related to GI registrations. The Registrar's role is categorized into two parts: Part A, which records details of registered geographical indications and Part B, which documents particulars of the registered authorized users (Das, 2010; Ministry of Commerce and Industry, 2023).

A schematic representation of the GI registration process is provided in Fig 2.

GI and Agricultural Identity in India

Indian agriculture is deeply intertwined with cultural traditions, food habits and agro-climatic diversity. GIs serve as a bridge between this heritage and modern market systems. For example:

- Basmati rice has become a symbol of India's culinary identity and export strength.
- Alphonso mangoes (Maharashtra) and Nagpur oranges showcase the regional ecological advantage.
- Chilli varieties like Guntur Sannam (Andhra Pradesh), Byadgi (Karnataka), and Bhiwapur (Maharashtra) have become global ambassadors of India's spice heritage.

The protection of these products through GI tags not only ensures authenticity and premium pricing but also strengthens rural economies by reducing market exploitation (Kumar *et al.*, 2022).

Geographical Indications in Indian Agriculture

One of the primary goals of intellectual property law is to encourage and protect creative expression, and this principle extends to Geographical Indications (GIs) in agriculture. Unlike patents or copyrights, which safeguard individual innovation, GIs recognize and protect the collective knowledge, practices, and resources of farming communities tied to specific regions (Das, 2010; Rangnekar, 2004). In India, several agricultural products enjoy GI status because of their unique qualities shaped by local climate, soil, and traditional farming expertise (Lukose, 2022).

Examples include Darjeeling Tea from West Bengal, renowned globally for its muscatel flavour (Chakraborty and Sarangi, 2018); Nagpur Oranges from Maharashtra, prized for their sweetness and juiciness (Lukose, 2022); Basmati Rice from the Indo-Gangetic plains, celebrated for its aroma and grain quality (Singh and Jaglan, 2018); and Malabar Pepper from Kerala, known for its pungency and essential oil content (Menon and Nair, 2017). Each of these products reflects a blend of natural factors and generations of agricultural skill, making them inseparable from their place of origin.

By granting GI protection, the law not only secures these products against misuse or false claims but also motivates farmers to preserve traditional cultivation methods and maintain quality standards (WIPO, 2019). This, in turn, enhances market value, supports rural livelihoods and strengthens India's agricultural heritage (Devi *et al.*, 2021). Thus, GIs in agriculture function as both an economic tool and a cultural safeguard, ensuring that community's benefit from the reputation they have built over centuries.

Legal Framework of GI in India

India's GI system is governed by the Geographical Indications of Goods (Registration and Protection) Act, 1999, which came into force on 15 September 2003. This Act provides a comprehensive legal mechanism to register and protect goods linked to their geographical origin. The law was enacted in compliance with India's obligations under the TRIPS Agreement (1995), which made GI protection mandatory for all WTO members (Das, 2010).

The GI Act empowers the Geographical Indications Registry, established in Chennai, to oversee registrations. The Act ensures:

- Protection of the name and reputation of GI products.
- Prevention of unauthorized use or misrepresentation.

- Legal recourse for infringement.

The protection is granted for 10 years and can be renewed indefinitely (Ministry of Commerce & Industry, 2003).

Categories of GI Products in India

As per the Geographical Indications Registry of India (2023), more than 450 products have received GI status, covering sectors such as:

- Agriculture and Horticulture (e.g., Darjeeling Tea, Basmati Rice, Alphonso Mango, Guntur Sannam Chilli) (Fig. 3).
- Handicrafts (e.g., Banarasi Saree, Mysore Silk).
- Manufactured Goods (e.g., Feni liquor from Goa).
- Foodstuffs (e.g., Odisha Rasagola, Agra Petha).

Out of these, over 100 products belong to the agriculture/horticulture category, underlining the importance of GI for Indian farmers and rural communities (GI Registry, 2023).

GI as a Tool for Agricultural Branding

GI tags act as collective intellectual property rights that strengthen agricultural branding. Unlike trademarks, which belong to individuals or firms, GIs are community-owned. Farmers producing a GI product must adhere to the product specification document (PSD) that defines standards, quality parameters and geographical boundaries (Kumar *et al.*, 2022).

Agricultural branding through GIs provides:

- *Market Differentiation*: Products like Nagpur Orange and Coorg Orange are instantly recognizable due to their unique agro-climatic features.
- *Price Premiums*: Darjeeling tea, after GI recognition, witnessed a 15–20% price rise in export markets (Chaturvedi, 2018).
- *Consumer Trust*: GI assures consumers of authenticity and quality.

International Trade and Export Potential

GI products have significant export potential. For instance:

- Darjeeling Tea is exported to over 40 countries.
- Basmati Rice commands a premium price in Europe and the Middle East.
- Guntur Sannam Chilli is a major export commodity in spice trade, contributing significantly to India's foreign exchange earnings (Spices Board of

India, 2022).

According to the World Trade Organization (2022), agricultural GIs can enhance rural development by ensuring higher returns to producers while preventing misuse of traditional names in international markets.

Socio-Economic Importance for Farmers

GI registration empowers farmers and rural producers by:

1. Protecting Traditional Knowledge – Local cultivation practices, seed varieties, and drying methods are preserved.
2. Strengthening Rural Livelihoods – GI-tagged chilli farmers in Byadgi (Karnataka) reported 20–25% better market prices compared to non-GI chilli (Patil and Raghavendra, 2021).
3. Reducing Middlemen Exploitation – Collective branding and certification allow farmer cooperatives to negotiate directly with exporters.
4. Women Empowerment – In regions like Odisha (Pipili applique GI), women's self-help groups are actively engaged in GI-based production and marketing.

Challenges in Indian GI implementation

Despite its promise, the GI system in Indian agriculture faces challenges:

- *Lack of Awareness*: Many smallholder farmers are unaware of the GI registration process (Kumar *et al.*, 2022).
- *Enforcement Issues*: Counterfeit GI products still enter markets, diluting authenticity.
- *Export Disputes*: Conflicts such as Basmati rice disputes between India and Pakistan highlight complexities in international GI recognition (WTO, 2022).
- *Value Chain Gaps*: Farmers often fail to capture the full premium due to weak branding, marketing, and certification mechanisms.

Recent Developments

Recent years have witnessed an increased policy push:

- The Agriculture Export Policy, 2018 emphasized GI-based branding for boosting exports.

The GI promotion campaigns (2020 onwards) by the Government of India under “One District One Product (ODOP)” and “Vocal for Local” movements have focused on globalizing GI products.



Fig. 3 : Geographical Indications Agricultural Goods.

- By 2023, India had registered around 120 agricultural GIs, including new entries like Gamosa of Assam (cultural GI) and Alibag White Onion (Maharashtra) (GI Registry, 2023).

Importance of GI in Agriculture

Protection of Traditional Knowledge

Geographical Indications (GIs) safeguard indigenous farming practices, traditional processing methods, and cultural heritage embedded within specific regions (Rangnekar, 2004). By documenting and associating products with their unique locality, GIs help preserve traditional agricultural knowledge and biodiversity. This, in turn, revitalizes ancient practices and supports community identity.

Market Differentiation and Value Addition

GI-tagged products attract premium pricing and enjoy enhanced market reputation due to assured authenticity and uniqueness (Giovannucci *et al.*, 2009). For example, Guntur Sannam chilli exports command higher prices than non-GI-labelled varieties (Prashar *et al.*, 2020). GI tags

also create consumer trust by preventing counterfeiting and misappropriation, thereby protecting brand value (Scalion, 2025). This fosters economic incentives for producers to maintain quality and traditional methods.

Rural Development and Farmer Empowerment

GI registration empowers smallholder farmers and rural communities by enabling collective marketing under a certified brand. This reduces middlemen exploitation and improves direct access to profitable markets (Chaturvedi, 2021). Moreover, GI status stimulates local employment generation, economic stability, and curbs rural-urban migration by increasing incomes and sustaining livelihoods (IJSRED, 2023; Scalion, 2025).

Global Trade and Export Promotion

GIs enhance export competitiveness by assuring international consumers about product quality, provenance, and authenticity (Giancarlo, 2017). Indian agricultural products like Darjeeling Tea, Basmati Rice, and Dalle Chilly benefit from heightened global demand supported by their GI status (Chadha, 2025; PIB, 2025).

This promotes better market access, boosts foreign exchange earnings and escalates India's presence in global specialty food markets.

Sustainability and Environmental Benefits

GI encourages the use of sustainable farming practices as producers strive to maintain product quality linked to specific ecological conditions.

Legal Protection Against Misuse

GI registration provides legal backing to prevent unauthorized usage of product names, combating counterfeit and imitation products.

Consumer Awareness and Traceability

GI tags, coupled with reliable traceability systems, increase consumer confidence in product origin and quality, enhancing demand.

Preservation of Biodiversity

Documenting traditional varieties and production methods in the GI process contributes to conserving agricultural biodiversity.

Chilli Varieties with GI Tags in India

Guntur Sannam (Andhra Pradesh)

- **GI Number / Year:** GI-129, 2010
- **Area:** Guntur–Prakasam chilli belt, Andhra Pradesh (also adjacent districts).
- **Profile and Origin:** A long-established *Capsicum annum* type, valued for both pungency and bright red colour. Traditionally grown in fertile black cotton soils of Guntur (Fig. 4).
- **GI Specification:** Fruits 5–15 cm long, thick skin; average pungency 35,000–40,000 SHU; ASTA colour $\approx$ 32; defined bands for capsaicin content and proximate composition.



Fig. 4 : Guntur Sannam (Andhra Pradesh).

- **Cultivation Data:** Guntur has >80,000 ha under chilli, with Sannam type dominating; average yield $\sim$ 8–10 quintals/acre.
- **Applicant / Authorized Users:** Spices Board of India (facilitator), local grower cooperatives and trader associations.
- **Value Chain and Market Significance:** India's largest wholesale chilli hub; strong export linkage. GI ensures separation from other hot types, backed by SHU/ASTA lab testing. Premium branding in global spice trade.

Byadgi (Karnataka)

- **GI Number / Year:** GI-129, 2010
- **Area:** Byadgi town and adjoining areas, Haveri district, Karnataka.
- **Profile and Origin:** Famous for deep red colour and low pungency; highly demanded for oleoresin and cosmetic/food industries (Fig. 5).
- **GI Specification:** Scoville 5,000–15,000 SHU; ASTA colour very high (>150–200); sub-types “dabbi” and “kaddi.”
- **Cultivation Data:** $\sim$ 70,000 ha (Karnataka Agriculture Dept., 2020); average yield 7–9 quintals/acre.
- **Applicant / Authorized Users:** Byadgi Chilli Growers' Association.
- **Value Chain and Market Significance:** GI strengthens market against substitution; colour extractors and food processors are main buyers. Premium contracts with exporters and oleoresin industry.

Bhiwapur Chilli (Maharashtra)

- **GI Number / Year:** GI-499, 2020
- **Area:** Bhiwapur, Nagpur district, Vidarbha region, Maharashtra.



Fig. 5 : Byadgi (Karnataka).



Fig. 6 : Bhiwapur Chilli (Maharashtra).

- **Profile and Origin:** Known locally as “Bhiwapuri Teekhat”; prized for bright red colour (high capsanthin) and moderate pungency (Fig. 6).
- **GI Specification:** 20,000–40,000 SHU; ASTA colour 100–150.
- **Cultivation Data:** 5,000–6,000 ha; yield 8–10 quintals/acre (rainfed).
- **Applicant / Authorized users:** Bhiwapur Growers’ Association.
- **Value Chain and Market Significance:** Strong local branding; 10–15% wholesale premium; growing demand in spice blends across Maharashtra.

Khola Chilli (Goa)

- **GI Number / Year:** GI-113, 2010
- **Area:** Khola village, Canacona taluk, South Goa.
- **Profile and Origin:** Organically cultivated traditional chilli; mild heat, very bright red colour (Fig. 7).
- **GI Specification:** Low pungency 5,000–8,000 SHU; ASTA >200.
- **Cultivation Data:** ~200–250 ha; production ~150–200 tonnes annually; mostly smallholders.
- **Applicant / Authorized Users:** Khola Chilli Cultivators Group.
- **Value Chain and Market Significance:** Widely used in Goan sausages, curries and pickles; premium ` 180–200/kg vs regular chilli at ` 120/kg. Strong organic identity.

Naga Mircha / Naga King Chilli (Nagaland)

- **GI Number / Year:** GI-207, 2008 (renewed 2012)



Fig. 7 : Khola Chilli (Goa).



Fig. 8 : Naga Mircha / Naga King Chilli (Nagaland).

- **Area:** Nagaland – Dimapur, Kohima, Peren districts.
- **Profile and Origin:** Globally renowned for extreme pungency and wrinkled appearance; *Capsicum chinense* group (Fig. 8).
- **GI Specification:** >1,000,000 SHU (among world’s hottest).
- **Cultivation Data:** 3,000–4,000 ha; average yield 4–5 quintals/acre.
- **Applicant / Authorized users:** Nagaland State Horticulture Department.
- **Value Chain and Market Significance:** Exported as dried, paste, pickle; strong domestic demand in Northeast. Premium niche product (~` 1,200–1,500/kg).

Dalle Khursani (Sikkim, West Bengal)

- **GI Number / Year:** GI-602, 2020
- **Area:** Entire state of Sikkim; Darjeeling hills, West Bengal.
- **Profile and Origin:** Small cherry-sized, intensely hot chilli; deep cultural and culinary value



Fig. 9 : Naga Mircha / Naga King Chilli (Nagaland).



Fig. 10 : Edayur Chilli (Kerala).



Fig. 11 : Mizo Chilli (Mizoram).
(Fig. 9).

- **GI Specification:** 100,000–350,000 SHU; distinct fruity aroma.
- **Cultivation Data:** 2,500–3,000 ha; average yield 6–8 quintals/acre.
- **Applicant / Authorized users:** NERAMAC (North Eastern Regional Agricultural Marketing Corporation).
- **Value Chain and Market Significance:** Consumed fresh, pickled, or fermented; sold at ¹ 400–600/kg fresh in specialty markets.

Edayur Chilli (Kerala)

- **GI Number / Year:** GI-620, 2021
- **Area:** Malappuram district, Kerala.
- **Profile and Origin:** Dark red fruits, moderate heat, noted for unique aroma and pest resistance (Fig. 10).
- **GI Specification:** 25,000–40,000 SHU.
- **Cultivation Data:** 1,500–2,000 ha; average yield 10–12 quintals/acre.
- **Applicant / Authorized users:** Edayur Chilli Farmers' Cooperative Society.
- **Value Chain and Market Significance:** Used in chilli powder blends; GI recognition expected to boost exports through Cochin port.

Mizo Chilli (Mizoram)

- **GI Number / Year:** GI-621, 2021
- **Area:** Mizoram – Aizawl and Champhai districts.
- **Profile and Origin:** Traditional thin-skinned chilli with smoky flavour; medium-high pungency (Fig. 11).
- **GI Specification:** 50,000–100,000 SHU; excellent for drying.
- **Cultivation Data:** ~2,000 ha; average yield 7–8 quintals/acre.
- **Applicant / Authorized Users:** Mizoram Farmers' Society.
- **Value Chain and Market Significance:** Consumed in local cuisine, pickles, chutneys; export potential to Bangladesh/Myanmar. GI recognition may enhance farmer incomes by 15–20%.

Value Chain and Market Dynamics of GI-Tagged Chillies in India

Production and Farmer-Level Dynamics

- Most GI chilli cultivation is smallholder-based, with average landholdings of 1–2 ha.
- Farmers benefit from the uniqueness of GI varieties (colour, pungency, aroma), but lack of awareness often limits collective branding.
- Contract farming is rare; instead, produce flows through local APMCs (Agricultural Produce Market Committees), village traders, or farmer cooperatives.
- Examples:
 - Byadgi APMC (Karnataka) is Asia's largest

Table 1 : Export Share of Major Indian Chilli Types (2022–23).

Chilli Variety (GI)	Key Export Markets	Volume (MT)	Avg. Export Price (USD/kg)	Importance
Guntur Sannam (AP/Telangana)	Sri Lanka, Bangladesh, Middle East, USA	~250,000	2.2–2.5	Most traded Indian chilli worldwide; balanced pungency.
Byadgi (Karnataka)	China, EU, USA	~90,000	2.8–3.5	Preferred for oleoresin (capsanthin); high colour.
Bhiwapur (Maharashtra)	Domestic markets (Nagpur, Vidarbha, limited exports)	~25,000	2.0–2.3	Regional preference, limited international visibility.
Naga Mircha / King Chilli (Nagaland, Manipur, Assam)	USA, UK, SE Asia (specialty markets)	~5,000	20–25	Extreme pungency; niche gourmet & hot-sauce markets.
Dalle Khursani (Sikkim)	Domestic (North India metros), small niche exports	~3,000	8–12	Organic certified under Sikkim Organic Mission.
Khola (Goa)	Domestic (Goa, Maharashtra), small boutique exports	~2,000	4–6	Known for bright red colour, used in Goan cuisine.
Mizo Chilli (Mizoram)	Bangladesh, Myanmar (cross-border), limited EU trials	~2,500	5–7	Smoked chilli, unique aroma.
Edayur Chilli (Kerala)	Domestic only	~1,000	2.0–2.5	Local niche, high demand in Kerala markets.

Table 2 : SWOT of GI Chillies in India.

Strengths	Weaknesses	Opportunities	Threats
Rich diversity of unique chilli landraces	Low farmer awareness of GI rights	Rising demand for origin-linked food	Climate change & pest outbreaks
Global demand for colour, heat, exotic traits	Weak AU registration and enforcement	Value-added products and exports	Adulteration risks trade bans
Institutional backing (GI Registry, Spices Board, APEDA)	Limited branding in export markets	Digital traceability, FPO-driven supply chains	Price volatility, trader dominance

chilli market yard, handling ~1 million tonnes annually, including GI-tagged Byadgi.

- Guntur Mirchi Yard (Andhra Pradesh) is India's biggest chilli market yard, trading 4,500–5,000 tonnes/day in peak season.

Processing and Value Addition

- Primary Processing: Sun-drying (Khola, Byadgi), fermentation/pickling (Dalle Khursani) and smoking (Mizo chilli).
- Secondary Processing: Chilli powder, oleoresin extraction (major for Guntur & Byadgi, 50% of India's chilli oleoresin exports).
- Innovative Products:

- Dalle Khursani paste/pickle certified organic under Sikkim Organic Mission.
- Naga Mircha hot sauces, catering to international niche markets.

Domestic Market Dynamics

- GI chillies enjoy strong regional brand loyalty (e.g., Goan households prefer Khola, Vidarbha consumers prefer Bhiwapur).
- Prices in local markets show a premium of 10–25% for GI chillies over generic varieties.
- Colour vs. pungency positioning influences buyers:
 - Byadgi - high colour, mild heat (preferred by oleoresin industry).

- Guntur Sannam - moderate colour, moderate heat (balanced use in spice blends).
- Naga Mircha - extreme pungency (specialty condiment).

Export and International Trade

- India is the world's largest chilli exporter, shipping ~500,000–600,000 tonnes annually (Spices Board, 2023).
- GI-tagged chillies strengthen India's "origin branding" in global spice markets.
- Byadgi chilli exports to China, USA and EU fetch higher demand due to oleoresin extraction potential.
- Naga Mircha and Dalle Khursani are niche exports, small in volume but high in value (premium >USD 20–25/kg in specialty markets).

Guntur Sannam is the most traded Indian chilli globally, shipped to Sri Lanka, Bangladesh, Middle East, USA (Table 1).

Institutional Role

- *Spices Board of India*: Provides export promotion, quality certification (ASTA colour, SHU tests).
- *APEDA (Agricultural & Processed Food Products Export Development Authority)*: Facilitates GI-based branding in international fairs.
- *GI Registry of India*: Ensures legal protection of varieties from imitation.
- *Farmer Producer Organizations (FPOs)*: Emerging role in linking GI chilli growers with e-NAM and direct export channels.

Challenges and Opportunities in the GI Chilli Sector

Challenges

a) Farmer Awareness and Adoption

- A majority of smallholders cultivating GI chillies are not aware of the GI tag or its benefits.
- Registration of Authorized Users (AUs) remains low — e.g., Byadgi and Guntur have thousands of growers, but only a few hundred have AU certificates (GI Registry, 2023).

b) Price Premium Realization

- While GI chillies command 10–25% higher prices in wholesale markets, the benefits often do not reach farmers.
- Middlemen and traders absorb much of the

margin, limiting rural income enhancement.

c) Quality Assurance & Adulteration

- Adulteration with synthetic dyes (Sudan Red, Rhodamine) is a recurrent problem, especially in Guntur exports, risking bans in EU markets (Spices Board, 2022).
- Maintaining uniform SHU and ASTA standards is difficult under fragmented farming systems.

d) Supply Chain Fragmentation

- Dependence on traditional APMCs increases transaction costs.
- Lack of direct farmer–exporter linkages means farmers have little control over branding.

e) Climate and Pest Pressures

- Rising temperatures and erratic rainfall affect flowering and fruit set in Byadgi and Khola.
- *Thrips parvispinus* (Karny), a recent invasive pest, has severely affected chilli yields in Andhra Pradesh and Karnataka.

f) Limited International Recognition

- Unlike "Champagne" or "Darjeeling Tea", Indian GI chillies are not widely recognized in global consumer markets.
- Exporters often label products by India origin, not specific GI names, diluting brand equity.

Opportunities

a) Premiumization & Niche Branding

- Global demand for "authentic origin spices" is growing.
- Byadgi can be positioned as the world's natural colouring agent; Naga Mircha and Dalle Khursani as superhot gourmet chillies.

b) Value-Added Products

- Pickles, sauces, oleoresins and nutraceuticals offer higher margins.
- Example: Naga King Chilli hot sauces retail at 10× raw chilli price in US/UK specialty markets.

c) Institutional Support

- One District One Product (ODOP) under Atma Nirbhar Bharat includes GI chillies (e.g., Guntur, Byadgi).
- APEDA and Spices Board are promoting GI branding at international fairs (e.g., Gulfood, Dubai 2023).

d) Digital Traceability & E-commerce

- Blockchain-based farm-to-fork traceability pilots are ongoing for turmeric and cardamom; scalable to chillies.
- Platforms like Amazon India, Flipkart, BigBasket already sell Dalle Khursani and Naga Mircha with GI tags.

e) Farmer Producer Organizations (FPOs)

- GI-specific FPOs can aggregate produce, reduce middlemen, and negotiate better prices.
- Example: Byadgi Chilli Growers' Association has begun direct export to China for oleoresin industries.

f) Climate-Smart Practices

- Development of drought-tolerant chilli hybrids within GI frameworks can ensure yield stability.
- Organic certification, as in Sikkim (Dalle Khursani), adds export competitiveness.

SWOT of GI Chillies in India**Policy Implications and Way Forward**

The sustained success of Geographical Indications (GIs) in the chilli sector requires proactive policy support, institutional innovations, and farmer-centric interventions. Despite the economic potential of GI tags, several bottlenecks—low farmer awareness, limited market visibility, weak enforcement and lack of international protection—still persist (Spices Board of India, 2023; APEDA, 2023). Addressing these gaps will ensure that the benefits of GI reach cultivators directly and strengthen India's position in global spice markets.

Strengthening Farmer Participation

Awareness creation is the foundation of a robust GI system. State agriculture departments, the Spices Board of India, and Krishi Vigyan Kendras (KVKs) must conduct targeted information campaigns to make farmers aware of the importance of GI and the process of becoming Authorized Users (AU). The existing AU registration process is cumbersome and paperwork-heavy. Digitization of forms, local facilitation centers, and online portals could streamline onboarding, ensuring greater farmer participation (WIPO, 2023).

Market Linkages and Branding

To maximize economic gains, GIs must be effectively positioned in both domestic and export markets. APEDA and the Spices Board can earmark dedicated GI chilli consignments under unified branding such as "Authentic Byadgi India" or "Original Guntur Chilli." On the domestic

front, supermarket chains and e-commerce platforms should prominently feature GI-labelled chilli powders, sauces, and condiments to enhance consumer recognition (APEDA, 2023).

Traceability and Quality assurance

A critical challenge in the spice trade is adulteration. Blockchain-enabled traceability, QR-coded certification, and digital GI authentication systems—already piloted in turmeric—should be extended to chilli supply chains (FAO, 2021). Establishing regional quality testing laboratories in each GI zone will also be essential. These labs should evaluate SHU (Scoville Heat Unit), ASTA (color value), aflatoxin levels, and pesticide residues to guarantee consistent quality and reinforce consumer trust (Spices Board of India, 2023).

Value-Addition and Rural Entrepreneurship

Value addition at the local level can multiply farmer incomes. Mini-processing plants for oleoresin extraction, sterilized chilli powder, and sauce production can retain profits within rural economies. Strategic branding of niche varieties offers significant opportunities:

- Naga Mircha (Nagaland) can be positioned in gourmet hot-sauce markets and "extreme heat" global challenges.
- Byadgi (Karnataka) can be marketed as a natural food colorant in nutraceuticals and cosmetics.
- Dalle Khursani (Sikkim/Darjeeling Himalayas) can be linked with organic Himalayan produce branding.

Such differentiated branding strategies could allow each chilli variety to occupy unique global niches (Chaturvedi, 2018).

Institutional Innovations

Farmer Producer Organizations (FPOs) can be empowered to function as Authorized User aggregators, enabling collective branding and direct farmer-to-market linkages. Public-private partnerships with spice exporters and multinational food companies can further enhance global market penetration (Government of India, 2023).

International Protection

Currently, few Indian GI chillies enjoy legal recognition outside India, unlike Darjeeling Tea, which has secured international protection in the EU. India must pursue reciprocal GI protection agreements with major importers such as the EU, USA and ASEAN countries to prevent misbranding and ensure global exclusivity (WTO, 2022).

Policy Integration

Linking GI initiatives with flagship programs such as One District One Product (ODOP) will ensure institutional funding, export support and branding visibility. Furthermore, integrating GI chilli farmers into climate-smart schemes (National Horticulture Mission, PMFBY crop insurance) can provide resilience against biotic stresses like thrips infestation and abiotic risks such as erratic rainfall (Vision IAS, 2025).

Roadmap for the Future

A phased roadmap could accelerate India's GI chilli sector:

- Short Term (1–2 years): Awareness drives, AU registrations, supermarket branding.
- Medium Term (3–5 years): Export campaigns, chilli festivals, full-scale traceability systems.
- Long Term (5–10 years): Achieving global recognition on par with Champagne or Darjeeling Tea, tapping premium markets, and ensuring equitable benefit-sharing for farmers.

Future Prospects and Global Relevance

The long-term relevance of GI chillies extends beyond India's borders, with rising global demand for authentic, traceable and heritage-based agricultural commodities. GI-tagged products globally have been shown to command 10–30% higher premiums than non-GI counterparts, while simultaneously supporting rural development and conserving biodiversity (WTO, 2022; WIPO, 2023).

India's ambition to expand its GI registry to nearly 10,000 products by 2030 highlights a national strategy to align cultural heritage with economic growth (Vision IAS, 2025). Within this context, chillies—India's most exported spice—are poised to become international flagbearers for the GI movement.

Emerging technologies will play a transformative role. Blockchain-based traceability, QR-code packaging, and e-commerce platforms could ensure transparent trade, mitigate adulteration, and connect smallholder farmers directly to premium buyers (FAO, 2021; APEDA, 2023). For indigenous chilli varieties from Odisha, Northeastern states, and central tribal belts, GI recognition can both secure farmer incomes and conserve agro-biodiversity (Das, 2010; Chaturvedi, 2018).

Internationally, Guntur Sannam and Byadgi chillies already enjoy market visibility, yet their branding potential remains underutilized. India must emulate the success of Darjeeling Tea, which has become a global symbol of

authenticity through coordinated branding, trade diplomacy, legal protection (Roy and Chakrabarti, 2020). Promotional campaigns at international food exhibitions, collaborations with global culinary institutes, and strategic positioning in gourmet and nutraceutical markets can further elevate GI chilli recognition.

Beyond trade, GI chillies hold promise for gastronomic tourism, where curated spice trails, regional food festivals, and chilli-themed experiences can strengthen rural livelihoods while preserving cultural identity.

In sum, the global relevance of GI chillies lies in their ability to merge heritage, authenticity, and sustainability. By embedding traditional cultivation systems into modern supply chains powered by traceability and branding, India can secure a unique global footprint for its chilli diversity and position itself as a leader in sustainable agri-cultural exports.

Conclusion

Geographical Indications (GI) serve as a powerful tool for preserving biodiversity, protecting traditional knowledge, and ensuring market differentiation for agricultural commodities. In India, where chilli cultivation spans centuries and diverse agro-climatic zones, GI registration has become an instrument of both cultural pride and economic opportunity. Varieties such as Guntur Sannam, Byadgi, Bhiwapur, Khola, Naga Mircha, and Dalle Khursani represent not just regional identities but also distinct sensory and nutritional qualities measured in Scoville Heat Units (SHU) and ASTA colour values. Despite their recognition, the economic benefits of GI tags remain underutilized. Farmers often lack awareness of their rights as Authorized Users, while fragmented supply chains dilute price premiums. Issues of adulteration, pest outbreaks, and climate stress further undermine brand reliability. However, opportunities lie in value addition, digital traceability, FPO-led aggregation, and international branding. Initiatives like One District One Product (ODOP) and export promotions by APEDA and the Spices Board can transform GI chillies from regional crops into globally recognized heritage foods. Looking ahead, the future of India's GI chilli sector depends on bridging the gap between legal recognition and market realization. A concerted policy push—encompassing farmer capacity-building, institutional innovation, and international protection—can enable GI chillies to achieve the same stature as Darjeeling Tea or Champagne. If these steps are pursued, GI chillies will not only ensure sustainable farmer incomes but also elevate India's status as the global leader in authentic, origin-linked spices.

Acknowledgements

The authors gratefully acknowledge the resources of the GI Registry (Chennai), Spices Board of India, and academic databases for access to laws, specifications, and peer-reviewed literature cited herein.

Author Contribution statement

This work was carried out in close collaboration among all authors. The team collectively contributed to the conceptualization of the review theme, literature survey, data compilation, critical analysis of Geographical Indication (GI) case studies, and refinement of the manuscript structure and arguments. All authors participated equally in the interpretation of findings, manuscript revisions, and approved the final version for publication.

Conflict of Interest statement

The authors declare that they have no known financial or non-financial conflicts of interest that could have appeared to influence the work reported in this paper.

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