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*Mini Review Article*

# Geographical Indications: Agricultural Perspectives with Special Reference to Rice Genetic Resources in India

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## Abstract

**Geographical Indications (GIs) have gained significant momentum to conserve local biodiversity, traditional knowledge and to promote local trade. A total of 696 GI shave been registered in India till July 2025, out of which 94.5% were domestic in nature.The handicraft goods stood first, accounting for 52.4%, followed by agricultural (31.5%), manufactured (7.9%) and food stuffs (7.8%). During the past 20 years, a total of 219 agricultural GIs have been registered in 73 agricultural crops and commodities in the country. These are quite diversified, including banana, brinjal, chilli, litchi, malta, mango, rice, sea buckthorn, sorghum tea, etc. The highest agricultural GIs were granted during the year 2023-24 (49). State-wise, Maharashtra ranked first with 38 agricultural GIs in force, followed byTamil Nadu (22), Karnataka & Kerala (21 each) and Uttarakhand (15). The traditional knowledge in rice culminated in to the highest agricultural GI registrations (31), followed by mango & chilli (16 each) and banana (8), etc. Kerala ranked first with 06 GIsfor rice genetic resources, followed by West Bengal (04), Assam & Maharashtra (03 each). The "Navara Rice" and "Palakkadan Matta Rice" have been reported with medicinal properties, whereas "Pokkali Rice", "Ambemohar Rice" and "Karen Musley Rice" have tolerance to salinity coupled with distinct aroma and quality characters. The "Jeera phool" and "Balaghat Chinoor" from central India are more suited for *kheer* preparation. In the realm of trade, farmers, tribes and communities traditionally engaged in biodiversity conservation can be sensitized for GI boosting, enabling them to fetch higher market prices and recognition.**

**Keywords**: Traditional knowledge, Agriculture, Geographical Indications, Rice

## 1. Introduction

In the realm of trade, agri-food systems have gained remarkable momentum towards market differentiation and production in the different parts globally (Bramley *et al.,* 2009). Like other Intellectual property rights (IPR), Geographical Indications (GIs) were introduced during the Uruguay Round trade negotiations in international perspectives (Nirosha and Mansingh, 2024; Torok *et al.,* 2020). The choice of the instituting and implementing framework was left open to the members in view of the social, ecological and public infrastructure (Marie-Vivien and Bienabe, 2017). By the year 2009, GIs were adopted in 167 countries and China and the European Union became with the largest number of registered GIs (Giovannucci *et al.,* 2009).Quality attributes of interest as per a registered GI are presumably associated with the specific origin or particular production process followed in that particular region (Moschini *et al.,* 2008; Vats, 2016). Beletti *et al.* (1999) reported that prevention of name usurpation is one

of the key elements for GIs in international markets. GIs registration is based on geographical and agro-ecological product standards/quality and prevents others whose products do not qualify to the appropriate standards (Marie-Vivien, 2010).

Geographical Indications (GI) protect the goods (agricultural, handicraft, natural and foodstuff) that originated or were manufactured from a definite geographical territory. The basic purpose of registering GIs is to classify goods with some signifier quality on the basis of their geographical origin (Vinayan, 2017). GIshave a special quality or reputation or any other unique characteristic essentially attributable to a definite geographical origin, *e.g.*, Coorg orange, Kolhapuri chappal, Naga mircha, etc. (Garcia *et al.,* 2007).The need for implementing and devising a mechanism for GI protection was felt soon after India became a member of the World Trade Organization (WTO). The GIs were covered under the Articles 22 to 24 of Part II, Section III of the Trade Related Aspects of Intellectual Property Rights (TRIPS) Agreement (Das, 2008). Srivastava (2003) reported that Article 22 of TRIPS does not imply reciprocal protection bindings on the member countries, however, Article 23 provides additional protection to GIs in case of wines and spirits(Mishra, 2021). India, enacted the Geographical Indications of Goods (Registration & Protection) Act, 1999 which came into force with effect from 15 Sept. 2003. Das *et al.* (2010) and Yadav *et al.* (2018) summarized that prior to the GI protection implementation,three different mechanisms,as the consumer protection act, passing-off actions in judgments and trademark certification were in operation for protecting niche-specific products. Chaudhary *et al.* (2017) summarized that trademark of goods or services are related to a particular company, whereas GIs are often predetermined with the name of geographical regions and areas.

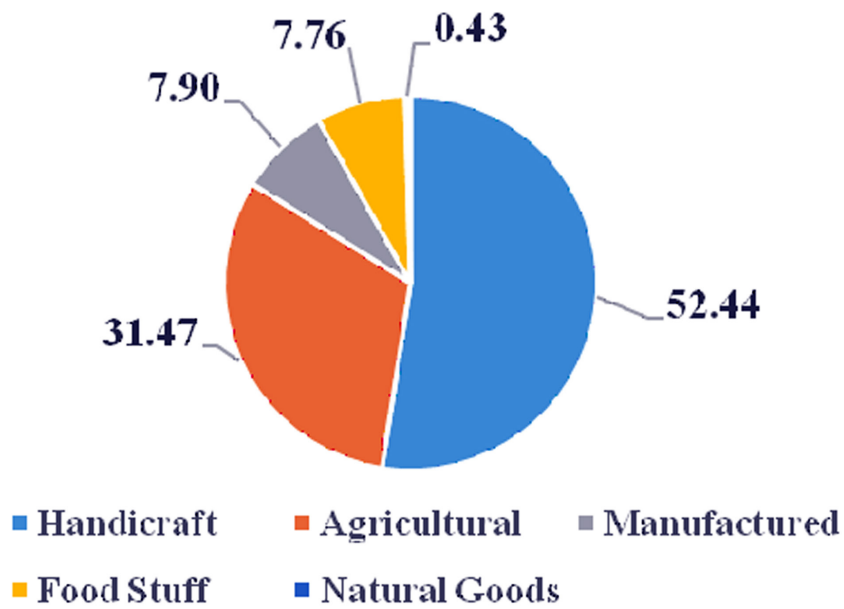


**Fig. 1:** GI Registration (%) in India

The geographical origin, quality and reputation for the registered GI goods are inseparably inter-related. GI registration confers legal protection, prevents unauthorized use of a registered indication by others, boosts exports, preserves cultural traditions and promotes the economic prosperity of producers of goods produced in a particular geographical territory (Ghosh, 2024). Kumar and Srivastava (2017)documented that GI protected agricultural goods and products can fetch higher prices by 10-15 per cent compared to the non-agricultural goods and products. Soam (2005) reported that only two GIs, namely "Darjeeling Tea" and "Pochampally Saree" were registered upto March 2005, however we could find one more GI, "Chanderi Sarees" during that period. A total of 696 Geographical Indications have been registered in India under different categories, including agricultural, handicraft, natural and food stuff till July 2025. In the realm of trade, 38 goods (33 manufactured and 5 food

stuffs) were also registered by the foreign countries in India. It was evident that the handicraft goods ranked first with 52.4% of the total GIs (Fig. 1), followed by agricultural (31.5%), manufactured (7.9%) and food stuff (7.8%). The present study reviewed the agricultural GIs with special reference to the rice genetic resources and presents up to date knowledge on agricultural GIs emerging in a big way in India and globally.

## 2. Scenario of global IPRs and GIs

The filing for patents, trademarks and industrial designs in Asia accounted for nearly 70% of the global Intellectual Property Rights (IPRs) filing during 2023, while it was only 58.4% during 2013 (Anonymous, 2025). Within Asia, IPRs filings were mainly focused in the countries, namely China, Japan and the Republic of Korea, which collectively accounted with a share of 91.1% of the total Asian IPRs filings in 2023. The figure for worldwide patent filings touched 3.6 million, the utility model amounted to 3.1 million and the trademark filing totaled to 15.2 million, reflecting a 2% decline over the year 2022. While in the case of GIs during 2023, China ranked first with 9785 GIs, followed by Germany (7586), Italy (6330), France (6098), Switzerland (4954), Turkey (1507) and USA (763). In case of European Union (EU) countries, 5376 GIs were in force throughout the EU regional system in every member state. The national and domestic GIs per cent varied from as low as 0.4% in Costa Rica to 100% in Bangladesh and Ethiopia. The close analysis of data revealed that above 90% of the protected GIs in the countries, including Turkey (99.8%), China (96.2%), India (93.6%), Brazil (92.4%), and Viet Nam (91.5%) were of domestic in nature, whereas nearly all the GIs in force in Costa Rica (99.6%) were of foreign origin (Anonymous, 2025). During 2023, protected GIs for wines and spirits pragmatically accounted for half of the global count (48.1%), whereas agricultural goods and foodstuffs shared 44.8% and handicrafts accounted for 4.2% of the global GIs. Furthermore, China reported the highest number of GIs in force for agricultural products and foodstuffs (8163), while the European Union had the most GIs in force (3329) in the case of wines and spirits.

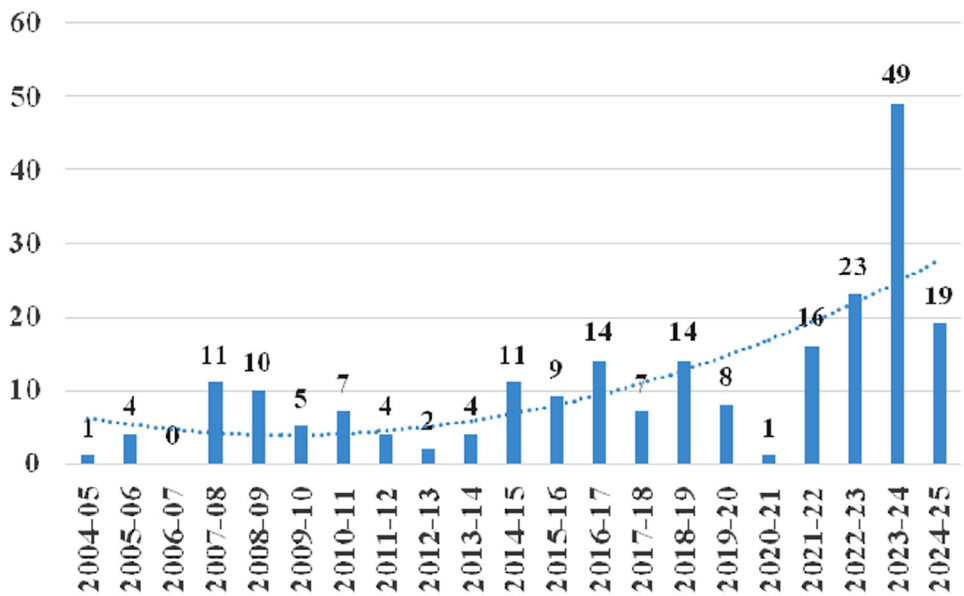


**Fig. 2:** Year wise agricultural GI registration in India

## 3. Yearly analysis of Indian agricultural GIs

After perusal of data, it could be ascertained that 219 GIs have been registered for the agricultural goods in India till July 2025. The year-wise graphical break-up is presented in Fig. 2. The first GI protection was granted to the "Darjeeling Tea (word and logo)" during the year 2004-05 for the state of West Bengal (Ravindran and Mathew, 2009). During the period of 2004-05 to 2024-25 (till July 2025),a total of 219GIs have been registered under the agricultural category, where the highest GIs (49) were registered during the year 2023-24. The GIs registered during 2023-24 were diversified and registered in crops, including banana, brinjal, chilli, litchi, malta, mango, rice, sea buckthorn, sorghum tea, etc.The second highest GIs (23) were registered in the year 2022-23, followed by 2021-22 (16), 2016-17 & 2018-19 (14 each), 2007-08 & 2014-15

(11 each). The year-wise GI protection for agricultural goods revealed that only one GI was registered during the year 2020-21 (Kashmir saffron),whereas two GIs, Madurai Malli jasmine flower (Tamil Nadu) and Bangalore blue grapes (Karnataka) were registered in the year 2012-13. The details of "Kashmir Saffron" specialty has been described by Saqib (2015).

## 4. State wise registration of agricultural GIs

Out of the total agricultural protected GIs,the highest GI registrations were granted for Maharashtra state (38), followed by Tamil Nadu (22), Karnataka & Kerala (21 each), Uttarakhand (15) and Assam& Uttar Pradesh (11 each). The agricultural products registered from Maharashtra were quite diversified, like"Mahabaleshwar Strawberry", "Nashik Grapes", "Kolhapur Jaggery", "Navapur Tur Dal", "Beed Custard Apple", "Jalgaon Banana", etc. Similarly, products registered from Uttarakhand, Kerala and Karnataka were also in different crops, mainly rice, coffee, brinjal, teak, jasmine, soybean, etc.The Indian states of Assam and Uttar Pradesh have been granted 11 GIs each, while the states, namely Andhra Pradesh, Rajasthan, Sikkim, Telangana and Tripura have registered single GI each (Fig. 3). In 11 cases, the GI protection was granted for two state geographical territories collectively, whereas the states of Kerala, Karnataka and Tamil Nadu were jointly granted GI protection for "Malabar Pepper" during the year 2007-08. Similarly, Punjab, Haryana, Delhi, Himachal Pradesh, Uttarakhand, Uttar Pradesh and Jammu & Kashmir conjointly were granted GI tag for "Basmati rice" during the year 2015-16.

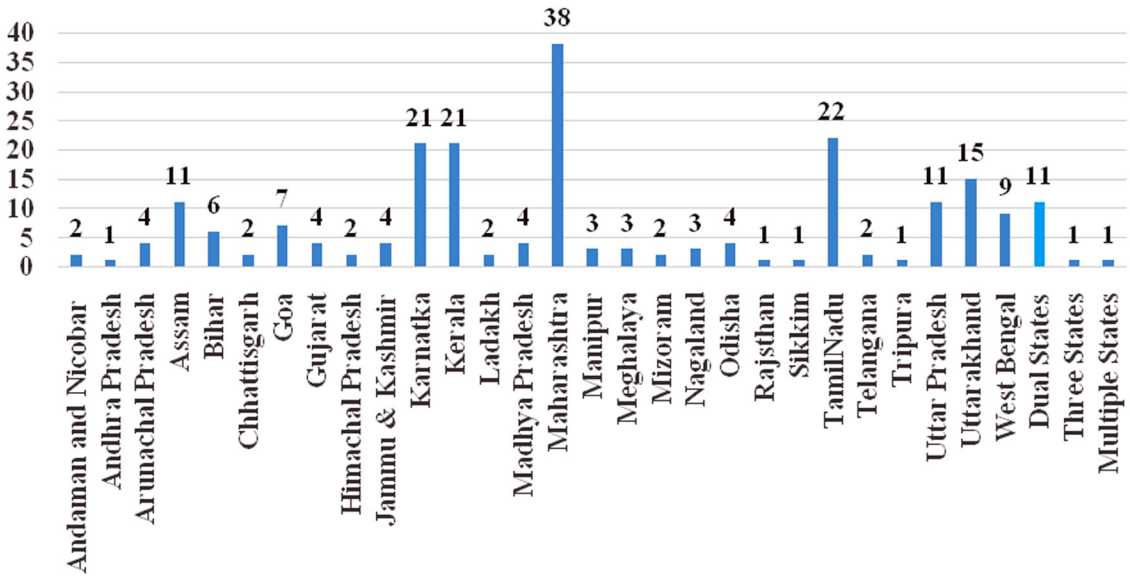


**Fig. 3:** State wise analysis of agricultural GIs

## 5. GI registered by foreign countries in India

As per GI framework network and global demand GI is not restricted in a particular geography and country. To compete with global trade, significant product quality assurance and boosting export GIs are also being claimed in other countries than the original geo-climate. In the registered Indian GIs, 38 Geographical Indications have also been registered till July 2025 by the foreign countries (Table 1). Lukose (2022) described that the European Union GI system is much advanced with much more than 5000 GI registrations, including 1624, 1577 and 258 for wines, agricultural products & food stuffs and spirit drinks, respectively. Ahuja (2004) described that association between place and registered GI becomes synonymous and cited the example of the Champagne region of France, known for "Champagne" making. The first foreign registered GI was an alcoholic beverage, "Peruvian Pisco" registered during the year 2009-10 (Patel and Zala, 2021). These geo-territorial goods were registered mainly under two categories,*viz.*, manufactured goods (32) and food stuffs (5). It was observed that the five foreign registered GIs for food stuff were "Prosciutto di Parma", "Asiago" and "Gorgonzola" (all three from Italy) and "Sitia Lasithiou Kritis" and "Kalamata" from Greece.

**Table 1:** Details of the registered GIs by the foreign countries in India

| S. No. | Registered GI | Category | Country | Year |
|---|---|---|---|---|
| 1 | Peruvian Pisco | Manufactured | Peru | 2009-10 |
| 2 | Champagne | Manufactured | France | 2010-11 |
| 3 | Napa Valley | Manufactured | USA | 2010-11 |
| 4 | Scotch Whisky | Manufactured | United Kingdom | 2010-11 |
| 5 | Prosciutto di Parma | Food stuff | Italy | 2010-11 |
| 6 | Cognac | Manufactured | France | 2011-12 |
| 7 | Porto | Manufactured | Portugal | 2011-12 |
| 8 | Douro | Manufactured | Portugal | 2011-12 |
| 9 | Tequila | Manufactured | Mexico | 2012-13 |
| 10 | Parmigiano Reggiano | Manufactured | Italy | 2016-17 |
| 11 | Prosecco | Manufactured | Italy | 2016-17 |
| 12 | Asiago | Food stuff | Italy | 2016-17 |
| 13 | Lamphun Brocade Thai Silk | Handicrafts | Thailand | 2017-18 |
| 14 | Grana Padano | Manufactured | Italy | 2018-19 |
| 15 | Chios Mastiha | Manufactured | Greece | 2021-22 |
| 16 | Gorgonzola | Food stuff | Italy | 2021-22 |
| 17 | Brunello Di Montalcino | Manufactured | Italy | 2021-22 |
| 18 | Lambrusco Di Sorbara | Manufactured | Italy | 2021-22 |
| 19 | Lambrusco Grasparossa Di Castelvetro | Manufactured | Italy | 2021-22 |
| 20 | Montepulciano D'abruzzo | Manufactured | Italy | 2021-22 |
| 21 | Zatecky chmel | Manufactured | Czech Republic | 2021-22 |
| 22 | Munchener Bier | Manufactured | Germany | 2021-22 |
| 23 | Toscano | Manufactured | Italy | 2021-22 |
| 24 | Conegliano Valdobbiadene Prosecco | Manufactured | Italy | 2021-22 |
| 25 | Franciacorta | Manufactured | Italy | 2021-22 |
| 26 | Chianti | Manufactured | Italy | 2021-22 |
| 27 | Bayerisches Bier | Manufactured | Germany | 2021-22 |
| 28 | Irish Cream/Irish Cream Liqueur | Manufactured | Ireland | 2021-22 |
| 29 | Brandy De Jerez | Manufactured | Spain | 2022-23 |
| 30 | Provolone Valpadana | Manufactured | Italy | 2022-23 |
| 31 | Ceskobudejovicke Pivo | Manufactured | Czech Republic | 2022-23 |
| 32 | Vino Nobile Di Montepulciano | Manufactured | Italy | 2022-23 |
| 33 | Chilean Pisco | Manufactured | Chile | 2022-23 |
| 34 | Sitia Lasithiou Kritis | Food stuff | Greece | 2023-24 |
| 35 | Kalamata | Food stuff | Greece | 2023-24 |
| 36 | Barolo | Manufactured | Italy | 2023-24 |
| 37 | Nihonshu/Japanese Sake | Manufactured | Japan | 2024-25 |
| 38 | Aceto Balsamico di Modena | Manufactured | Italy | 2024-25 |

## 6. Agricultural crops and commodities for GI protection

The total of 219 agricultural GIs were reviewed and it was found that these have been registered with unique geographical features for 73 agricultural crops and commodities. The details of the crops and commodities are given in Table 2. The highest GI registrations were granted for rice (31), followed by chilli &mango (16 each), banana &betel leaf (8 each) and coffee, orange & pigeon pea (7 each). Kishore (2018) reported that horticultural items contributed nearly 75% of the total agricultural GIs till 2018, the present study also substantiated the dominance of the horticultural crops in the total registered agricultural GIs. The two GIs in rice were granted for Kerala during 2007-08 for "Navara rice" and "Palakkadan Matta rice". The crops, namely brinjal, tea and turmeric were also registered for GI protection with 6 unique GI tags in each case. Chaudhary *et al.,* (2022) reported that GIs in force have transformed social and human development, cultural heritage and increased likelihood of reclaiming market share also true for agricultural GIs.

After perusal of the data it was observed that single GI in each case was registered for aeracanut, amaranth, amchur (dried mango powder), anardana (dried pomegranate powder), aonla, apricot, barnyard millet, sapota, chyura oil, clove, cucumber, cumin, custard apple, dates, finger millet, fig etc. (Table 2). Nirosha and Mansingh (2024) reported that the Indian government has launched different programs for promoting GIs in the international market. The Agricultural and Processed Food Products

**Table 2:** Details of the agricultural crops registered for Geographical Indications in India

| Sr. No. | Crop | No. | Sr. No. | Crop | No. | Sr. No. | Crop | No. |
|---|---|---|---|---|---|---|---|---|
| 1 | Aeracanut | 1 | 26 | Finger millet | 1 | 50 | Onion | 4 |
| 2 | Amaranth | 1 | 27 | Fig | 1 | 51 | Orange | 7 |
| 3 | Amchur | 1 | 28 | Garlic | 3 | 52 | Peach | 1 |
| 4 | Anardana | 1 | 29 | Ginger | 3 | 53 | Pepper | 2 |
| 5 | Aonla | 1 | 30 | Grapes | 3 | 54 | Pineapple | 2 |
| 6 | Apricot | 1 | 31 | Guava | 2 | 55 | Pomello | 1 |
| 7 | Banana | 8 | 32 | Herb (decorative) | 1 | 56 | Pomegranate | 1 |
| 8 | Barnyard millet | 1 | 33 | Jack fruit | 1 | 57 | Premna Herb | 1 |
| 9 | Beans | 5 | 34 | Jaggary | 3 | 58 | Raisins | 1 |
| 10 | Bengal gram | 1 | 35 | Jamun | 2 | 59 | Rice | 31 |
| 11 | Betel leaf | 8 | 36 | Jasmine | 4 | 60 | Saffron | 1 |
| 12 | Brinjal | 6 | 37 | Job's tear | 1 | 61 | Seabuckthorn | 1 |
| 13 | Cashew | 3 | 38 | Jute leaves fermented | 1 | 62 | Sesame | 1 |
| 14 | Cardamom | 3 | 39 | Karonda | 1 | 63 | Sorghum | 2 |
| 15 | Chilli | 16 | 40 | Kewda Flower | 1 | 64 | Soybean | 1 |
| 16 | Chikoo | 2 | 41 | Khardwi Food additive | 1 | 65 | Strawberry | 1 |
| 17 | Chyura Oil | 1 | 42 | Kokum | 1 | 66 | Tamarind | 1 |
| 18 | Clove | 2 | 43 | Lemon | 5 | 67 | Tea | 6 |
| 19 | Coconut | 2 | 44 | Litchi | 3 | 68 | Teak | 1 |
| 20 | Coffee | 7 | 45 | Makhana | 1 | 69 | Tejpat | 1 |
| 21 | Coriander | 2 | 46 | Malta | 1 | 70 | Tomato | 1 |
| 22 | Cucumber | 1 | 47 | Mango | 16 | 71 | Tur dal | 7 |
| 23 | Cumin | 1 | 48 | Mehndi | 1 | 72 | Turmeric | 6 |
| 24 | Custard Apple | 1 | 49 | Okra | 1 | 73 | Wheat | 3 |
| 25 | Dates | 1 | | | | | | |

**Table 3:** Details of the registered Geographical Indications in rice crop up to July 2025

| S. No. | Geographical Indications | State | Special features | Registration Year |
|---|---|---|---|---|
| 1 | Navara Rice | Kerala | Medicinal properties for paralysis and other neuro muscular conditions | 2007-08 |
| 2 | Palakkadan Matta Rice (Royal rice) | Kerala | Higher Mn and Zn contents and possess medicinal properties | 2007-08 |
| 3 | Pokkali Rice | Kerala | Salinity tolerant, higher protein content and distinct organoleptic character | 2008-09 |
| 4 | Wayanad Jeerakasala Rice | Kerala | Medium size grains, scented with unique fragrance and aroma | 2010-11 |
| 5 | Wayanad Gandhakasala Rice | Kerala | Short bold with natural sandal wood fragrance and aroma | 2010-11 |
| 6 | Kalanamak Rice | Uttar Pradesh | Black husk, high iron, zinc, protein and aromatic, low glycaemic index | 2013-14 |
| 7 | Kaipad Rice | Kerala | Kaipad ecosystem (naturally grown with aquaculture) | 2013-14 |
| 8 | Basmati Rice | Punjab, Haryana, Delhi, Himachal Pradesh, Uttarakhand, Uttar Pradesh, Jammu and Kashmir | Long grains with distinct aroma and texture | 2015-16 |
| 9 | Ajara Ghansal Rice | Maharashtra | Short bold aromatic rice | 2015-16 |
| 10 | Ambemohar Rice | Maharashtra | Strong aroma like blossom of mango, tolerant to slat stress | 2016-17 |
| 11 | Joha Rice | Assam | Unique aroma, superfine kernel and good cooking qualities | 2016-17 |
| 12 | Gobindobhog Rice | West Bengal | Short grains, aromatic with pleasant aroma | 2017-18 |
| 13 | Tulapanji Rice | West Bengal | Short grains, non-sticky suitable for biryani, fried rice, insect resistance | 2017-18 |
| 14 | Katarni Rice | Bihar | Aromatic flavour, palatability, and suitable for flattened rice flakes | 2017-18 |
| 15 | Boka Chaul | Assam | Semi-glutinous, low amylose content and easy cooking quality | 2018-19 |
| 16 | Jeeraphool | Chhattisgarh | Aromatic, soft rice, very fine short slender identical to cumin and suitable for *kheer* making | 2018-19 |
| 17 | Chokuwa Rice | Assam | Semi-glutinous winter rice (*Sali*)with low amylose content (12-17%) | 2019-20 |
| 18 | Chak - Hao | Manipur and Nagaland | Black scented with unique aroma and high antioxidant properties | 2019-20 |
| 19 | Balaghat Chinnor | Madhya Pradesh | Unique taste, aroma, softness and suitable for *kheer* making | 2021-22 |
| 20 | Nagri Dubraj | Chhattisgarh | Short grain and aromatic | 2022-23 |
| 21 | Adamchini Chawal | Uttar Pradesh | Short-bold, scented, good cooking quality and possess drought tolerance | 2022-23 |
| 22 | Bhandara Chinoor Rice | Maharashtra | Good fragrance and taste | 2023-24 |
| 23 | Mushqbudji Rice | Jammu and Kashmir | Aromatic short rice with light ivory colour | 2023-24 |

| | | | | |
|---|---|---|---|---|
| 24 | Marcha Rice | Bihar | Suitable for flattened rice flakes | 2023-24 |
| 25 | Khaw Tai (Khamti Rice) | Arunachal Pradesh | Potent scent, sweet flavor, white hue and higher nutritional value | 2023-24 |
| 26 | Lal Chawal (Red Rice) | Uttarakhand | Nutritious, unique aroma, higher in Mn, and Fe | 2023-24 |
| 27 | Kalonunia Rice | West Bengal | Black hulled, good in aroma, texture and taste | 2023-24 |
| 28 | Koraput Kalajeera Rice | Odisha | Black hulled, short slender, good in aroma, texture and taste | 2023-24 |
| 29 | Karen Musley Rice | Andaman and Nicobar Islands | Aromatic, higher nutritional value and salinity tolerance | 2024-25 |
| 30 | Radhunipagal Rice | West Bengal | Aromatic, short grains, sweetish in taste with medicinal properties | 2024-25 |
| 31 | Ramanadu Chithiraikar Rice | Tamil Nadu | Red rice with bold and round grains with high nutritional value | 2024-25 |

Export Development Authority (APEDA) facilitated the export of various GI products and goods, including "Naga Mircha", "Black Rice", mangoes. APEDA also organized promotional events and buyer–seller meets in Belgium and Denmark. Additionally, the Department for Promotion of Industry and Internal Trade (DPIIT) has organized exhibitions, conferences, and workshops to promote GI products in India and abroad. Additionally, the Ministry of Textiles, the Spices Board of India, the Tea Board of India, the Export Promotion Council for Handicrafts, etc. are actively engaged in promoting and exporting GIs in India and abroad.

**7. GI protection in rice genetic resources**

Rice is a staple food crop in India grown in diverse agro-ecological conditions. Rice contributed 41.5% (13.82 m t) of the total food grain production during 2023-24 in India. Rice farming has a vast history of above 7000 years and caters to the need of around 50% of the world population (Chen *et al.,* 2024). India is one of the largest contributors toensure global food security and also exporting rice and with a market stake that surpassed 40% during 2022 (Nayak *et al.,* 2024).The diverse agro-ecological cultivation of rice enriched the niche specific adaptations, genetic resources conservation and traditional knowledge. Rice germplasm diversity is so huge that nearly 1.18 lakh accessions have been conserved and more than 245 unique stocks have been registered with the national gene bank. The niche specific germplasm has unique characteristics, climatic resilience and special quality traits, resultantly, 31 GIs have been registered in rice. In India, the rice GIs are qualified in Class 30 along with coffee, tea, cocoa, sugar, tapioca, etc. These accounts for nearly 14.1% of the agricultural and 4.4% of the total GI protection till July 2025. The details of the registered rice GIs are presented in Table 3. The registered rice GIs are unique mainly for their aromatic fragrance, short fine grains, medicinal properties and product specific development like flattened rice, *kheer*, pulao and biryani.

State-wise, the highest GIs were registered by Kerala (06), followed by West Bengal (04), Assam & Maharashtra (03 each) and Bihar, Chhattisgarh and Uttar Pradesh (2 each). The "Navara Rice" and "Palakkadan Matta Rice" have been reported with medicinal properties and the special feature is related to the geographical territory of Kerala. These specific GIs in rice convey proclaimed quality and uniqueness, which is characteristically associated with the distinct geographical locality, area andregion of Kerala (Aggarwal *et al.,* 2014). "Pokkali Rice", "Ambemohar Rice" and "Karen Musley Rice" have tolerance to salinity and distinct organoleptic characters and aroma. The geographical origin also plays a significant role in the raw product quality and in agreement, the "Jeeraphool" and "Balaghat Chinoor" from central India are more suited for *kheer* preparation. Likewise, "Katarni rice" and "Marcha rice" from Bihar are widely used for flattened rice flakes preparations. "Kaipad Rice" from Kerala itself defines a Kaipad ecosystem for naturally grown rice in the saline-prone coastal wetland with aquaculture in certain regions, namely Ezhome panchayat of Kannur district and on the banks of Korapuzha, Chaliyar, Kallayipuzha and Poonoor in Kozhikode and Kasargod districts. Similarly, GI tags granted for Kalanamak Rice (Uttar Pradesh), Chak-Hao (Manipur and Nagaland),

Kalonunia Rice (West Bengal) and Koraput Kalajeera Rice (Odisha) have the unique black hull, high antioxidant activities and cooking qualities. The GI tag was granted for the unique long grains, strong aroma and excellent cooking quality of "Basmati Rice" for the geographical territories of Punjab, Haryana, Delhi, Himachal Pradesh, Uttarakhand, Uttar Pradesh and Jammu & Kashmir (Jena and Grote, 2010)."Joha Rice" of Assam and "Gobindobhog Rice" and"Tulapanji Rice" from West Bengal are famous for their unique aroma, grain texture and cooking qualities.

Sharma (2019) analysed that 103 agricultural GIs were registered, which were nearly 30% of the total granted GIs during 2019. Singhal (2008) emphasized that patents and copyright are envisioned to reward investments for innovation, while GIs are likely to pay producers for a geographical product, specially favoured for agricultural goods. The agricultural GIS have been protected for 73 agricultural crops and commodities across the states and union territories.

## Conclusion

GI protection is associated with the traditional knowledge, quality signalling, market access and rural developmental dimensions. Traditional knowledge and biodiversity can be safeguarded through an effective GI system. Globalization and liberalization have opened new horizons in the international markets for producers engaged in GIs and even situated in the less organized markets and remote geographical locations. GIs can have multi-dimensional impacts, including social, cultural economic and environmental impacts. Under the Indian scenario, agricultural diversity can have positive impacts on exports, economic gains and cultural heritage. There is an urgent need for sensitizing farmers, tribes and communities who are engaged in biodiversity conservation over the centuries. The grant of GI protection will enable them to fetch higher prices for their niche specific production and manufactured products. Good progress has been made but keeping in mind the huge Indian biodiversity still the scope exists for GI boosting in India. Besides, special geo-climatic attributes, the crop GIs also possess unique gene constellations need to be envisaged for climate resilience and sustainable agriculture.

## Author contributions

The review was written and enriched by VK, RS and GPS. All authors read, edited, and approved the final manuscript.

## Conflict of interest

The authors declare no conflict of interest.

## Ethical Approval

The article doesn't contain any study involving ethical approval.

## Generative AI or AI/Assisted Technologies use in Manuscript Preparation

No

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