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Medicinal herbs cultivation to ensure a sustainable supply of quality raw herbal drugs: A review

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ABSTRACT

Geographical Indications (GIs) are closely associated with product quality, as the agroecological conditions of a region impart unique characteristics to agricultural commodities. These distinctive quality traits facilitate the filing and registration of GI products. India, being one of the world's mega-biodiversity regions, possesses a rich diversity of medicinal plants. However, the increasing demand for herbal medicines has led to destructive harvesting practices, threatening the natural populations of these valuable species. Therefore, the protection and promotion of GIs can play a significant role in branding and marketing region-specific products, thereby enhancing the economic prosperity of local producers and manufacturers. In addition to supporting regional economic development, GI registration also strengthens export potential. Among the GI-tagged horticultural commodities, spices, medicinal, and aromatic crops together constitute less than 25% of the total share. Although GI registration in the horticulture sector has progressed considerably over the years, medicinal and aromatic crops still possess very few GI tags, highlighting the urgent need for greater awareness, documentation, and registration efforts in this sector.

Introduction

Raw herbal drugs are typically associated with the region where they are produced and are influenced by distinct local geographical conditions. The product's attributes, traits or reputation should primarily stem from its origin or roots. The growing consumer awareness regarding drug quality has prompted extensive scholarly investigation into the multidimensional nature of quality (Ilbery & Kneafsey, 2000). Consequently, more stringent regulatory frameworks have been implemented to

mitigate the risks associated with food consumption and to safeguard public health (De Rosa, 2015). To address this issue, the World Trade Organization (WTO) has established various forms of Intellectual Property Rights (IPRs) aimed at supporting local producers of agricultural commodities and ensuring the provision of high-quality products, and one of them is Geographical Indication (GI). A geographical indication is any indication that has a good originating in a region or locality, where a particular quality, reputation, or other characteristic of the good is primarily attributable to its geographical origin

(WIPO, 2024). Since the adoption of the Agreement on Trade-Related Aspects of Intellectual Property Rights (the TRIPS Agreement) in 1994, which contains a section on geographical indications, this form of intellectual property (IP) has attracted increasing attention from policymakers and trade negotiators, as well as producers, lawyers, and economists across the world (European Commission WIPO, 2024).

The focus of GI protections has historically been on agricultural or food products, rather than non-edible items such as medicinal plants. Intellectual Property Rights (IPR) related to traditional medicinal plants did not attract significant attention until 1994-1995, when the United States Patent and Trademark Office granted a patent for turmeric due to its wound-healing properties. Around the same time, in 1994, the European Patent Office awarded a patent for Neem (*Azadirachta indica*) for its antifungal applications. Both patents were later revoked following legal objections from India. In response to such instances of biopiracy, the Indian government launched the Traditional Knowledge Digital Library (TKDL) in 2001. This initiative aimed to document and digitize traditional medicinal formulations from Indian systems of medicine, making them globally accessible to safeguard against unauthorized intellectual property claims (James, 2016; Pandit et al., 2024). Following this, the Geographical Indication (GI) tag system in India was officially launched with the enactment of the Geographical Indications of Goods (Registration and Protection) Act, 1999, which came into effect on 15th September 2003 (PIB, 2003). This legislation provides legal protection to products uniquely linked to specific geographical locations, recognizing their distinct qualities and reputation. According to the 2023 World Intellectual Property Indicators (WIPO) report, approximately 58,400 GIs were registered and in force across 91 countries and regions globally. China reported the highest number of active GIs (9,785), followed by Germany (7,586), Italy (6,330), and France (6,098). In 2023, goods and services related to wines and spirits constituted the largest category, comprising 48.1% of the total, while agricultural products and foodstuffs accounted for 44.8%, and handicrafts represented 4.2%.

As of 2024, Asia recorded 3,973 registered GIs, of which 658 originated from India. Indian GIs, 203 were classified under the category of agricultural products (WIPO, 2024; FAO, 2025). Darjeeling Tea was the first Indian product to receive a Geographical Indication (GI) tag in 2004-2005. Since then, India has registered over 658 GI-tagged products across diverse categories, including agricultural commodities, handicrafts, textiles, and food items. However, the number of GI registrations pertaining specifically to medicinal and aromatic crop products remains limited, with only approximately 11 entries. This number further decreases when considering exclusively botanically derived substances used for therapeutic applications (Sachin et al., 2023; Kadasani, 2023). Several factors contribute to this, including limited documentation and scientific validation of traditional knowledge related to medicinal plants, which makes it challenging to establish a clear link between the plant and its geographic origin. Along with weak enforcement mechanisms, insufficient institutional support further contributes to the neglect of GI for medicinal plants in national and international discourse.

Cultivating medicinal plants in ecologically suitable regions is vital for optimizing their phytochemical composition, therapeutic efficacy and long-term sustainability. Environmental variables such as climate, soil type, altitude, and indigenous farming practices significantly influence the biosynthesis of active constituents in these plants. When grown in their native or ecologically optimal zones, medicinal plants tend to exhibit superior yields and higher concentrations of bioactive compounds, e.g., Nagori Ashwagandha, Maghai Paan, Sojat Heena, Kashmiri Kesar, Ganjam Kewda, etc. Additionally, region-specific cultivation plays a key role in conserving local biodiversity, safeguarding traditional ethnobotanical knowledge, and improving the socio-economic conditions of rural communities (Kala et al., 2006; Sharma et al., 2020). Therefore, GI of medicinal plants is essential for preserving traditional knowledge, protecting biodiversity, promoting sustainable livelihoods, and supplying quality raw herbal drugs.

Table 1. List of medicinal plants filed for GI application

Name and Application No.	Crop	Region	Unique traits	Status
Nagori Ashwagandha and 1143.	<i>Withania somnifera</i> (Linn.) Dunal	Arid track of central to western Rajasthan.	Pencil thickness, brittle, dry root without any cavity, and having $\geq 35\%$ starch content in roots.	Approved

Tanner's Senna of Kutch (Kutchi Aval) and 1528.	<i>Senna auriculata</i> L. Roxb	Kutch district of Gujarat.	Tannin content and antioxidant activity in bark, leaf, and pod harvested from the Kutch region	Filed
Southeast Bengal Brahmi and 1391.	<i>Bacopa monnieri</i> (L.) Wettst.	North 24 Parganas, Medinipur, Nadia, Hooghly, Kolkata, Howrah, Sagar Islands and the nearby wetland areas of West Bengal	Rich in Bacoside A content and maximum herbage yield	Filed
West Bengal Thankuni Kola) and 2017	<i>Centella asiatica</i>	West Bengal districts such as Darjeeling, Dinajpur, Malda, Murshidabad, Burdwan, Hooghly and Kolkata	Small-leaved (5.42-7.16 cm ²) variant rich in bioactive secondary metabolites such as Asiaticoside (4.14%) and Madecassoside (2.32%).	Filed
'Kangan Saji of Ghaggar and 1617	<i>Haloxylon stocksii</i> (Boiss.)	Ghaggar belt of Rajasthan, especially in Vijaynagar, Anupgarh and Suratgarh Tehsils of Sri Ganganagar as well as some parts of Hanumangarh and Bikaner districts of Rajasthan	Choa, Rota, and Saji salts are rich in carbonate (350-355 g/ kg), bicarbonate (75-80 g/ kg), sodium (324-328 g/ kg), and chloride (220-228 g/ kg).	Filed

Nagori Ashwagandha

The cultivation of *Withania somnifera* (Ashwagandha) is concentrated extensively in the western and central regions of Rajasthan, notably in the former Nagaur district and adjoining areas, including Bikaner, Churu, Barmer, Sikar, and Jodhpur (Bikaner District Gazetteer, 1962). Among the region-specific 'Nagori Ashwagandha' is internationally recognized due to its adaptation to the unique phytogeographic conditions of this semi-arid zone. This landrace exhibits distinct root characteristics, such as root length, root thickness, root brittleness, and higher starch content in the root, even at physiological maturity, under sandy to loamy sandy soils (Saran et al., 2025). The genotype-environment interaction in this region significantly influenced root yield and phytochemical composition. Notably, roots of the variety Vallabh Shahi Ashwagandha-1 (VSA-1) selected from Nagori Ashwagandha contains thicker and more brittle roots as compared to those of other varieties.

In addition, the Nagori Ashwagandha demonstrates superior root morphology, including fresh root girth

(4.17 cm), dry root girth (1.63 cm), root yield (5 t/ ha), starch yield (2.70 t/ ha) and a brittleness score of 9.33 (on a 10-point scale) due to minimum crude fiber (7.55-8.31%) content (Fig. 1). The minimum qualitative benchmark for Nagori Ashwagandha includes pencil-thick, cavity-free, brittle dry roots with a starch content of $\geq 35\%$ at crop maturity (Saran et al., 2025). These traits underscore the importance of region-specific cultivation in enhancing both the quality and pharmacological potential of ashwagandha.

Southeast West Bengal Brahmi

The Southeast West Bengal Brahmi ecotype is predominantly distributed in the southeastern region of West Bengal, particularly within the North 24 Parganas district and adjacent wetland areas (Hooker, 1890; Chowdhury and Mukherjee, 2015; Pattanayak et al., 2016; Mukherjee, 2018; Naskar et al., 2022). This elite germplasm of *Bacopa monnieri* (Linn.) Dunal is characterized by the longest pedicels (Fig. 2), its high saponin content, especially Bacoside A (3.65%) and its major constituent bacoside-A3 (0.679%), which are the primary bioactive

compounds contributing to its pharmacological efficacy (Saran et al., 2022).

Among Brahmi accessions collected from various geographic regions across India, those from the wetlands of southeast West Bengal consistently exhibit the highest bacoside accumulation, with Bacoside A content reaching up to 7.55 µg, surpassing levels observed in accessions from other parts of the country (Dey et al., 2020).

The DBM-4 genotype from wetlands of south-eastern West Bengal yielded the highest dry herbage at 134 q/ha, representing a 9% increase over the check variety (124 q/ha). In terms of morphological characteristics, along with superior pedicel length, averaging 2.96 cm, which is about 19% longer than the check variety's pedicel length of 2.49 cm (Saran et al., 2022). Additionally, the Brahmi variety Vallabhi Ganga Brahmi-1, developed through selective breeding from germplasm collected in the wetlands of south-eastern West Bengal, has demonstrated significantly higher total bacoside yield, reaching 181 kg/ha, approximately 58% greater than the standard check variety CIM-Jagriti, which yields 115 kg/ha.

The genotype demonstrates exceptional performance in terms of both biomass production and phytochemical yield when cultivated in the wetland agro-ecology of this region. This variety is particularly suited for commercial cultivation due to its high dry herbage yield potential (up to 170 q/ha) and elevated Bacoside A content, meeting and exceeding industrial quality standards (≥1.5%) (Fig. 3).



Fig. 1. Roots of Nagori Ashwagandha



Fig. 2. Brahmi germplasm DBM-4 vs CIM Jagriti (Check)

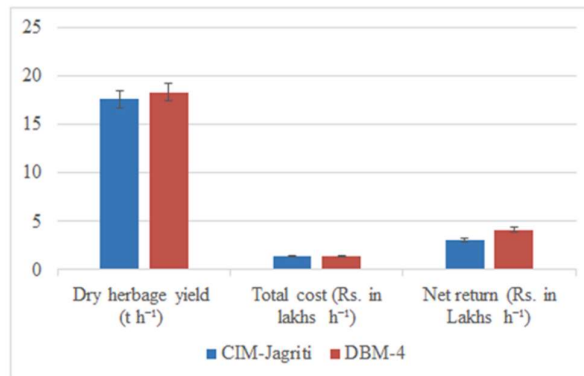


Fig. 3. Economic performance of Brahmi (DBM-4 and CIM Jagriti)

Tanner's Senna of Kutch (Kutchi Aval)

Tanner's Senna of Kutch (Kutchi Aval), scientifically known as *Senna auriculata*, is commonly found across the coastal and semi-arid regions of Kutch, Gujarat (Kutch District Gazetteers, 1971). It is a branched shrub with a 1.5-5 m height, trunk diameter of 20 cm, and brown lenticellate bark. The fruit of this Senna is visibly distinct in shape and size from other species of Senna (Fig. 4). Its distinctiveness and commercial importance stem from its high tannin content, primarily extracted from the bark. The flowers of *S. auriculata* (L.) Roxb. have been reported to contain a wide range of bioactive

compounds, including alkaloids, glycosides, saponins, polyphenols, tannins, phlorotannins, terpenoids, triterpenes, carbohydrates, proteins, amino acids, anthraquinones, aloe-emodin, and sitosterols. The plant's leaves and stems are commonly used as alternatives to *S. angustifolia* (Tinnevely Senna), especially for extracting sennosides and in hair dye formulations with henna. These phytoconstituents are linked to therapeutic effects, notably in managing diabetes mellitus and other health conditions (Prasathkumar et al., 2021; Nille et al., 2024).



Fig. 4. Plant parts of Tanner's Senna of Kutch (Kutchi Aval)

Kangan Saji of Ghaggar

The 'Kangan Saji of Ghaggar' (*Haloxylon stocksii*) is a widely distributed, cultivated plant in the Ghaggar belt of Rajasthan, especially in Vijaynagar, Anupgarh, and Suratgarh Tehsils of Sri Ganganagar (Sri Ganganagar district Gazetteer, 1972; Hedge, 1997), as well as some parts of Hanumangarh and Bikaner districts of Rajasthan—the 'Kangan Saji of Ghaggar' dwells differently from others in climate and edaphic characteristics. This species is characterized by its ability to accumulate high levels of sodium and chloride ions within leaf vacuoles. The plant features glabrous stems and ellipsoid, trigonous leaves that are obtuse or acute at the tip, measuring 0.3 to 0.8 cm in length (Rathore et al., 2012). Its primary use lies in the production of 'Saji'—also known as barilla or soda ash through the combustion of air-dried plant material. The Saji, derived from *H. stocksii* grown along the Ghaggar riverbed, is regarded as superior in quality. Three main grades of Saji salt are

traditionally recognized: Choa, Intermediate (rota) and Saji. Choa salt, noted for its porous, ashy texture and white to purplish colour, is considered the highest quality, while the standard Saji is a denser, darker, stone-like material. The quality of Saji salt depends significantly on the skill of the local artisans during the burning and processing stages. The Bawaria community of Rajasthan continues to maintain this traditional practice. Additionally, factors such as soil type, plant variety, shrub age, and agronomic practices influence the final quality of the product. (Ahmed et al., 2006).

West Bengal Thankuni (Gotu Kola)

The West Bengal Thankuni, commonly known as Mandukarpani in India, Gotu Kola worldwide, Golpatta, Paise Jhar, Athane Jhar in the Darjeeling area and Dholamonnia in the Dinajpur area of West Bengal (Subba et al., 2024), is an important medicinal herb that is used for its neuroprotective, immunomodulatory, anti-cancer, antimicrobial, antioxidative, and nerve-regenerative properties (Sabaragamuwa et al., 2018). In West Bengal, particularly, this plant often grows naturally as a weed in agricultural fields or on wastelands and is known as *Centella asiatica* (syn., *Hydrocotyle asiatica*) and *H. verticillata* (Hooker, 1886). Many people have cultivated it in their home gardens, either for its significant medicinal properties or for using its leaves as a leafy vegetable (Mondal and Khatua, 2015).

The bioactive compounds present in this plant are referred to as centellosides, consisting of two saponins (asiaticoside and madecassoside) and two saponinogens (asiatic acid and madecassic acid) (Nav et al., 2021). These bioactive constituents are present in all plant parts, with leaves serving as the primary site of accumulation. Their quantitative profiles are strongly modulated by ecological factors and the geographical provenance of the plant material (Singh et al., 2022). Consequently, the selection and large-scale cultivation of elite, high-metabolite-yielding chemotypes are crucial for enhancing both agricultural productivity and industrial applications. The West Bengal Thankuni (Gotu Kola) small-leaved (5.42-7.16 cm²) variant is rich in bioactive secondary metabolites such as Asiaticoside (4.14%) and Madecassoside (2.32%), which fit the industrial benchmarks. In contrast, the broad-leaved (21.92-33.15 cm²) variant from Gujarat is rich in Madecassic acid and Asiatic acid. The Thankuni has been reported to contain the highest asiaticoside content (1.51–4.20%) among collections from different agro-ecological regions of India, with the maximum recorded in an accession from the Kolkata region (Rohini and Smitha, 2022).

Table 2. Secondary metabolite content in *Centella asiatica* from different phytogeographic regions

Location	Asiaticoside (%)	Madecassoside (%)	Madecassic acid (%)	Asiatic acid (%)	Total Triterpenes (%)
West Bengal	4.138	2.32	0.062	0.030	6.550
Nagaland (NEH)	1.511	0.86	0.169	0.068	2.608
Gujarat	0.543	1.987	0.260	0.194	2.984

The overall concentration of these secondary metabolites in West Bengal Thankuni (Gotu Kola) from West Bengal significantly exceeds that reported in the related species *Hydrocotyle verticillata*, underscoring its distinct phytochemical superiority and promising therapeutic potential for addressing emerging health disorders.

Conclusion

This review highlights the critical role of Geographical Indications (GIs) in recognizing, preserving, and promoting the unique identity and traditional knowledge associated with medicinal and aromatic plants (MAPs) in India. Despite historically limited attention to non-edible products under GI frameworks, this study showcases four distinct and region-specific medicinal plants: Nagori Ashwagandha, Southeast West Bengal Brahmi, West Bengal Thankuni (Gotu Kola) Tanner's, Senna of Kutch (Kutchi Aval), and Kangan Saji of Ghaggar, which demonstrate clear geographic and phytochemical distinctiveness. These landraces not only exhibit superior quality attributes and bioactive profiles but are also integral to local economies, sustainable livelihoods and biodiversity conservation. Documenting and validating the unique geographical and quality-linked characteristics of these resources strengthens the case for GI registration and supports the broader objectives of sustainable development, rural empowerment and global competitiveness of Indian herbal products. Promoting GIs in the MAPs sector can help ensure quality assurance, traceability and market differentiation, while also protecting indigenous knowledge systems. As consumer demand for authentic and region-specific herbal products continues to rise, establishing strong GI protection for medicinal plants becomes increasingly imperative for safeguarding India's rich phyto-pharmaceutical heritage.

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Author's Contribution

Parmeshwar Lal Saran, K.A. Kalariya, Rohan Sarkar, and Manish Kumar Mittal served as PI and Co-PIs of the project. They contributed to the GI filing process, conducted data collection and analysis, and drafted the review manuscript. Mrs. Manjari was also involved in sampling and data compilation as a Research Fellow under the GI Project.

Conflict of Interest

The author has no conflict of interest.

Data Sharing

This article did not generate any supplementary data.

References

- Ahmed, E., Nawaz, S. A., Malik, A. and Choudhary, M. I. 2006. Isolation and cholinesterase-inhibition studies of sterols from *Haloxylon recurvum*. *Bioorganic & Medicinal Chemistry Letters*, 16(3): 573-580.
- Chowdhury, M. and Mukherjee, R. 2014. Wild edible plants consumed by local communities of Maldah district of West Bengal, India. *Indian Journal of Scientific Research*, 3(2):163-170.
- De Rosa, M. 2014. The role of geographical indication in supporting food safety: a not taken for granted nexus. *Italian Journal of Food Safety*, 4(4): 4931. <https://doi.org/10.4081/ijfs.2015.4931>
- Dey, A., Hazra, A.K., Nandy, S., Kaur, P. and Pandey, D.K. 2020. Selection of elite germplasms for industrially viable medicinal crop *Bacopa monnieri* for bacoside A production: an HPTLC-coupled chemotaxonomic study. *Industrial Crops and Products*, 158: 112975.

- District Gazetteer of Kutch, 1971. <https://archive.org/details/dli.ministry.13697>.
- European Commission WIPP. 2024. https://policy.trade.ec.europa.eu/enforcement-and-protection/protecting-eu-creations-inventions-and-designs/geographical-indications_en.
- FAO. 2025. <https://www.fao.org/geographical-indications/en>.
- Hooker, J.D. 1886. The Flora of British India. Vol. 3. London: L. Reeve & Co.
- Hooker, J.D. 1890. The flora of British India. L. Reeve.
- Ilbery, B. and Kneafsey, M. 2000. Registering regional speciality food and drink products in the United Kingdom: the case of PDOs and PGIs. *Area*, 32(3): 317-325. <https://doi.org/10.1111/j.1475-4762.2000.tb00144.x>
- James, T.C. 2016. IPR issues related to medicinal and aromatic plants (herbs and their allied products). *Journal of Traditional Folk Practices*, 2(1): 7-17.
- Kadasani, T. 2023. Medicinal Plants and GI Protection: Preserving India's Medicinal Wealth.
- Kala, C.P., Dhyani, P.P. and Sajwan, B.S. 2006. Developing the medicinal plants sector in northern India: challenges and opportunities. *Journal of Ethnobiology Ethnomedicine*, 2: 32.
- Kalariya, K.A., Sarkar, R., Baria, V.K., Reddy, N.R. and Das, M. 2025. Technology Information Booklet 3.0. ICAR-Directorate of Medicinal and Aromatic Plants Research, Anand (Gujarat).
- Mondal, B. and Khatua, D.C. 2015. White rot of *Centella asiatica* and two weeds in West Bengal, India. *Journal of Crop and Weed*, 11(1): 225-226.
- Mukherjee, S. K. 2018. Some common medicinal plants for the welfare of the people of West Bengal, India. Dynamics in Biology (Life Science for Next Generation). New Delhi: Akinik Publication, pp. 42-47.
- Naskar, C., Mukherjee, S.K. and Datta, M.D. 2022. Wild Medicinal Plants of South 24 Parganas District, West Bengal, India. *Universal Journal of Plant Science*, 9(1): 1-2. <https://doi.org/10.13189/ujps.2022.090101>
- Nav, S.N., Ebrahimi, S.N., Sonboli, A. and Mirjalili, M.H. 2021. Variability association and path analysis of centellosides and agro-morphological characteristics in Iranian *Centella asiatica* (L.) Urban ecotypes. *South African Journal of Botany*, 139: 254-266. <https://doi.org/10.1016/j.sajb.2021.03.006>
- Nille, G.C., Mishra, S.K., Chaudhary, A.K. and Reddy, K.R. 2021. Ethnopharmacological, phytochemical, pharmacological, and toxicological review on *Senna auriculata* (L.) Roxb.: A special insight to antidiabetic property. *Frontiers in Pharmacology*, 12: 647887. <https://doi.org/10.3389/fphar.2021.647887>
- Pandit, R.D., Upadhyaya, A. and Gupta, C. 2024. Geographical indication differentiation to traditional medicinal and aromatic plants used in Ayurvedic medicines for reputation and recognition of their superior pharmaceutical quality, clinical efficacy and economic value. *Annals of Ayurvedic Medicine*, 12(3): 284-292. <https://doi.org/10.5455/AAM.152880>
- Pattanayak, S., Mandal, T.K. and Bandyopadhyay, S.K. 2016. Ethnomedicinal study of plants used for the protection and stimulation of the liver in southern West Bengal, India. *Exploratory Animal and Medical Research*, 6(2): 164-78.
- Prasathkumar, M., Raja, K., Vasanth, K., Khusro, A., Sadhasivam, S., Sahibzada, M.U., Gawwad, M. R., Al Farraj, D.A. and Elshikh, M.S. 2021. Phytochemical screening and in vitro antibacterial, antioxidant, anti-inflammatory, anti-diabetic, and wound healing attributes of *Senna auriculata* (L.) Roxb. leaves. *Arabian Journal of Chemistry*, 14(9): 103345.
- PIB (Press Information Bureau). 2003. Geographical Indications of Goods Act Comes into Force [Internet]. New Delhi: Press Information Bureau, Government of India. <https://archive.pib.gov.in/release02/lyr2003>
- Rathore, V.S., Singh, J.P. and Roy, M.M. 2012. *Haloxylon stocksii* (Boiss.) Benth. A promising halophyte: Distribution, cultivation and utilization. *Genetic Resources and Crop Evolution*, 59(6): 1213-1221.
- Rohini, M.R. and Smitha, G.R. 2022. Studying the effect of morphotype and harvest season on yield and quality of Indian genotypes of *Centella asiatica*: A potential medicinal herb cum underutilized green leafy vegetable. *South African Journal of Botany*, 145: 275-283. <https://doi.org/10.1016/j.sajb.2021.11.005>
- Sabaragamuwa, R., Perera, C.O. and Fedrizzi, B. 2018. *Centella asiatica* (Gotu kola) as a neuroprotectant and its potential role in healthy ageing. *Trends in Food Science & Technology*, 79: 88-97.
- Sachin, A.J., Karthik Nayaka, V.S., Kalal P. and Reddy V.R. 2023. Geographical indications (GI) of spices, plantation, medicinal and aromatic crops. *Indian Horticulture*, 68(4): 40-44.

- Saran, P.L., Damor, H.I., Lodaya, D.H., Suthar, M.K., Kalariya, K.A. and Roy, S. 2022. Identification of potential accessions of *Bacopa monnieri* L. for herbage yield and bacosides A content. *Industrial Crops and Products*, 176:114348.
- Saran, P.L., Kumar, S., Sarkar, R., Kalariya, K.A., Reddy, N.R. and Das, M. 2025. Identification of elite accession of Ashwagandha (*Withania somnifera* L. Dunal) for root yield and brittleness. *Industrial Crops and Products*, 223:120161. <https://doi.org/10.1016/j.indcrop.2024.120161>
- Sehgal, K.K. 1972. District Gazetteer of Ganganagar. <https://archive.org/details/dli.csl.3351>
- Sehgal, K.K., 1962. District Gazetteer of Bikaner. <https://archive.org/details/in.ernet.dli.2015.120386>.
- Sharma, R., Manhas. R. K. and Magotra, R. 2020. Ethnoveterinary remedies of medicinal plants used for the treatment of different ailments in the Chenab valley, Western Himalaya. *Environment, Development and Sustainability*, 22(3): 2705–2732.
- Singh, S.P., Misra, A., Kumar, B., Adhikari, D., Srivastava, S. and Barik, S.K. 2022. Identification of potential cultivation areas for centelloside-specific elite chemotypes of *Centella asiatica* (L.) using ecological niche modelling. *Industrial Crops and Products*, 188:115657. <https://doi.org/10.1016/j.indcrop.2022.115657>
- Subba, Y., Hazra, S. and Rahaman, C.H. 2024. Quantitative ethnobotany of medicinal plants from Darjeeling district of West Bengal, India, along with phytochemistry and toxicity study of *Betula alnoides* Buch.-Ham. ex D. Don bark. *Plants*, 13(24):3505. <http://doi.org/10.3390/plants13243505>
- WIPO. 2024. <https://www.wipo.int/web-publications/world-intellectual-property-indicators-2024-highlights/en/geographical-indications>