Economic Impact of CSIR-IHBT Technologies

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Contents

S. No.	Title	Page No.
1	Economic impact of floriculture crops through intervention of CSIR-IHBT's agrotechnologies under CSIR Floriculture Mission	1
2	Background- CSIR Floriculture Mission	1
3	Global and National scenario of flower marketing	3
4	Economic impact of lilium	6
5	Technology transfer and societal impact	9
6	Impact evaluation of lilium cultivation	16
7	Economic impact of gladiolus	17
8	Technology transfer and societal impact	19
9	Impact evaluation of gladiolus cultivation	21
10	Economic impact of tulip	24
11	Technology transfer and societal impact	27
12	Impact evaluation of tulip cultivation	38
13	Economic impact of marigold	30
14	Technology transfer and societal impact	33
15	Impact evaluation of marigold cultivation	35
16	Economic impact of gerbera	37
17	Technology transfer and societal impact	40
18	Impact evaluation of gerbera cultivation	41
19	Economic impact of stevia through intervention of CSIR-IHBT's Stevia Agro and Processing technology	43
20	Technology transfer and societal impact	51
21	Impact evaluation of stevia cultivation	55
22	Economic impact of Poshan Abhiyan through intervention of CSIR-IHBT's Food and Nutrition Technologies	56
23	Chronological account of the intervention by CSIR Lab	57
24	Key industry partners supplying technology materials in Kangra district	62
25	Socio-economic impact of CSIR-IHBT technology-based products integrated in Poshan Abhiyan	65
26	Economic impact of aromatic crops through intervention of CSIR-IHBT's agrotechnologies under CSIR Aroma Mission	69
27	Background- CSIR Aroma Mission	69
28	Global and national scenario of aromatic plants marketing	70
29	Economic impact of Damask rose	81
30	Impact evaluation of Damask rose cultivation	85
31	Economic impact of aromatic marigold	86
32	Impact evaluation of aromatic marigold cultivation	89
33	Economic impact of lemongrass	90
34	Impact evaluation of lemongrass cultivation	93
35	Economic impact of chamomile	95
36	Impact evaluation of chamomile cultivation	97

Economic impact of floriculture crops through intervention of CSIR-IHBT's agrotechnologies under CSIR Floriculture Mission

Background- CSIR Floriculture Mission

Floriculture, the science and business of cultivating ornamental plants, is rapidly emerging as a vibrant sector within Indian agriculture. The global floriculture industry is growing at a rate of 6%–10% annually, yet India holds only a marginal 0.61% share in this market. Despite having the second-largest area under flower cultivation after China, India's position in global floricultural exports remains limited, ranking 29th in the world.

Domestically, the Indian floriculture market is expanding at a compound annual growth rate (CAGR) of over 20%, with major production states being Tamil Nadu, Karnataka, and West Bengal. India's strength lies in its rich agro-climatic diversity, which supports the cultivation of a wide range of flowers across different seasons and regions. However, the sector continues to face significant constraints, ranging from poor infrastructure and cold-chain logistics to lack of quality planting material, skilled manpower, and market linkages.

Recognizing both the untapped potential and existing challenges, the Council of Scientific and Industrial Research (CSIR) has launched the Floriculture Mission to revitalize the sector using scientific innovations and technology. CSIR has a strong legacy in floriculture, having developed improved varieties and standardized agrotechnologies for crops like gladiolus, gerbera, rose, chrysanthemum, and lilium. CSIR-Institute of Himalayan Bioresource Technology (IHBT) has led pioneering efforts in varietal development, protected cultivation, and capacity building.

The CSIR Floriculture Mission aims to create a science-driven, market-oriented, and employment-generating floriculture ecosystem. It leverages India's biodiversity to develop new floral varieties, enhance cultivation practices, and introduce value-added products for both domestic and international markets. The mission also promotes the domestication of wild ornamental plants—many of which have high aesthetic and commercial value—through advanced breeding techniques, including hybridization and molecular tools.

With strong support from the Government of India, which has identified floriculture as a "sunrise industry" with full export-oriented status, the mission is positioned to boost farmer incomes, generate rural and urban employment, and improve India's standing in the global flower trade.

Market potential of flowers under Floriculture Mission

Overview

India's floriculture sector is witnessing robust growth, fuelled by increasing urbanization, demand for decorative plants, rising disposable incomes, and export opportunities. As of 2018, the domestic floriculture market stood at ₹15,700 crore and is projected to reach ₹47,200 crore by 2024 at a CAGR of 20.1%. Continuing this trend, the Indian floriculture industry is expected to exceed ₹95,000 crore by 2030, driven by:

- Expanding use of flowers in events, religious ceremonies, landscaping, and wellness sectors
- Increased investment in polyhouse and greenhouse technologies
- Greater emphasis on import substitution and floriculture exports
- Rising awareness about eco-friendly, bio-based ornamental products

Production landscape

India's floriculture sector has witnessed significant growth, with the total area under flower cultivation recorded at approximately 2,78,000 hectares, as per the National Horticulture Board data for 2022-23. The production includes about 1.659 million tonnes of loose flowers and 0.484 million tonnes of cut flowers. Tamil Nadu leads the country in flower production with a 20% share, followed by Karnataka (13.5%) and West Bengal (12.2%), with other contributing states including Andhra Pradesh, Maharashtra, Madhya Pradesh, Gujarat, Odisha, Uttar Pradesh, Himachal Pradesh and Uttarakhand. The country's diverse agro-climatic zones offer an unmatched advantage for year-round and off-season flower production, especially in the Himalayan and Northeastern regions. Additionally, India hosts robust nursery and planting material hubs in regions like Hyderabad, Kadiam , Kalimpong, Kolkata, Pune, Gajraula, Saharanpur, and Bengaluru, supporting the supply chain of quality planting materials. This diverse and extensive production landscape positions India strongly for further development in domestic and export floriculture markets.

Types of flowers grown

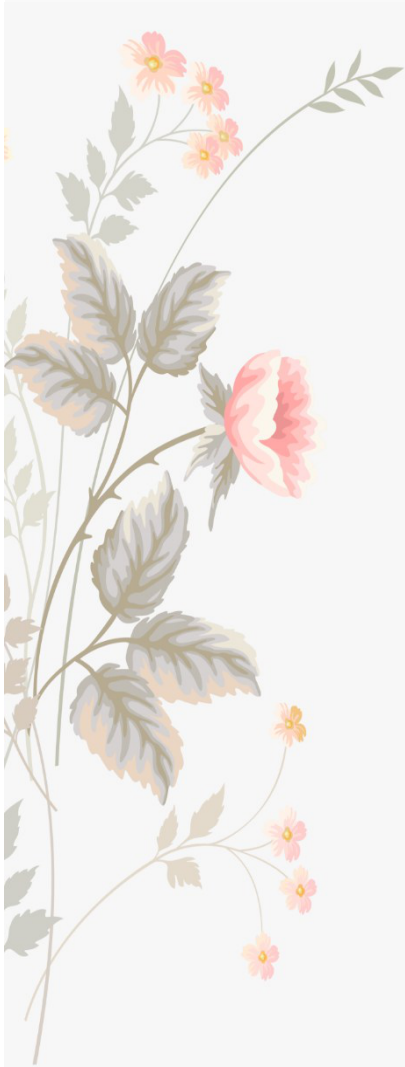
- **Cut flowers**: rose, gerbera, carnation, chrysanthemum, gladiolus, lilies
- **Loose flowers**: marigold, jasmine

Domestic market trends

- Major demand is from urban centres and metros, driven by weddings, festivals, events, and religious offerings.
- 98.5% of flowers are grown under open cultivation; only 1.5% under protected environments (polyhouses/greenhouses).
- Flower nurseries are prominent in Hyderabad, Pune, Kolkata, Kalimpong, Kadiam, Bengaluru, and Gajraula.

Market infrastructure

- Marketing channels include growers, wholesalers, retailers, auction houses, exporters, and end consumers.
- Bangalore is the only city with a dedicated flower auction centre.
- Limited cold chain and logistics infrastructure remain key bottlenecks.



Key challenges

- Lack of quality planting material
- Inadequate cold chain and storage facilities
- Poor market linkages and export infrastructure
- High freight costs
- Limited adoption of modern cultivation technologies

Opportunities

- High domestic demand, especially during festive and wedding seasons
- Potential to substitute imports with indigenous high-value flowers
- Scope for value addition through dry flowers and floral products
- Employment and entrepreneurship opportunities in nurseries, bouquet making, floral design, and export
- Growing interest in protected cultivation and urban floriculture

Global and National scenario of flower marketing

Global scenario

The global floriculture industry has evolved into a highly organized and technology-driven sector, valued at approximately ₹48,706 crores. More than 145 countries participate in floriculture trade, with a sustained annual growth rate of 6–10%. The global demand is largely concentrated in developed nations, with Netherlands, Colombia, Ecuador, Kenya, Japan, and USA dominating the export market. The Netherlands alone accounts for about 58% of the world's cut flower exports, acting as the central hub for international flower trade through the Aalsmeer auction. Colombia and Ecuador contribute 14% and 7% respectively, with their focus on roses and other premium cut flowers.

The international flower trade is highly influenced by consumer trends, seasonality, and major occasions (Valentine's Day, Mother's Day, Christmas, etc.), leading to peak demand cycles. Technological innovations in greenhouse cultivation, cold chain logistics, and floriculture biotechnology have helped developed nations optimize quality and supply.

National scenario – India

India's flower market was valued at ₹15,700 crores in 2018 and is projected to reach ₹47,200 crores by 2024, growing at a CAGR of 20.1%. Despite ranking second globally in area under flower cultivation, India's share in global flower exports remains low at about 0.61%. India's exports are dominated by dry flowers, which make up around 67% of the total export value. Cut flowers such as roses, carnations, chrysanthemums, and gerberas are mainly exported to USA, Netherlands, UK, Germany, and UAE.

Domestically, demand is driven by cultural, religious, and social functions, with metropolitan cities like Delhi, Mumbai, Bengaluru, and Hyderabad being major consumer markets. However, the Indian flower marketing system is still largely informal, involving growers, local vendors, commission agents, and retailers. Only Bengaluru has a structured flower auction centre. Other major flower hubs like Kolkata, Pune, and Hyderabad lack dedicated marketing infrastructure.

Export and import data of floriculture crops

Export scenario
India exported ~17,500 MT of floriculture products worth ₹618.20 crore in 2024–25.
Major export items: Fresh cut flowers, dry flowers, cut foliage, potted plants, planting material.
Top export destinations: USA, Netherlands, UK, Germany, UAE
Dry flowers contribute 67% of export value.
India's share in global floriculture trade: ~0.61%
Ranking in exports: 29th globally
Top exporters globally: Netherlands (58%), Colombia (14%), Ecuador (7%)
Import scenario
Flowers worth ₹800 crore are imported annually.
Main imports: orchids, proteas, calla lilies, tulip, lilium, heliconia, indoor plants
Major suppliers: Thailand, Netherlands, China

Economic impact of lilium

Introduction

Lilium is a high-value bulbous crop that ranks 4th in global flower trade demand. In India, the annual demand stands at around 4 million bulbs, most of which are imported from the Netherlands. Due to high procurement costs, domestic cultivation has remained less profitable. Additionally, the tropical climate in India's plains restricts continuous flower production, necessitating expensive cold storage for bulbs during the summer months. However, recent initiatives in high-altitude regions like Lahaul, Leh, and Kargil (Himachal Pradesh and Ladakh) have demonstrated promising results. The natural winter chill in these areas fulfills the bulbs' chilling requirements, eliminating the need for artificial cold storage and reducing production costs. Globally, the genus Lilium holds significant economic importance as a cut flower. Belonging to the Liliaceae family, it comprises over 100 species and 9,400 cultivars, classified into seven categories. Native to the Northern Hemisphere, particularly Asia, Europe, and North America, lilies are prized for their size, beauty, and longevity, ranking among the top ten cut flowers worldwide. In the Netherlands, a major hub for floriculture, lilies are the fourth most important flower crop. Their commercial value stems from high demand in international markets, making them a lucrative option for farmers.

In India, CSIR-IHBT has developed off-season lilium cultivation technology. The institute established the first demonstration plot in Ladakh, encouraging farmers in remote areas to adopt this high-value crop. Over 530,000 bulbs were distributed in Ladakh, 394,000 in Himachal Pradesh, and 48,000 in Uttarakhand, enabling farmers to earn 5-6 times more than from traditional crops like peas and potatoes.

Market survey: Lilium

Global and National scenario of lilium

The global floriculture market, including lilies, is projected to reach $65–70 billion by 2025 (CAGR ~5.2%), driven by rising demand for ornamental plants, eco-friendly farming, and hybrid varieties. The Netherlands, Kenya, and Colombia dominate exports, with Asia-Pacific emerging as a high-growth region (Grand View Research, 2023).

The global floriculture market is forecast to grow at a CAGR of 5.5–6% from 2023 to 2030, reaching $85–90 billion by 2030, with lilies remaining a top ornamental crop due to their cultural and aesthetic appeal.

Source: https://www.grandviewresearch.com/industry-analysis/cut-flowers-market-report

Global scenario

Top Exporters: Netherlands ($2.3 B in cut flowers annually, lilies as a key category), Colombia ($2.3 B in cut flowers annually, lilies as a key category), Colombia ($1.8 B), Kenya ($1 B).

Top Importers: EU (Germany, France), U.S. ($800M in flower imports), and Japan.

Lily Trade: Accounts for ~15% of global bulb and cut flower trade, driven by weddings, festivals, and ornamental demand.

Source: https://comtradeplus.un.org

National scenario of lilium

Lilium cultivation in India is still at a nascent stage but shows promising growth, particularly in temperate regions such as Himachal Pradesh, Uttarakhand, and Jammu & Kashmir. With increasing demand for cut flowers during weddings and festivals, hybrid varieties like Asiatic and Oriental lilies are gaining traction.

India: imports & exports of lilium

Imports: India imports 90% of lily bulbs from the Netherlands (₹80–100 crore/year) due to limited domestic bulb production (APEDA, 2023).

Exports: Minimal exports (₹5–10 crore/year), mainly to Gulf countries and Southeast Asia (APEDA).

Source: https://apeda.gov.in/

Production: ~70 million stems annually (UN Comtrade, 2023).

Key players: Smallholder farmers and MSMEs like M/s Red Mirchi Associates, M/s Dharitri Agrotech Pvt. Ltd, M/s Subziro Pvt Ltd., M/s KF Bioplants

Production & cultivation:

India's lilium cultivation is nascent but growing, primarily in Himachal Pradesh, Uttarakhand, and Jammu & Kashmir, where temperate climates support bulb farming. Hybrid varieties (e.g., Asiatic and Oriental lilies) are gaining popularity for weddings and festivals.

Production: ~15–20 million stems annually (National Horticulture Board, 2022).

Key Players: Smallholder farmers and startups like KF Bioplants and Pune Floriculture.

Presence in Indian states

Number of MTAs (Material Transfer Agreements): From April 2021 to March 2025, a total of 62 MTAs have been signed to provide the planting material of lilium to the farmers in the states of Himachal Pradesh, Punjab, and the UT of Ladakh as shown in Fig 1.1.

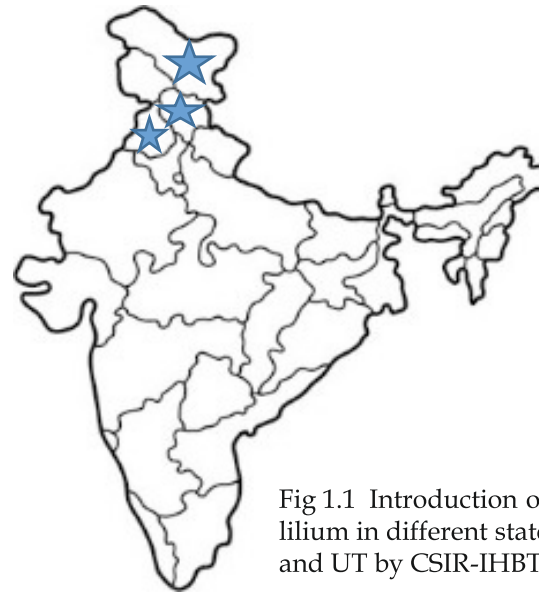


Fig 1.1 Introduction of lilium in different states and UT by CSIR-IHBT

Actor	Core roles	Beneficiaries
CSIR	Agrotechnology	Farmers/growers
IHBT	Varietal Improvement	Entrepreneurs
	Popularization and Commercialization	Farmers' Societies & Clusters

Stakeholder mapping

Agrotechnology:

The CSIR-IHBT has developed the agrotechnology of for quality flower production and multiplication of bulbs. CSIR-IHBT has developed package of practices on lilium cultivation which includes all aspects regarding soil, climate, soil preparation, propagation techniques, varietal selection, bulb size, time of planting, planting density, planting depth, irrigation, nutrition, hoeing, weeding, pinching, disbudding, insect and disease management, grading, packaging and transportation of flowers. The CSIR-IHBT has been promoting lilium cultivation and supporting the farmers by providing bulbs to the interested farmers. The exposure visits were also undertaken as part of extension activities to promote lilium cultivation among the interested farmers. Next year in 2022, the institute supplied a good quantity of bulbs to the farmers' group, like the self-help group in Leh and Rangyul Ladakh Organic Farmers' Society, Kargil, with training on its cultivation, post-harvest handling, and packaging. Overall, CSIR-IHBT had distributed over 9.7 Lakh bulbs to the lilium growers from 2021 to 2024. One of the key areas of assistance provided by CSIR-IHBT has been to raise awareness about lilium cultivation and motivating farmers to grow lilium. The mode of reaching out to the interested farmers was training, exposure visits, demonstration, and kisanmela. In August 2022, farmers from Leh and Kargil were able to sell their produce to the Delhi flower market through an air flight. The farmers are also selling the lilium flowers in the local markets of Leh, Kargil, and Srinagar (J&K). Some entrepreneurs also opened flower shops in Leh and Kargil.

Technology Readiness Level (TRL): 9 for Agrotechnology

Details of Transfer of Technology (if any): 2 (The Shansha farmer cluster in Lahaul, Himachal Pradesh; and Gondhla farmers cluster, Lahaul, Himachal Pradesh)

IHBT developed the agrotechnology for lilium over a period of about 4-5 years. Eight scientists have been engaged in the development of this agrotechnology.

Major milestone:

The local entrepreneurs established Ladakh's first flower shops, such as Serchen Flower Shop and Blumen Florals Leh, which utilized social media platforms to expand their customer base. To further enhance the economic viability of this high-value crop, cold chain and storage solutions were introduced in Ladakh, Himachal Pradesh, and Uttarakhand. Between 2021 and 2024, the mission distributed a total of 15.74 lakh lilium bulbs to Ladakh, Himachal Pradesh, and Uttarakhand. This initiative resulted in the establishment of approximately 7.56 hectares of lilium cultivation, generating an estimated net income of around ₹9.72 crore.

In the Mandi district of Himachal Pradesh, farmers are increasingly shifting from traditional flower crops to high value lilium cultivation, drawn by its superior profitability and climate resilience. This success story demonstrates how technology is revolutionizing hill agriculture by providing farmers with a sustainable, high-return alternative that perfectly suits Mandi's temperate climate, while significantly reducing their market risks compared to traditional floriculture crops.

Technology transfer and societal impact

The success of lilium cultivation in these regions can be attributed to several factors. The cold-chain infrastructure ensured proper storage and transportation, while Ladakh's cold-arid climate naturally minimized pest pressure. Improved market linkages to major cities like Delhi further enhanced profitability. By reducing dependence on imports and providing farmers with a high-income alternative, lilium farming has emerged as a transformative opportunity for agriculture in India's high-altitude regions. With continued support and expansion, it has the potential to strengthen India's position in the global floriculture market.

The large quality planting material (15.74 Lakh bulbs) of lilium has been further provided to support the farmers and growers covering an area of 7.56 hectares.

Training and awareness programme

During last 17 years, 34 awareness cum training programmes were conducted on agrotechnology of lilium, and about 771 beneficiaries participated from Ladakh, Himachal Pradesh and Uttarakhand. A list for training programmes and details about participants from 2021 to 2025 is given in Table 1.1.

Table 1.1: Details of participants in training programme on lilium cultivation technology

Sr. No.	Date	Location	Number of Farmers/Growers Participated
1.	12-02-2008	Kangra	23
2.	18-02-2009	Lahaul&Spiti	38
3.	17-12-2009	Chamba	51
4.	16-02-2010	Chamba	14
5.	21-02-2011	Chamba	41
6.	08-09-2011	Bilaspur	76
7.	09-09-2011	Kangra	31
8.	19-07-2011	Hoshiarpur, Una	27
9.	28-06-2011	Kangra	26
10.	22-06-2011	Bilaspur	25
11.	19-03-2013	Chowari, Chamba	23
12.	19-02-2013	Chowari, Chamba	21
13.	09-07-2015	Una	25
14.	30-06-2016	Jagla village, Lahaul&Spiti	55
15.	01-07-2016	Jhalma, Lahaul&Spiti	22
16.	26-07-2016	Mandi	7
17.	23-01-2017	Palampur	19
18.	13-02-2017	Haripur, Kangra	90
19.	15-03-2017	Kinnaur	15
20.	22-03-2017	Jwalamukhi, Dehra, Dharamshala and Kangra	26
21.	08-09-2021	Centre for High Altitude Biology, at Ribling, Lahaul, HP	16
22.	23-08-2021	Khinning, Lahaul, H.P.	32
23.	08-08-2021	Leh, Ladakh (UT)	25
24.	07-08-2021	Leh, Ladakh (UT)	36
25.	23-08-2021	Lahual&Spiti, H.P.	35
26.	11-06-2021	Jhandutta, Bilaspur	10
27.	19-09-2023	Lahaul&Spiti, HP	60
28.	10-10-2023	CSIR-IHBT Palampur, HP	20
29.	27.08.2024	Lahaul	20
30.	15-12-2024	Udham Singh Nagar, Uttarakhand	15
31.	15-01-2025	Mashobra, Shimla	14
32.	24-04-2025	Khunagi, Bagsiad, Mandi	14
33.	25-04-2025	Rahidhar, Bagsiad, Mandi	18
34.	15-01-2025	Mashobra, Shimla	14
Total			771

Impact evaluation of lilium cultivation:

Particulars	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	1.33	5.16	0.26	0.7	7.45
Total production (lilium spikes)	3,93,010	15,24,760	76,829	2,06,847	22,01,446
Gross Return (INR)	2,51,03,496.2	9,73,94,015.27	49,07,450	1,32,12,366	14,06,17,328.2
Cost of Production (Operational Cost+ Fixed Cost) (INR)	1,34,02,799.6	5,19,98,831.6	26,20,096	70,54,105.1	7,50,75,832.45
Net return (INR) /per year per season	1,17,00,696.6	4,53,95,183.66	22,87,354	61,58,261.3	6,55,41,495.79
Employment generation (Direct+ Indirect): Total man-days generated/ season	24,472	94,944	4,784	12,880	1,37,080

Socio-economic impact of lilium cultivation through CSIR-IHBT's lilium agrotechnology intervention from 2021-22 to 2024-25:

- Total Area covered under lilium Crop: 7.45 hectares (Protected Cultivation)
- Planting material distributed: 16,22,260
- Production of lilium spikes: 22,01,446
- Revenue generation/ Gross returns from sale of lilium spikes: INR 14,06,17,328
- Net returns (after deducting cost of production): INR 6,55,41,496
- Employment generation (man-days): 1,37,080
- Benefit Cost Ratio: 1.87

Economic impact of gladiolus

Introduction

Gladiolus is a popular ornamental flower in India, widely grown for its striking, colorful spikes used in bouquets, decorations, and floral arrangements. Gladiolus is among the popular cut flowers cultivated in India, alongside roses, tuberose, anthurium, carnations, and marigold. It holds significant commercial value, especially during festive seasons, weddings, and public functions.

Gladiolus plays an important role in rural livelihoods by offering farmers a profitable alternative to traditional crops. Its relatively short growing cycle and high market demand make it a viable income-generating option. Floriculture-based enterprises around gladiolus cultivation support employment opportunities, particularly for women and smallholder farmers, through planting, harvesting, and marketing activities. Moreover, institutions like CSIR-IHBT promote its cultivation by providing quality corms and scientific training, thereby enhancing productivity, income, and the sustainability of farming in several regions.

Market survey: Gladiolus

Global and National scenario of gladiolus

Gladiolus is a prominent cut flower globally, consistently ranking among the top ten in the floriculture industry. The wholesale farm gate value of gladiolus cut flowers was reported at approximately $14.83 million in 2020. The country's diverse agro-climatic conditions facilitate year-round cultivation of gladiolus, contributing to both domestic markets and export potential. India's overall floriculture market is projected to expand from $3.8 billion in 2025 to $9.4 billion by 2035, registering a CAGR of 8.7%

Global scenario

Top Exporters: The global trade of gladiolus cut flowers is led by a few key countries. The Netherlands stands as the top exporter, accounting for around 55% of global gladiolus exports, owing to its advanced floriculture infrastructure and global flower trade networks. Costa Rica follows as the second-largest exporter with a 20% share, and Malaysia ranks third, contributing about 13% to the global market.

Top Importers: Kazakhstan is the leading importer, receiving approximately 34% of global gladiolus exports, followed by the United States with a 20% share and Vietnam with 18%.

Gladiolus Trade in India: India's export of gladiolus remains limited, with small volumes mainly sent to Sri Lanka, Malaysia, and Nepal. Imports also occur to meet demand for specific varieties. The sector faces challenges like unorganized marketing, limited post-harvest infrastructure, and low international visibility. However, with quality improvements, better logistics, and market promotion, India holds potential to expand its gladiolus trade and support farmer incomes.

Production & cultivation:

Gladiolus is widely cultivated across India, especially in states like Himachal Pradesh, Uttarakhand, Punjab, Haryana, Maharashtra, and parts of South India such as Karnataka and Tamil Nadu. The flower thrives in well-drained, sandy loam soils with moderate temperatures and ample sunlight. Typically grown from corms, gladiolus cultivation involves planting in the winter or early spring season, with a growing period of about 90 to 120 days. Due to its vibrant colors and long vase life, it is popular for ornamental use in floral arrangements and events. Gladiolus cultivation provides farmers with a profitable alternative to traditional crops and contributes to rural livelihoods through floriculture-based employment and enterprises.

India: imports & exports of gladiolus

Imports: Imported gladiolus flowers supplement domestic production, meeting the demand for specific varieties and enhancing the diversity of available blooms in the Indian market. The importation also reflects the growing consumer preference for a wider range of floral options, contributing to the floriculture sector's expansion in India.

Exports: India's export of gladiolus cut flowers is relatively modest compared to other floriculture products. Between September 2023 and August 2024, India exported a total of gladiolus, valued at approximately $2,746.19. The primary destinations for these exports were Sri Lanka, Malaysia, and Nepal.

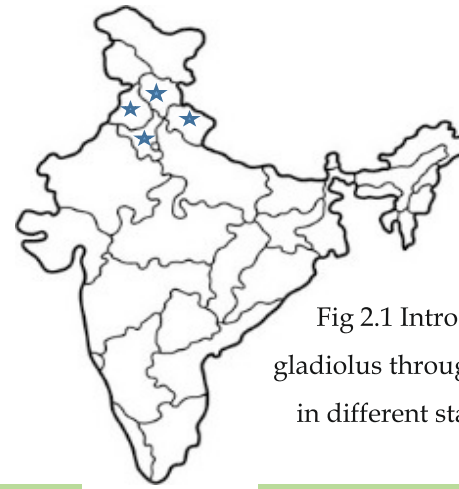


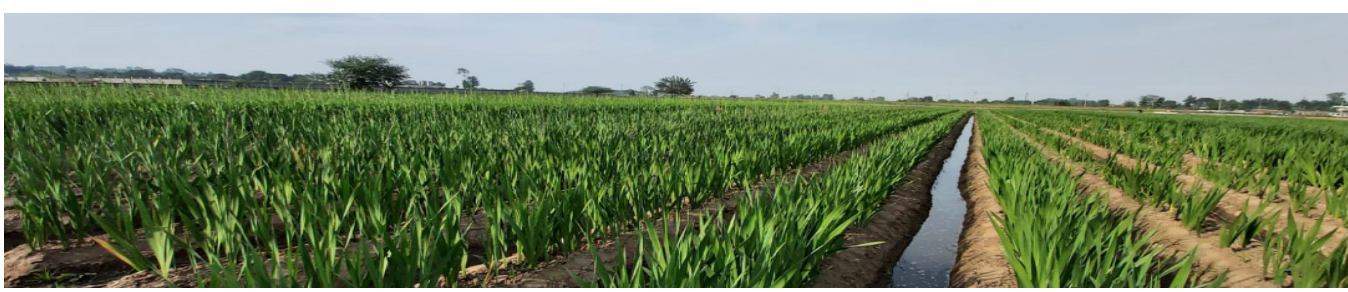
Fig 2.1 Introduction of gladiolus through CSIR-IHBT in different states of India

Actor	Core roles	Beneficiaries
CSIR	Agrotechnology	Farmers/growers
IHBT	Varietal Improvement	Entrepreneurs
	Popularization and Commercialization	Farmers' Societies & Clusters

Stakeholder mapping

Agrotechnology:

CSIR-IHBT has developed advanced agrotechnology for gladiolus cultivation that is well-suited to the agro-climatic conditions of the Himalayan and adjoining regions. Their approach includes the introduction of high-yielding and disease-resistant varieties, along with optimized planting techniques such as ideal corm size, spacing, and planting depth to ensure healthy growth and abundant flower spikes. Soil and nutrient management practices based on soil health assessments help maintain fertility and boost plant vigor. Integrated pest and disease management combines eco-friendly methods, including biological controls and limited pesticide use, to effectively manage common pests and diseases like thrips and corm rot. Additionally, CSIR-IHBT provides guidelines for proper harvesting and post-harvest handling to extend vase life and preserve flower quality during storage and transport. This comprehensive technology package supports farmers in achieving higher productivity, better flower quality, and improved profitability while promoting sustainable gladiolus cultivation.



Details of Transfer of Technology (if any):

Agro-technologies related to gladiolus cultivation and postharvest handling were transferred to progressive farmers and Self Help Groups under the CSIR Floriculture Mission.

Technology transfer and societal impact

Gladiolus cultivation supports rural livelihoods by providing income and employment, especially for small farmers and women. It promotes crop diversification and boosts local floriculture markets, contributing to economic stability and rural development.

Training and awareness programme

Total of 17 awareness cum training programmes were conducted on agrotechnology of gladiolus, and about 475 were participated from Punjab, Maharashtra, West Bengal, Himachal Pradesh, J&K and Uttarakhand (Table 2.1).

Sr. No.	Date	Location	Number of Farmers/Growers Participated
1.	20/01/2022	Ludhiana, Punjab	25
2.	07/10/2021	Kangra	12
3.	05/09/2021	Mandi	35
4.	11/02/2022	CSIR-IHBT Palampur	40
5.	23/05/2022	Solan	20
6.	19/04/2022	Leh, Ladakh	22
7.	20/04/2022	Kargil, Ladakh	28
8.	18/05/2022	Haridwar, Uttarakhand	35
9.	09/01/2023	Shimla	30
10.	18/05/2023	CSIR-IHBT Palampur	40
11.	28/10/2023	Fatehgarh, Punjab	25
12.	21/09/2023	Leh, Ladakh	50
13.	07/02/2024	Baijnath, Kangra	20
14.	15/07/2024	Hamirpur, H.P.	23
15.	22/10/2024	CSIR-IHBT Palampur	30
16.	19/12/2024	Panchrukhi, Palampur	15
17.	11/03/2025	Nainital, Uttarakhand	25
Total			475

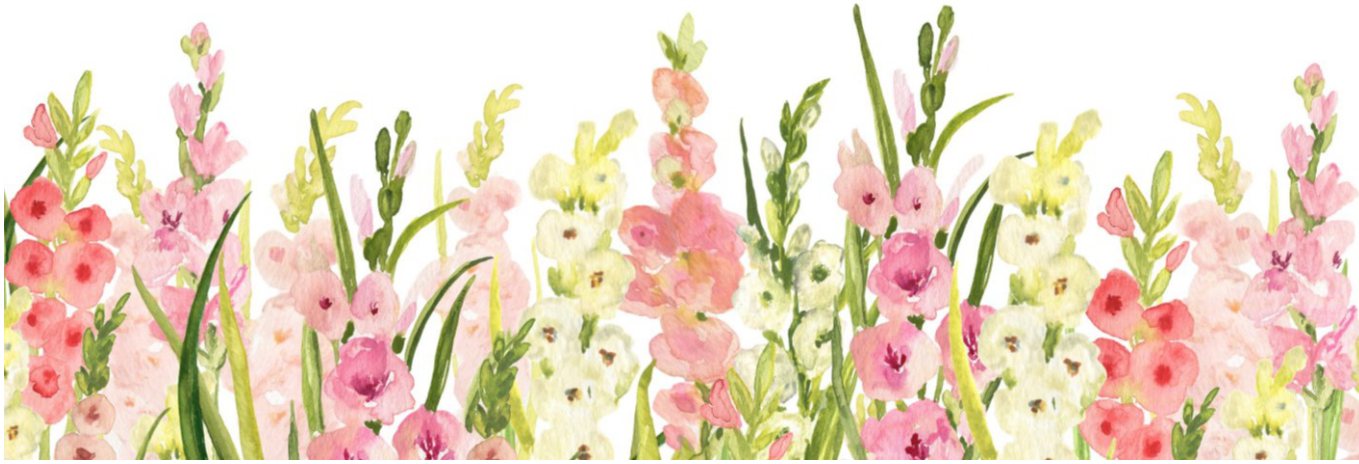
Table 2.1: Details of participants in the training programme on gladiolus cultivation technology

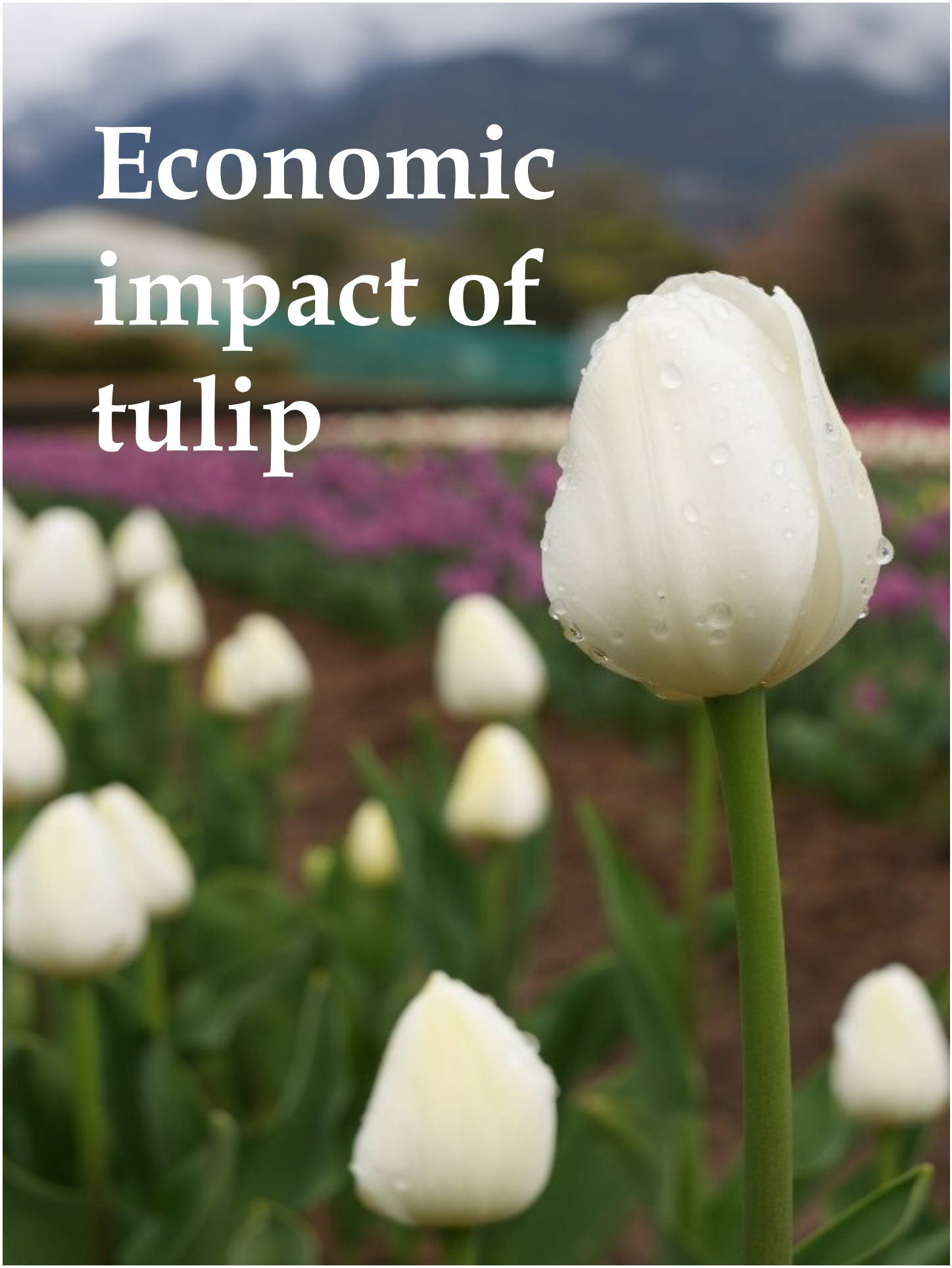
Impact evaluation of gladiolus cultivation

Particulars	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	26.40	54.47	5.10	5	90.97
Total production (No. of Spikes)	1967580	4137721	468598	438600	7012499
Gross Return (INR)	3,17,97,451	65,606,331	61,42,689	60,22,244	10,95,68,716
Cost of Production (INR)	94,27,207	1,94,50,757	18,21,165	17,85,456	3,24,84,586
Net return/per year per season (INR)	2,23,70,243	4,61,55,574	43,21,524	42,36,788	7,70,84,130
Employment generation(Direct+Indirect): Total man-days generated	4,788	9,879	925	907	16,499

Socio-economic impact of gladiolus cultivation through intervention of CSIR-IHBT's gladiolus interventions from 2021 to 2025:

- Total Area covered under gladiolus crop: 91 hectares (Open Field Cultivation)
- Planting material distributed: 1,28,55,392
- Production of gladiolus flowers/spikes: 1,31,12,499
- Revenue generation/ Gross returns from sale of gladiolus spikes: INR 10,95,73,365
- Net returns (after deducting cost of production): INR 7,70,84,130
- Employment generation (man-days): 16,499
- Benefit Cost Ratio: 3.37





Economic impact of tulip

Introduction

Tulip, a globally admired ornamental flower, is gaining popularity in India due to rising domestic demand. Traditionally dependent on imports, India's commercial tulip cultivation was limited. However, this is changing as tulip farming expands in high-altitude regions like Ladakh, Himachal Pradesh, and Uttarakhand.

The success in these areas is driven by location-specific agrotechnology that enables off-season tulip production. The naturally cold climate in these temperate zones meets the winter chilling requirements essential for tulip bulbs to break dormancy and flower uniformly. In lower-altitude regions, cold storage is used to artificially vernalize bulbs, ensuring uniform flowering and allowing cultivation across more agro-climatic zones.

Key inputs for successful cultivation include disease-free, high-quality bulbs, region-specific planting protocols, and efficient postharvest cold-chain management to maintain flower freshness and shelf life. This scalable, eco-adaptive technology reduces reliance on imports and promotes climate-resilient horticulture by utilizing natural climatic advantages.

Beyond economic benefits, tulip cultivation offers new rural livelihood opportunities in remote, high-altitude areas. It provides farmers with high-value crops, timely market access, and improved competitiveness in domestic markets.

In summary, adopting location-specific agrotechnology for tulip farming presents a sustainable, profitable opportunity that supports indigenous horticulture, reduces import dependence, and fosters rural economic development through climate-smart practices.

Market survey: Tulip

Global and National scenario of tulip

The global tulip market is valued at around $6.3 billion in 2024 and is expected to grow at a CAGR of 4.8% to reach $9.6 billion by 2033. The Netherlands leads global production, while Vietnam, Ukraine, and Indonesia are top importers of tulip flowers. In India, tulip cultivation is expanding in high-altitude regions like Jammu & Kashmir, Ladakh, and Himachal Pradesh, supported by cold climates and advanced agrotechnologies. The Indian flower delivery market, with tulips as a fast-growing segment, is projected to reach $445 million by 2030. Rising domestic demand and improved cultivation methods are driving India's shift from imports to local production.

Global scenario

Top Exporters: The Netherlands dominates the global tulip market as the largest exporter of tulip bulbs and cut flowers, followed by countries like Turkey and France.

Top Importers: Leading importers of tulips include Vietnam, Ukraine, Indonesia, and the United States, where demand for ornamental flowers is high.

Tulip trade in India: India's tulip trade has been traditionally driven by imports, primarily from the Netherlands. The rising domestic demand and limited local production due to climatic constraints have kept imports significant. However, expansion of tulip cultivation in high-altitude regions like Ladakh and Himachal Pradesh, along with the adoption of cold storage and off-season growing technologies, is gradually boosting indigenous production and reducing import dependence.

Production & cultivation:
Tulip cultivation is mainly done in India in high-altitude states like Himachal Pradesh, Uttarakhand, and the UT of Ladakh, where the cold climate suits bulb growth. Production is still small but growing, driven by government research bodies like the Indian Council of Agricultural Research (ICAR), and local horticulture departments. Key players include regional farmers and agricultural institutions promoting modern techniques to boost domestic tulip farming.

India: imports & exports of tulip
Imports: India imports tulip bulbs mainly from the Netherlands. Tulip imports constitute less than 1% of India's total floriculture imports.
Exports: India's tulip export is minimal, primarily due to limited domestic cultivation. However, regions like Jammu & Kashmir have been promoting tulip cultivation, aiming to boost local production and explore export opportunities.

Presence in Indian states
Number of MTAs :
From April 2021 to March 2025, a total of 10MTAs have been signed to provide the planting material of tulip to the farmers in the state of Himachal Pradesh, Ladakh as shown in Fig3.1

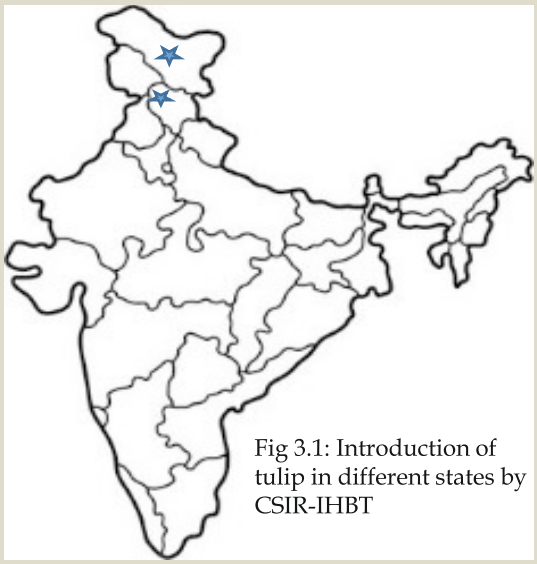
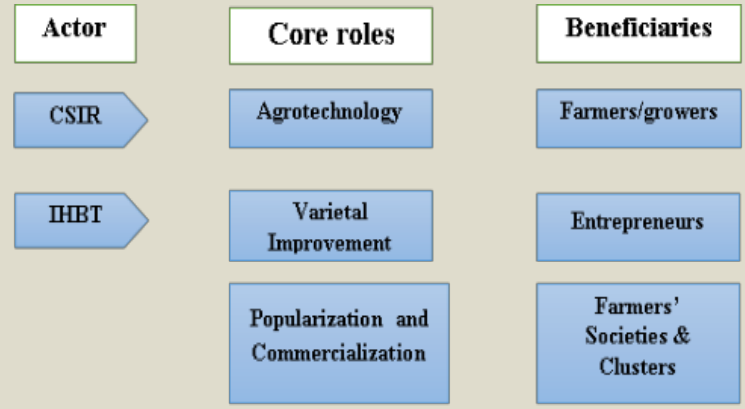


Fig 3.1: Introduction of tulip in different states by CSIR-IHBT



Stakeholder mapping

Agrotechnology:

CSIR-IHBT, Palampur, has played a pioneering role in developing and promoting agrotechnology for tulip cultivation in India. The institute has standardized cultivation practices suited for Indian high-altitude regions like Ladakh, Himachal Pradesh, and Uttarakhand. This enabled domestic production of high-quality tulip bulbs, reducing dependence on imports. Developed climate-resilient, location-specific tulip cultivation packages, ideal for fragile mountain ecosystems. Facilitated farmers' training and capacity building, thereby boosting income through high-value floriculture. Promoted tulip as a commercial cut-flower crop, increasing farmer returns by 5–6 times compared to traditional crops.

The exposure visits were also undertaken as part of extension activities to promote tulip cultivation among the interested farmers. The institute opened Himachal's first tulip garden at its premises, i.e., Palampur, in February 2022. The crop performed well with respect to spike length and number of florets. In 2023, the institute signed an agreement with NDMC Delhi for the supply of tulip bulbs being generated in the Lahaul region of Himachal Pradesh. In 2024,the institute supplied a good quantity of bulbs to the NDMC Delhi. Overall, CSIR-IHBT had distributed over 2.0 Lakh bulbs to the tulip growers from 2022 to 2024. One of the key areas of assistance provided by CSIR-IHBT has been to raise awareness about cultivation and motivating farmers to grow tulip. The mode of reaching out to the interested farmers was training, exposure visits, demonstration, and kisan mela.

Details of Transfer of Technology (if any):

Agro-technologies related to tulip cultivation, bulb production, and postharvest handling were transferred to progressive farmers and SHGs under the CSIR Floriculture Mission.

MTA –10

ToT signed with private sector partners for scaling tulip bulb production (M/s Dharitri Agro Farms Pvt. Ltd., Uttarakhand).

Major milestone:

The CSIR-IHBT has laid the demonstration for the first time in three villages, i.e., Khangsar, Gondhla, and Udaipur of Lahaul district. The crop performed well with respect to spike length, number of florets, and bulb production.

The institute supplied a good quantity of bulbs to the farmers' group, such as self-help groups in Lahaul, Gondhla Cut Flower Cluster, Shansha Cut Flower Cluster, Mahadev Floriculture Society, and in Leh and Rangyul Ladakh Organic Farmers' Society, Kargil.

The farmers are selling tulip flowers in the local markets of Leh and Kargil. To further enhance the economic viability of this high-value crop, cold chain and storage solutions were introduced in Ladakh, Himachal Pradesh, and Uttarakhand.

This initiative resulted in the establishment of approximately 1.15 hectares of tulip cultivation, generating an estimated net income of around 70 lakhs.

Technology transfer and societal impact

The tulip cultivation model supported seasonal employment and income generation, particularly for women and youth in tribal and remote areas. Encouraged self-employment through floriculture-based micro-enterprises. Himachal's first tulip garden promoted agro-tourism. More than one lakh people visited in 2025

Training and awareness programme

Total of 10 awareness cum training programmes were conducted on agrotechnology of tulip, and about 376 were participated from Ladakh, Himachal Pradesh, and Uttarakhand (Table 3.1).

Sr. No.	Date	Location	Number of Farmers/Growers Participated
1.	07-08-2021	Leh, Ladakh	36
2.	23-08-2021	Lahaul and Spiti, H.P.	35
3.	20/04/2022	Leh, Ladakh	50
4.	15/02/2023	CSIR-IHBT Palampur	45
5.	30/06/2023	Udaipur Lahaul	25
6.	06/08/2023	Lahaul and Spiti, H.P.	35
7.	21/09/2023	Lahaul and Spiti, H.P.	60
8.	18/01/2024	CSIR-IHBT Palampur	40
9.	10/07/2024	Kargil, Ladakh	20
10.	14/07/2024	Leh, Ladakh	30
Total			376

Table 3.1. Details of participants in the training programme on tulip cultivation technology

Impact evaluation of tulip cultivation

Particulars	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	0.37	0.47	0.13	0.18	1.15
Total production (no. of sticks)	30400	33700	27099	82000	173199
Gross Return (INR)	1305400	1348000	1083960	3280000	7017360
Cost of Production (INR)	405000	426100	315600	759000	1905700
Net return/per year per season (INR)	900400	921900	768360	2521000	5111660

Socio-economic impact of tulip cultivation through CSIR-IHBT's Tulip agrotechnology intervention from 2022-25:

- Total Area covered under tulip crop: 1.15 hectares
- Planting material distributed: 1.42 Lakhs bulbs
- Revenue generation/ Gross returns from the sale of tulip cut flowers: INR 70.16 lakhs
- Net returns (after deducting the cost of production): INR 51.11 lakhs
- Benefit to cost ratio: 3.68


Economic
impact of
marigold

Introduction

Marigold is one of the most popular and commercially significant flowers cultivated in India. Known for its bright colors and strong fragrance, it holds cultural and religious importance, especially during festivals like Diwali and Dussehra, and is widely used in temples, garlands, and decorative arrangements.

Marigold cultivation is well-suited to Indian agro-climatic conditions and is typically grown in well-drained sandy loam to loamy soils with a pH of 6.0–7.5. It thrives in warm, sunny weather and can be grown throughout the year, with main sowing seasons in June–July, September–October, and January–February. Farmers propagate marigold through seeds, and the crop matures in about 2.5 to 3 months.

Marigold cultivation plays a vital role in improving rural livelihoods. It provides a reliable source of income for small and marginal farmers due to its short cultivation cycle and good market value. The sector generates significant rural employment, particularly for women, who are often engaged in tasks like garland making and marketing. Additionally, marigold supports allied industries such as nurseries and flower-based decorative product businesses. As demand continues to grow during festive and wedding seasons, marigold remains a key floriculture crop with a strong economic and social impact across many parts of India.

Market survey

Global and National scenario of marigold

The global marigold market was valued at approximately $157.87 million in 2023. It is expected to reach $242.13 million by 2030, growing at a CAGR of 6.3% during the forecast period. The Asia-Pacific region dominates the marigold market, with countries like India and China being significant producers and consumers, driven by both ornamental and cultural uses. The Government of India supports floriculture, including marigold cultivation, under schemes such as the Mission for Integrated Development of Horticulture (MIDH), Rashtriya Krishi Vikas Yojana (RKVY), and the CSIR-Floriculture Mission, encouraging its spread across rural and peri-urban areas. The top marigold-producing states in India include Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal, Odisha, Maharashtra, and Chhattisgarh. These states grow marigolds extensively for local markets as well as for supply to urban centres. In North India, marigold is cultivated in states like Uttarakhand (Almora, Nainital, Tehri), Himachal Pradesh (Kangra, Mandi, Bilaspur), Punjab (Ludhiana, Patiala, Jalandhar), Haryana (Panipat, Gurgaon), Uttar Pradesh (Varanasi, Lucknow, Ayodhya), and Jammu region of J&K. Supported by self-help groups, research institutions like CSIR-IHBT, and government schemes, it serves temple markets and urban demand, especially during festivals. Marigold farming promotes rural income, crop diversification, and employment in these regions.

Global scenario

Top Exporters: India is among the leading producers and exporters of marigold flowers and petals. Other top exporting countries of marigold flowers and related products include China, Mexico, Peru, and Thailand. These nations benefit from favorable agro-climatic conditions and low-cost production.

Top Importers: The major importing countries include the United States, Germany, Japan, the Netherlands, and South Korea, where marigold products are used in food, nutraceuticals, cosmetics, and ornamental sectors.

Marigold Trade in India: Marigold trade in India is a significant component of the country's floriculture industry, driven by high domestic demand and growing export potential. The flower is widely traded in local mandis and urban flower markets, especially during festivals, weddings, and religious events, where its vibrant color and cultural significance make it a preferred choice. States like Tamil Nadu, Karnataka, West Bengal, and Andhra Pradesh are major suppliers, with flowers transported across states to meet peak seasonal demand.

Production & cultivation:

It is cultivated across various agro-climatic zones throughout the year, with major production in states like Tamil Nadu, Karnataka, West Bengal, and Andhra Pradesh. In north India, marigold cultivation is gaining momentum, particularly in states such as Uttarakhand, Himachal Pradesh, Punjab, Haryana, Uttar Pradesh, and parts of Jammu & Kashmir. These regions grow marigold for religious use, festivals, and decorative purposes, especially during peak seasons like Diwali, Dussehra, and weddings. Farmers prefer marigold due to its short crop cycle (2.5 to 3 months) and attractive returns. Government initiatives, support from research institutions like CSIR-IHBT, and the involvement of women-led self-help groups have further encouraged its cultivation in the northern hill and plain regions

India: imports & exports of marigold

Imports: In 2023, India imported approximately $1.86 million worth of cut flowers and flower buds suitable for bouquets or ornamental purposes, accounting for about 5.45% of the total floral imports into the country.

Exports: Marigold flowers play a significant role in India's floriculture export sector. In the fiscal year 2023–24, India exported a total of 19,677.89 MT of flowers, valued at approximately $86.63 million

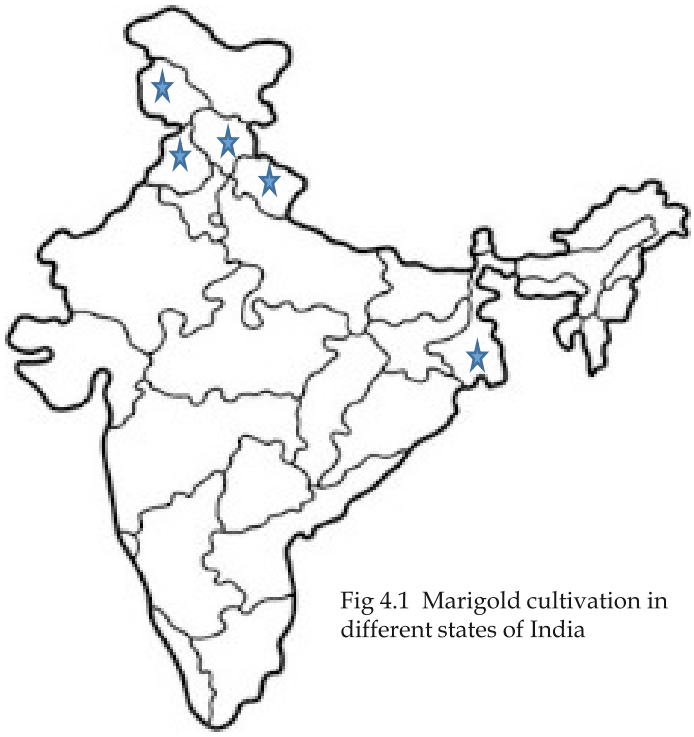


Fig 4.1 Marigold cultivation in different states of India

Presence in Indian states
Number of MTA:

From April 2021 to March 2025, a total of 75 MTA have been signed to provide the planting material of marigold to the farmers in the states of Punjab, West Bengal, Himachal Pradesh, J&K, and Uttarakhand as shown in fig4.1.

Actor	Core roles	Beneficiaries
CSIR	Agrotechnology	Farmers/growers
IHBT	Varietal Improvement	Entrepreneurs
	Popularization and Commercialization	Farmers' Societies & Clusters

Stakeholder mapping

Agrotechnology:
CSIR-IHBT plays a vital role in advancing marigold flower cultivation, especially in the Himalayan and northern hill regions of India. CSIR-IHBT focuses on developing improved marigold varieties that are high-yielding, disease-resistant, and suited to the agro-climatic conditions of hilly terrains. They also provide scientific guidance on best agronomic practices, including soil management, irrigation, pest control, and post-harvest handling to enhance productivity and quality. Through its research and development initiatives, CSIR-IHBT promotes sustainable and climate-resilient marigold farming that benefits small and marginal farmers by increasing income and livelihood opportunities. Additionally, CSIR-IHBT supports capacity building and training programs for farmers and self-help groups, facilitating technology transfer and adoption of improved cultivation techniques. Their efforts have helped expand marigold cultivation in states like Himachal Pradesh, Uttarakhand, and Jammu & Kashmir, thereby strengthening the floriculture sector in these regions.

Details of Transfer of Technology:
Agro-technologies related to marigold cultivation and postharvest handling were transferred to progressive farmers and SHGs under the CSIR Floriculture Mission.
MTA –75

Major milestone:
CSIR-IHBT has significantly contributed to promoting marigold flower cultivation across various Indian states by developing and disseminating region-specific agrotechnologies and high-lutein marigold varieties. In Himachal Pradesh, the institute established successful cultivation clusters by training farmers and linking them with pigment extraction industries, thereby boosting their income and encouraging commercial-scale floriculture. In Punjab and Haryana, CSIR-IHBT introduced marigold as a profitable alternative to traditional crops, supplying quality planting material and conducting capacity-building programs. The institute adapted cultivation practices to suit hilly terrains, enabling climate-resilient farming and empowering rural communities, especially women, through floriculture-based micro-enterprises. These interventions have collectively strengthened the marigold value chain and contributed to sustainable rural development.

Quality planting material

Technology transfer and societal impact

Marigold cultivation positively impacts society by generating rural employment, especially for women, enhancing livelihoods through income from floriculture, and supporting cultural and religious practices where marigolds are in high demand. It also promotes sustainable agriculture, as marigolds can act as natural pest repellents.

Training and awareness programme

Total of 25 awareness cum training programmes were conducted on agrotechnology of marigold, and about 745 were participated from Punjab, Maharashtra, West Bengal, Himachal Pradesh, J&K and Uttarakhand.

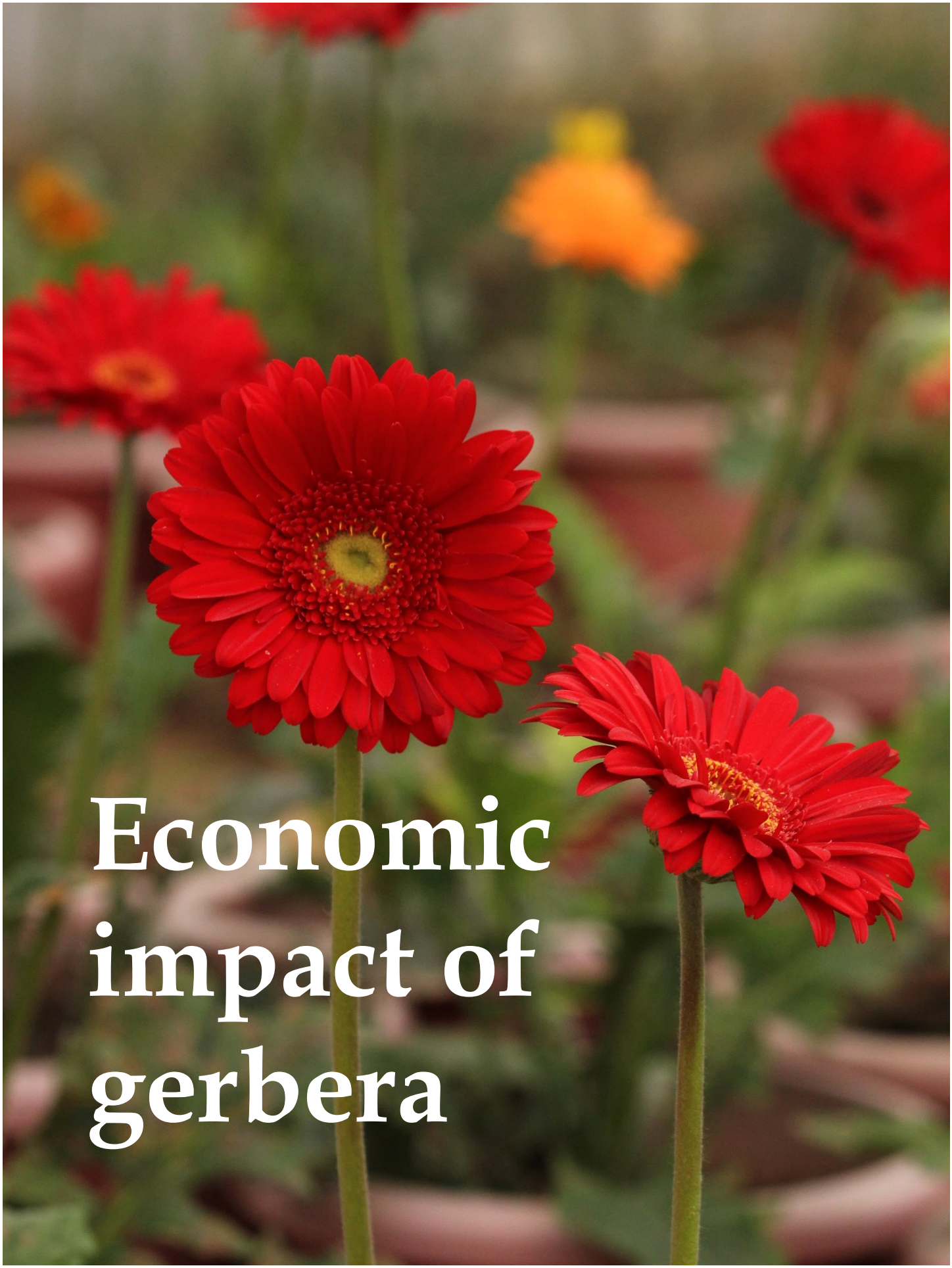
Sr. No.	Date	Location	Number of Farmers/Growers Participated
1.	28/10/2021	Khalet, Palampur, H.P.	25
2.	14/10/2021	Una, H.P.	17
3.	06/10/2021	Kalimong, West Bengal	70
4.	04/10/2021	Darjeeling, West Bengal	18
5.	29/07/2021	Pune, Maharashtra	16
6.	24/06/2021	Dharamshala, H.P.	12
7.	11/06/2021	Bilaspur, H.P.	10
8.	16//05/2022	Nainital, Uttarakhand	35
9.	10/05/2022	CSIR-IHBT Palampur	30
10.	16/01/2022	Samba, J&K	50
11.	20/01/2022	Ludhiana, Punjab	25
12.	06/11/2021	CSIR-IHBT Palampur	60
13.	25/11/2021	Hamirpur, H.P.	94
14.	11/10/2022	Shimla, H.P.	50
15.	01/07/2022	Panchrukhi, Palampur	25
16.	12/02/2022	Jawalaji, Kangra	30
17.	05/07/2023	Fatehgarh, Punjab	25
18.	08/09/2023	Mandi, H.P.	18
19.	21/03/2023	Hamirpur, H.P.	15
20.	08/11/2023	CSIR-IHBT Palampur	20
21.	12/03/2025	Champawat, Uttarakhand	15
22.	15/03/2025	Nainital, Uttarakhand	20
23.	11/07/2024	Kullu, H.P.	10
24.	25/06/2024	Kangra, H.P.	25
25.	16/08/2024	Dehra, Kangra, H.P.	30
Total			745

Impact evaluation of marigold cultivation

Particulars	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	52.86	975.89	140.59	150.11	1319.45
Total production (in kg)	394600	7285019	1049504	1120571	9849694
Gross Return (INR)	31567992	582801508	83960348	89645692	787975540
Cost of Production (INR)	8310356	153424009	22102779	23599461	207436605
Net return/per year per season (INR)	23258022	429384627	61858595	66047327	580548572

Socio-economic impact of marigold cultivation through CSIR-IHBT's marigold agrotechnology intervention from 2021-25:

- Total Area covered under marigold Crop: 1319.45 hectares
- Planting material distributed: 1038 kg of seed
- Revenue generation/ Gross returns from sale of marigold cut flower: INR 787975540
- Net returns (after deducting cost of production): INR 580548572
- Benefit-cost ratio: 3.80



Economic impact of gerbera

Introduction

Gerbera is a globally significant cut flower, ranking as the fifth most used worldwide after rose, carnation, chrysanthemum, and tulip and is valued for its vibrant colors, long vase life, and high market demand. Originally from South Africa, it has become a major floriculture crop, especially under protected cultivation (polyhouses).

Gerbera is widely cultivated in Himachal Pradesh, Uttarakhand, Punjab, Haryana, and Jammu & Kashmir, mainly under protected cultivation (polyhouses).

Gerbera is a highly popular flower in floriculture. Available in a wide range of bright and attractive shades, it is widely used in bouquets, decorations, weddings, and various events. One of its key advantages is its ability to be cultivated year-round under controlled conditions such as polyhouses, ensuring consistent production and supply. Gerbera offers high returns to farmers, especially when compared to traditional crops, making it an attractive option for small and marginal landholders. Its popularity is further supported by government initiatives that provide subsidies, training, and infrastructure under horticulture missions. Additionally, the flower holds strong export potential due to its quality and appeal in international markets. These combined factors-beauty, profitability, adaptability, and institutional support—make gerbera a favoured crop in modern floriculture.

Market survey: Gerbera

Global and National scenario of gerbera

It constitutes a notable segment of the global cut flowers market. The global cut flowers market was valued at approximately $39.08 billion in 2024 and is projected to reach $51.83 billion by 2030, growing at a CAGR of 4.9% from 2025 to 2030. Within this market, the combined segment of chrysanthemums and gerberas is expected to grow at a CAGR of 5.3% over the next eight years.

Global scenario

Top Exporters: The Netherlands stands as the top global exporter of gerbera flowers, accounting for approximately 49% of global exports, with around 868 shipments. It is followed by China, which contributes 18% of the global share with 328 shipments, and Malaysia, which holds 9% of the market with 168 shipments. Together, these three countries represent over 75% of the global gerbera exports.

Top Importers: Leading importers of gerbera include Russia, Kazakhstan, Ukraine, India, and the United Arab Emirates, where demand for ornamental flowers is high.

Gerbera Trade in India: Gerbera cultivation and trade in India have grown significantly, driven by rising domestic demand and niche export opportunities. Major producing states like Maharashtra, Karnataka, and Himachal Pradesh use protected cultivation methods supported by government subsidies, making it profitable for farmers. While India exports gerbera primarily to neighboring countries like Bhutan and Nepal, its share in the global export market remains modest. Advances in cultivation techniques and the growing popularity of online flower sales further boost domestic consumption, strengthening India’s position in the regional floriculture industry

Production & cultivation:
Gerbera cultivation in Himachal Pradesh, Punjab, Uttarakhand, and Haryana is growing rapidly, mainly under protected polyhouse conditions supported by government subsidies and training. Key players include KF Bioplants, Rise N Shine, Florance, and Flora Farms, and agricultural institutions promoting modern techniques to boost domestic gerbera farming.

India: imports & exports of gerbera
Imports: India imported many gerbera flowers, making it the fourth-largest importer globally, accounting for approximately 14% of the world's total gerbera imports
Exports: Gerbera is among the top exported flowers; it can be inferred that its contribution is substantial.

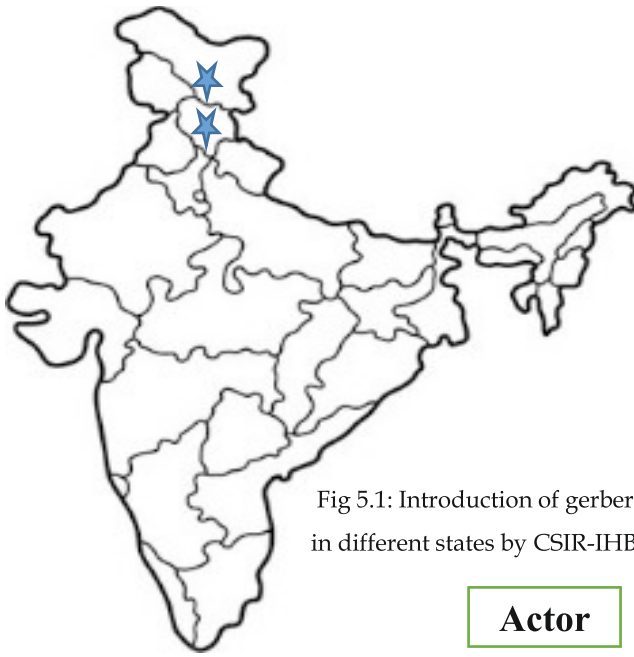


Fig 5.1: Introduction of gerbera in different states by CSIR-IHBT

Presence in Indian States
Number of MTAs:
From April 2021 to March 2025, a total of 87 MTAs have been signed to provide the planting material of lilium to the farmers in the state of Himachal Pradesh, Ladakh as shown in fig 5.1

Actor	Core roles	Beneficiaries
CSIR	Agrotechnology	Farmers/growers
IHBT	Varietal Improvement	Entrepreneurs
	Popularization and Commercialization	Farmers' Societies & Clusters

Stakeholder mapping

Agrotechnology:
CSIR-IHBT, Palampur, has significantly advanced the agrotechnology of gerbera cultivation, particularly in the challenging climatic conditions of the Western Himalayas. The institute has developed several improved gerbera cultivars such as Him Saumya, Him Gaurav, Him Aabha, Him Apoorva, and Him Keerti, which are registered with the Plant Germplasm Registration Committee to ensure quality and authenticity. Their agrotechnological approach includes promoting protected cultivation methods like polyhouses and shade nets, optimizing soil and nutrient management, implementing integrated pest management, and improving post-harvest handling to extend the flowers' shelf life. CSIR-IHBT's research focuses on genotype evaluation, stability analysis across environments, and developing micropropagation protocols for mass multiplication of healthy planting material. These efforts have resulted in identifying superior genotypes with enhanced flower size and performance. Additionally, the institute actively transfers technology to farmers and entrepreneurs through training programs, workshops, and collaborations, helping diversify agriculture in Himachal Pradesh and offering farmers profitable alternatives to traditional crops.

Details of Transfer of Technology (if any):
Agro-technologies related to gerbera cultivation and postharvest handling were transferred to progressive farmers and SHGs under the CSIR Floriculture Mission.
MTA –87

Major milestone:
The institute supplied a good quantity of gerbera plants to the farmers' group, such as self-help groups, in many regions of Himachal Pradesh, Punjab, Haryana, and Uttarakhand. The farmers are selling the gerbera flowers in the Delhi market. To further enhance the economic viability of this high-value crop, cold chain and storage solutions were also introduced to the farmers' groups.

Technology transfer and societal impact

Gerbera cultivation has created new livelihood opportunities, especially for small and marginal farmers and rural women. It promotes income diversification, helping farmers move beyond traditional crops to higher-value floriculture, thereby improving their economic stability. The cultivation of gerbera under protected conditions generates employment in related sectors such as nursery management, post-harvest handling, and marketing. Additionally, the flower's popularity in local and export markets boosts regional economies and encourages sustainable agricultural practices. Overall, gerbera farming contributes to rural development, women's empowerment, and enhanced quality of life in farming communities.

Training and awareness programme

Total of 12 awareness cum training programmes were conducted on agrotechnology of gerbera, and about 423 were participated from Himachal Pradesh, Punjab, Haryana and Uttarakhand. A list for training programmes and details about participants from 2021 to 2025 is given below.

Sr. No.	Date	Location	Number of Farmers/Growers Participated
1.	03/03/2022	Una H.P.	43
2.	28/04/2022	BagsiadMandi	20
3.	15/05/2022	Nainital, Uttarakhand	42
4.	01/07/2022	Panchrukhi H.P.	25
5.	22/07/2022	Kharnal, HP	30
6.	02/05/2023	Baijnath, Kangra	40
7.	05/06/2023	Dharamshala	70
8.	14/09/2023	CSIR-IHBT Palampur	30
9.	28/07/2023	Haryana	53
10.	06/12/2024	Kangra	25
11.	15/01/2025	Shimla	35
12.	08/03/2025	Sujanpur	10
Total			423

Impact evaluation of gerbera cultivation

Particulars	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	3.46	3.77	0.45	0.58	8.26
Gross Return (in INR)	1868400	2035800	243000	313200	4460400
Cost of Production (in INR)	1447352.6	1577028.7	188239.5	242619.8	3455240.6
Net return/per year per season (in INR)	421047.4	458771.3	54760.5	70580.2	1005159.4

Socio-economic impact of gerbera cultivation through CSIR-IHBT agrotechnology intervention from 2021-25:

- Total Area covered under gerbera crop: 8.26 hectares
- Planting material distributed: 4.16 lakhs plants
- Revenue generation/ Gross returns from sale of gerbera cut flower: INR 4460400
- Net returns (after deducting cost of production): INR 1005159.4
- Benefit-cost ratio: 1.29


Economic
impact of
stevia

Background stevia:

Stevia is a sweet sugar substitute, which is about 50 to 300 times sweeter than sugar. Extracted from the leaves of *Stevia rebaudiana*, a plant native to areas of Paraguay and Brazil. The active compounds are steviol glycosides (mainly stevioside and rebaudioside). Stevia is heat-stable, pH-stable, and not fermentable. Humans cannot metabolize the glycosides in stevia, and it therefore has zero calories. Its taste has a slower onset and longer duration than that of sugar. Stevia is used in sugar- and calorie-reduced food and beverage products as an alternative to variants with sugar.

There is a growing consumer demand for healthier food and beverage options, driven by increasing concerns over obesity, diabetes, and overall wellness. Stevia, as a natural, low-calorie sweetener, perfectly meets this demand by offering a healthier alternative to traditional sugar. Moreover, the versatility of stevia makes it suitable for a wide range of food and beverage applications, including soft drinks, dairy products, snacks, baked goods, and sauces. Its ability to maintain sweetness and flavour stability under various processing conditions further enhances its appeal to manufacturers in the food and beverage industry.

CSIR-IHBT has developed Agrotechnology and Processing Technology for stevia. The "HimStevia" developed by the institute has a 14.5% total glycoside content.

Market survey: Stevia

Global and National scenario of stevia

Various studies have been done on the market for stevia by firms across the globe. Some of the estimates by firms are as

- The Stevia Market size is estimated at $0.93 billion in 2025, and is expected to reach $1.50 billion by 2030, at a CAGR of 10.12% during the forecast period (2025-2030). Source:https://www.mordorintelligence.com/industry-reports/stevia-market
- Allied Market Research published a report, titled, "Stevia Market by Form (Powder Extracts and Liquid Extracts), Application (Bakery & Confectionery, Beverages, Sweeteners and Others), Source (Conventional and Organic), End-Use (Food & Beverages and Pharmaceuticals): Global Opportunity Analysis and Industry Forecast, 2024-2033". According to the report, the stevia market was valued at $534.2 million in 2023 and is estimated to reach $876.5 million by 2034, growing at a CAGR of 4.8% from 2024 to 2034.
  Source: Allied Market Research
- The global market was valued at $0.84 billion in 2023 and is projected to reach $1.77 billion by 2032.
  Source :SkyQuest Technology Consulting

Export and import data of stevia

India: Export of stevia

The demand for food & beverages in stevia market is driven by various factors. India exported 436 shipments of stevia from October 2023 to September 2024. These exports were made by 109 Indian exporters to 170 buyers, marking a growth rate of 4% compared to the preceding twelve months. Most of the stevia exports from India go to the United States, Sri Lanka, and Canada. Globally, the top three exporters of stevia are China, Indonesia, and India. China leads the world in stevia exports with 6,546 shipments, followed by Indonesia with 5,017 shipments, and India taking the third spot with 3,295 shipments.

Source: https://www.volza.com/p/stevia/export/export-from-india/

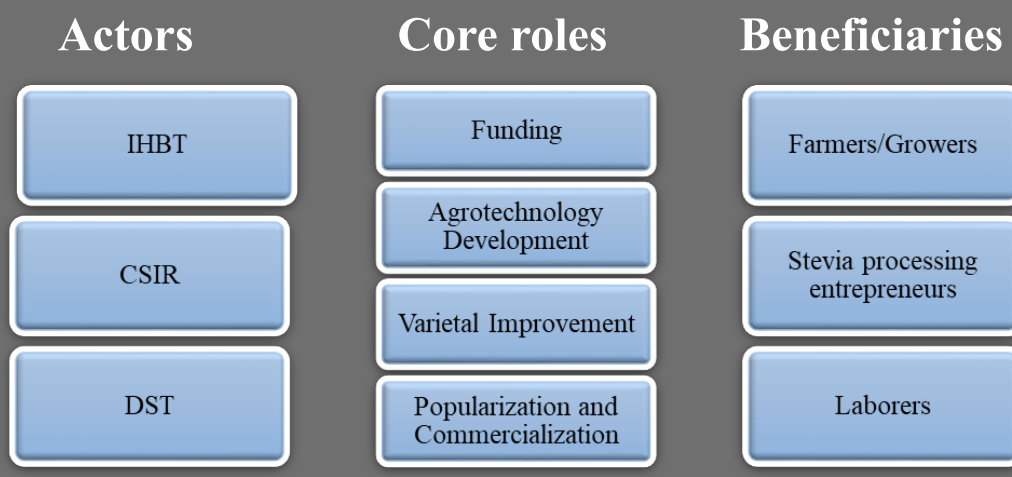
India: Import of stevia

India imported 114 shipments of Stevia during October 2023 to September 2024 .These imports were supplied by 42 foreign exporters to 39 Indian buyers, marking a growth rate of 39% compared to the preceding twelve months. Within this period, in Sep 2024 alone, India imported 18 stevia shipments. This marks a year-on-year growth of 80% compared to Sep 2023, and a 260% sequential increase from Aug 2024. India imports most of its stevia (stevia leaf extracts and products derived from it) from China, Malaysia, and the United States. Globally, the top three importers of stevia are the United States, Peru, and Ecuador. The United States leads the world in stevia imports with 6,471 shipments, followed by Peru with 2,394 shipments, and Ecuador taking the third spot with 1,825 shipments.

Presence in Indian States
Number of MTAs:

From April 2022 to March 2025 a total of 17 MTAs have been signed to provide the seed and planting material of stevia to the Farmers in the state of Himachal Pradesh, Punjab, Jammu and Kashmir, Delhi, Madhya Pradesh, Chhattisgarh, Haryana, Maharashtra, Rajasthan, Gujarat, West Bengal, Uttar Pradesh, Uttarakhand, Andhra Pradesh, Bihar as shown in Fig 6.1.

Fig 6.1 Introduction of Stevia in different states by CSIR-IHBT



Stakeholder mapping

Agrotechnology:

The institute has developed and released 'Him Stevia'(CSIR-IHBT-ST-01), a clonal cultivar of stevia. 'Him Stevia' has been developed through a hybridization and selection approach, having a desirable steviol glycoside profile. The cultivar was selected for a higher proportion of Reb-A content as compared to stevioside, and has a high content of Reb-A (~7.4%) compared to stevioside (~5.8%), Reb-A/stevioside ratio is 1.25, and total glycoside content of about 14.5% (on dry weight basis). Good agricultural practices have also been developed by CSIR-IHBT for higher biomass (3.5 – 4.0 t/ha/year), resulting in 20-25 % more yields for different agroclimatic conditions.

Good Agricultural Practices have also been developed by CSIR-IHBT for higher biomass yield for different agroclimatic conditions. For the promotion of stevia throughout India, CSIR-IHBT has developed a nutrient management technique, water management, weed management, standardization of crop geometry and plant population. Agro-technologies for cultivation under conservation agriculture and abiotic stress conditions have also been developed. On average, the dry leaf yield of stevia is 3.5–4.0 t/ha/year, which fetches a market price of INR 120/kg, resulting in a net return of INR 2.40-3.00 lakhs/ha/year. The Institute has promoted stevia cultivation in the states of Punjab, Haryana, Uttarakhand, Himachal Pradesh, Uttar Pradesh, Maharashtra, Andhra Pradesh, Gujarat, Odisha, Jharkhand, and Chhattisgarh. Through agrotechnological intervention, the cost of cultivation has been reduced by 23-25%, and yield has been improved up to 28%. The Good Agricultural Practices for stevia developed by the Institute include

- Technique for generating quality planting material (QPM)
- Standardization of plant population and crop geometry
- Optimization of nutritional doses
- Weed management technology
- Water management technology
- Optimized harvesting time
- Resource conservation technology
- Abiotic stress (salinity and drought) Management
- Breaking apical dominance for increasing leaf biomass

Stevia field visited by the DG, CSIR
TRL: >8 for Agrotechnology
Details of Transfer of Technology (if any):
1. Agrotechnology for Stevia transferred to Agri Natural India, Ludhiana on 2nd January 2019.
2. Technology Transfer Agreement for Processing of Steviol Glycosides to M/s RJ Saints Tehsil HaroliDistt. Una on 27th February 2023.
M/s DLB Herbs India Pvt. Ltd., New Delhi
M/s MaaDanteshwari Herbal Products (MDHP) Pvt. Ltd, Bastar, Chhattisgarh

Major Milestone:
CSIR-IHBT has a "Transfer of Technology" agreement to provide the technology for the Processing of Steviol Glycosides to M/s RJ Saints, Tehsil Haroli,Distt. Una on 27th February 2023. Within a duration of two years, M/s RJ Saints has successfully established the stevia processing plant. On 15th March, 2025 Dr. (Mrs.) N. Kalaiselvi, Director General CSIR & Secretary DSIR, Govt. of India, inaugurated the RJ Saints Stevia processing plant at Singha in Una District of Himachal Pradesh that has been developed with the technical support of CSIR-IHBT, Palampur.

Process Technology:

The institute has also developed a green process for converting dry stevia leaf into steviol glycoside powder, ready to serve stevia liquid and powder sachets with a purity of more than 95%. The salient feature of the technology is the water-based extraction process. The average yield of the finished product is around 8 % (w/w basis). In addition to this, the product meets the Joint FAO/WHO Expert Committee on Food Additives (JECFA) international guidelines.

TRL: >6 for processing technology

Tentative CapEx & OpEx requirement: Rs. 2.5 Cr on Machinery for steviol extraction (batch capacity: 300 kg/batch)

Patents:

Vietnam: 0142555 A1/2006
Korea: 049563518/2009
PCT: WO038221/2006

Technology transfer and societal impact:

The agrotechnology developed by the institute has been transferred to eight entrepreneurs/industries for commercial cultivation on a pan-India basis. Among them, three parties (M/s Agri Natural India, New Model Town, Ludhiana, Punjab; M/s DLB Herbs India Pvt. Ltd., New Delhi; and M/s MaaDanteshwari Herbal Products Pvt. Ltd, Bastar, Chhattisgarh) are cultivating on a large scale in Punjab, Haryana, Jharkhand, and Chhattisgarh. Moreover, the institute has also promoted stevia cultivation directly in the states of Punjab, Haryana, Uttarakhand, HP, UP, Maharashtra, Andhra Pradesh, Assam, Jharkhand, Madhya Pradesh, Tamil Nadu, and Chhattisgarh by supplying planting material, which covered ~2350 acres across India. About 2600 farmers have directly benefited from stevia cultivation. Entrepreneurs have also been supported by the institute for the processing of stevia, and the liquid product of stevia is available in the market.

Training and awareness programme

During last 7 years, 78 awareness cum training programmes were conducted on agrotechnology of stevia, and about 1554 were participated from different parts of the country. A list for training programmes and details about participants from 2022 to 2025 is given below.

Sr. No.	Date	Location	Number of Farmers/Students/Growers Participated
1.	07/03/2022	MDU, Rohtak(at CSIR-IHBT)	33
2.	10/03/2022	NABARD, Himachal Pradesh , (at CSIR-IHBT)	24
3.	09/05/2022	Himachal Pradesh Horticulture Officers (at CSIR-IHBT)	13
4.	08/06/2022	Farmers from ChowkiManiar District Una(at CSIR-IHBT)	8
5.	28/12/2022	BHU, Varanasi (Students) (at CSIR-IHBT)	11
6.	23/01/2023	Farmers from Block Bhoranj, District Hamirpur (H.P.) (at CSIR-IHBT)	28
7.	30/01/2023	Farmers from Gagret District Una (H.P.) (at CSIR-IHBT)	30
8.	07/02/2023	Farmers from Ghumarwin, District Bilaspur (H.P.), (at CSIR-IHBT)	30
9.	10/02/2023	Farmers from Block- Tissa, District Chamba (H.P.), (at CSIR-IHBT)	30
10.	21/02/2023	Farmers from District Kangra (H.P.), (at CSIR-IHBT)	30
11.	23/02/2023	Farmers from District Mandi (H.P.), (at CSIR-IHBT)	50
12.	24/02/2023	Farmers from District Shimla (H.P.), (at CSIR-IHBT)	29
13.	02/03/2023	Farmers from Kullu&SolanDistrict (H.P.), (at CSIR-IHBT)	57
14.	14/03/2023	Farmers from District Kangra (H.P.), (at CSIR-IHBT)	30
15.	06/06/2023	Farmers from District Shimla (Chopal) (H.P.), (at CSIR- IHBT)	18
16.	12/10/2023	Farmers from Meghalaya (at CSIR-IHBT)	21
17.	19/10/2023	Farmers from Meghalya (at CSIR-IHBT)	20
18.	23/11/2023	NABARD Haryana Regional Office, Chandigarh (at CSIR-IHBT)	17
19.	20/02/2024	M.Sc. Botany Students & Teachers of JamiaHamdard University, New Delhi, (at CSIR-IHBT)	17
20.	03/07/2024	BHU, Varanasi, U.P. (Students), (at CSIR-IHBT)	25
21.	10/07/2024	BHU, Varanasi, U.P. (Students), (at CSIR-IHBT)	28
22.	22/08/2024	Board of Directors of Farmer Producer Company (Under NABARD), (at CSIR-IHBT)	16
23.	03/12/2024	Self Help Group, Wild Life Division, Kullu, (at CSIR-IHBT)	16
24.	08/01/2025	BHU, Varanasi, U.P. (Students), (at CSIR-IHBT)	24
25.	21/04/2025	PT. Khushilal Sharma Govt. Ayurveda College, Bhopal, M.P., (at CSIR-IHBT)	57
26.	22/04/2025	NEDAC, (at CSIR-IHBT)	34
	Total		696

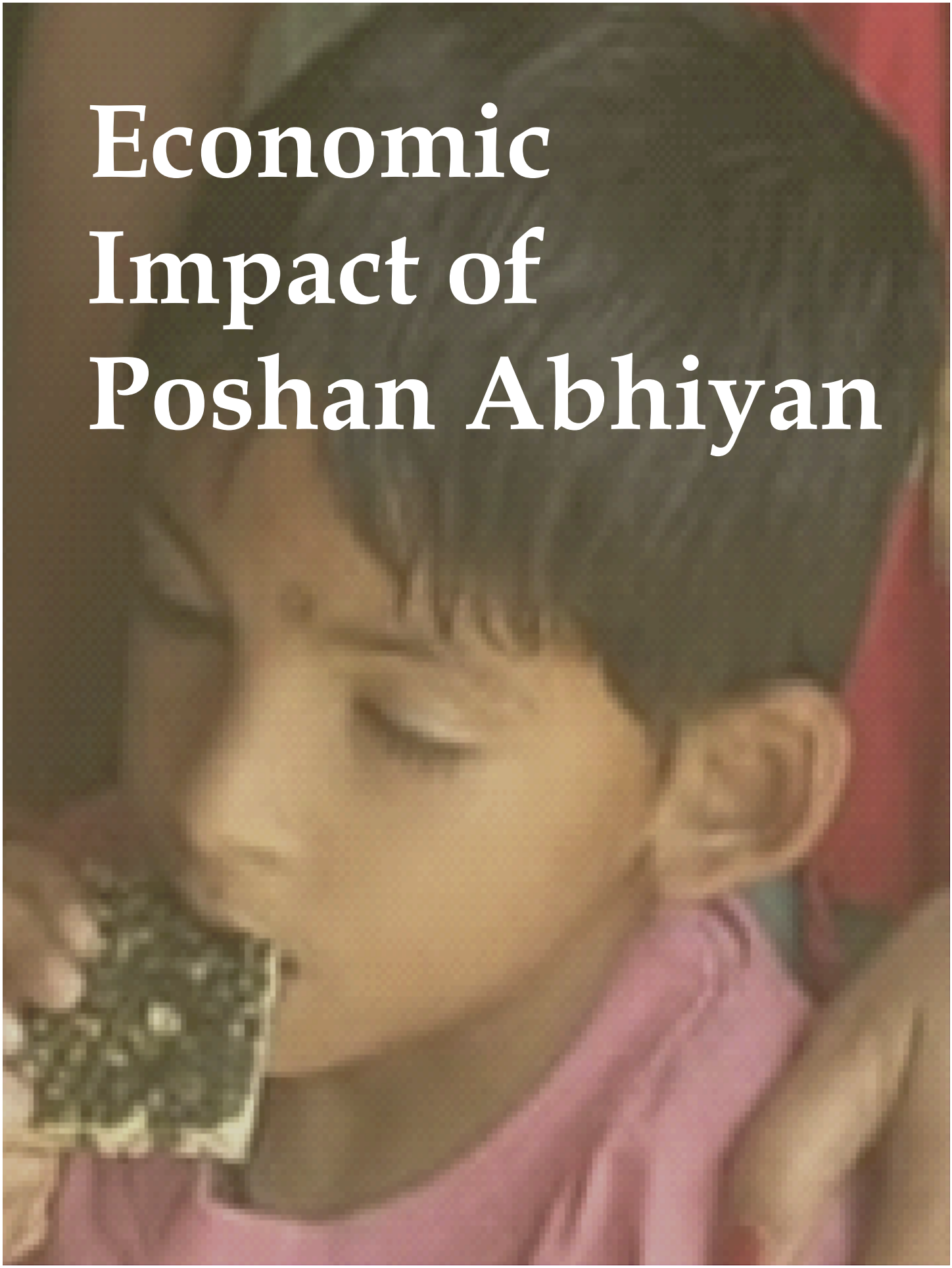
Socio-economic impact of stevia cultivation through CSIR-IHBT's stevia agrotechnology intervention from 2020-21 to 2024-25:

- Total area covered under stevia crop: 265 hectares (Open Field Cultivation)
- Planting material distributed: 1,17,379 plants; and 39.13 kg seeds
- Production of stevia leaves: 927 tonnes
- Revenue generation/ Gross returns from sale of stevia leaves: INR 11,68,00,000.00
- Net returns (after deducting cost of production): INR 5,47,00,000.00
- Employment generation (man-days): 75,525
- Benefit-cost ratio: 8.25

Impact Evaluation of Stevia Cultivation

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	50	76	65	22	52	265
Gross Return (Sale Price * Total Produce) in Lakhs	210	320	273	92	273	1168
Cost of Production (INR): Operational Cost + Fixed Cost	103	157	136	52	136	584
Net return/per year per season (INR)	97	148	124	41	137	547
Employment generation (Direct+Indirect): Total man-days generated/ season	14,250	21,660	18,525	6,270	14,820	75,525

Economic Impact of Poshan Abhiyan



Introduction

According to National Family Health Survey (NFHS) 5 (2019-21), 35.5% of children under the age of five are stunted, 19.3% are wasted, while 32.1% are underweight in India. In case of women belonging to reproductive age (15 – 49 years), nearly 53% of them are anaemic. The burden of IDA is 3.0 times higher than the average globally for other geographies at a similar level of development, and adolescent girls and women are disproportionately affected. The major reason behind the high prevalence of malnutrition among the Indian population is the inability to meet the Recommended Dietary Allowances (RDA) of energy, protein, and essential micronutrients like iron, zinc, vitamin A, and vitamin B-complex. A survey by Minocha et al. indicated that the Indian population does not even meet the 50% RDA for the aforesaid nutrients. Most of the states in India performed poorly in managing the double burden, especially IDA, with a significant increase in the prevalence of anaemia when compared to NFHS 4 (2015-16), and most of them were identified to be under the red zone.

The Government of India, in March 2018, launched the Poshan Abhiyan scheme (also known as the National Nutrition Mission), a flagship program aimed at improving nutritional outcomes for children, pregnant women, and lactating mothers. The mission adopts a convergence approach involving various ministries and leverages technology, targeted interventions, and community mobilization to reduce stunting, undernutrition, anaemia, and low birth weight.

Market survey

Global and National scenario of food-based products to combat malnutrition

Global scenario

Malnutrition remains a significant global challenge, affecting millions of people, particularly in low- and middle-income countries. According to the World Health Organization (WHO), nearly 45% of deaths among children under five are linked to malnutrition. Food-based interventions have been a cornerstone in addressing this issue, especially through fortified foods, specialized nutrition products, and dietary diversification. The global approach includes the development of nutrient-dense, affordable food products designed to improve the intake of essential vitamins and minerals, such as micronutrient powders, fortified cereals, and ready-to-use therapeutic foods (RUTFs). These products have been crucial in treating conditions like stunting, wasting, and micronutrient deficiencies in children, as well as improving maternal health.

National scenario (India)

In India, malnutrition continues to be a pressing issue, despite significant economic growth. The NFHS reports high levels of stunting, underweight, and anaemia, particularly among children, women, and adolescent girls. The government of India has recognized the importance of food-based solutions, and several initiatives, such as the *Poshan Abhiyan*, focus on promoting nutrition through both food diversification and fortification. Food-based interventions like fortified rice, oil, and milk, along with initiatives like Integrated Child Development Services (ICDS) and midday meal schemes, aim to provide nutritious food to vulnerable populations.

Recent strides have been made in food fortification programs, where staple foods like millet, wheat, etc. are fortified with essential micronutrients, helping to address widespread deficiencies. In addition, products like *nutrition-dense ready-to-use supplements*, *fortified snacks*, and *complementary foods* are increasingly being used to combat specific deficiencies in children and women, ensuring the delivery of critical nutrients in an accessible and sustainable manner.

Both globally and nationally, food-based products are emerging as powerful tools in the fight against malnutrition, though challenges remain in terms of accessibility, affordability, and awareness.

Export and import data of food-based products

India's food processing sector has shown significant growth, with processed food exports increasing by 150% over the past nine years. In FY 2023–24, these exports reached approximately $7.7 billion, accounting for 23.4% of total agricultural exports. Key export items include processed vegetables ($787 million), pulses ($687 million), groundnuts ($861 million), and cereal preparations ($842 million).

On the import side, India primarily imports food-based products to meet domestic demand and address nutritional gaps.

Chronological Account of the Intervention by CSIR Lab

CSIR-IHBT interventions

Addressing the double burden of malnutrition, CSIR-IHBT has developed various low-cost food products fortified with protein and micronutrients such as (i) iron and zinc-enriched Spirulina-based energy bars, (ii) iron-enriched cereal bars, (iii) multigrain protein beverage mix, (iv) protein and fibre-enriched cereal bars

The salient features of these food products are -

- The products meet 15% to 20% RDA of iron and protein for the target age group per serving
- They do not contain added preservatives or any artificial additives
- The products are developed based on traditional knowledge and contain indigenous bioresources such as millets, pulses, and green leafy vegetables, and enriched with micronutrient-rich single-cell protein – *Arthospira platensis* (Spirulina)
- Products are ready to eat or ready to reconstitute with minimal cooking interventions
- Products have long shelf life and do not require any special storage conditions

The products have been designed in such a way that the process can be scaled up and are easy to distribute, ensuring safety during distribution. In addition, the products can be externally fortified with micronutrients, mainly iron, zinc, vitamin A, vitamin B12, vitamin C, and folic acid, meeting at least 25% of the RDA.

Nutritional quality & Bioefficacy of the products

The nutritional quality and bio-efficacy of the aforesaid products have been validated on experimental animal models (rats) before taking the human acceptance trials. The products promoted recovery from malnutrition by improving the growth and haemoglobin levels, increasing the serum iron and protein concentration in malnourished rats and reducing the malnutrition induced oxidative stress and modulating the gut microbiome of the rats. The protein and micronutrient enriched food products promoted the growth of gut-friendly bacteria such as *Lactobacillus* sp., *Bifidobacterium* sp., *Akkermansiamuciniphila* and simultaneously inhibited the growth of harmful bacteria such as Helicobacter pylori that damage the intestinal integrity and function.

The products were further validated through human supplementation studies conducted in collaboration with Rajiv Gandhi Government Post Graduate Ayurvedic College, Paprola, Himachal Pradesh. Separate studies were conducted for three of the CSIR-IHBT products, viz., Iron-enriched Spirulina peanut bar, Multigrain protein mixes, and Protein and fibre-enriched multigrain bars, with necessary ethical committee approvals. The products were supplemented to anaemic and healthy patients for a period of 30 to 45 days, and several parameters such as haematology, serum biochemistry, liver and kidney function tests were assessed before and after supplementation. Further, subjective parameters such as improvement in appetite, reduction in fatigue, and ability to carry out heavy work were evaluated. Supplementation of the products resulted in an overall improvement in the health and well-being of the anaemic patients.

Major activities aligning with National Missions

POSHAN Abhiyaan - Prime Minister's Overarching Scheme for Holistic Nutrition has the major objectives of

- Prevent and reduce stunting in children (0- 6 years)
- Prevent and reduce under-nutrition (underweight prevalence) in children (0-6 years)
- Reduce the prevalence of anaemia among young Children (6-59 months)
- Reduce the prevalence of anaemia among women and adolescent Girls in the age group of 15-49 years
- Reduce Low Birth Weight (LBW)

In this context, CSIR-IHBT has a collaboration with the Directorate of Women and Child Development, Govt of Himachal Pradesh in three programs:

Mission Bharpoor in Kangra – Targeting 920 nos. of Severely Acute Malnourished (SAM) and moderately acute malnourished (MAM) children in Kangra. Phase 1 was completed between January 2024 and November 2024.

Six protein and micronutrient fortified food products have been integrated into the program

- Iron-enriched Spirulina-based bars
- Iron-enriched fruit bars
- Protein and fibre-enriched energy bars
- Multigrain protein mixes
- High-protein millet cookies
- Protein and micronutrient fortified Ready to Use Therapeutic Foods (RUTF) peanut butter bars

These products are designed to address specific nutritional deficiencies and provide a sustainable solution for improving dietary health.

Iron-enriched Spirulina-based bars

Salient features of the technology:

- Meets 25% RDA levels of iron and zinc per 30g serving
- Preservative and additive-free
- Meets 8% RDA level of betacarotene (provitaminA) perserving
- Meets6-8% RDA of proteins per serving
- Source of nutraceuticals-Phycocyanin(4mg per serving)
- Shelf life of the product is up to 3months

Market potential:

The Spirulina and algae-based functional foods market is pegged at $2 billion and is growing annually at 5.6%. India is the second-largest exporter of food-grade Spirulina biomass.

End users/ Stakeholders:

Food and nutraceuticals consumers

Iron enriched fruit bars

Salient features of the technology:

- Nutritionally (Iron) enriched Nutri Bar to combat malnutrition.
- Nutri bar meets 40% Recommended Dietary Allowance (RDA) requirement of Iron.
- Utilizes naturalbio-resources such as crop residues and spice mixes
- Free from additives and preservatives
- Shelf life of the products is up to 6 months

Market Potential:
Global Bars market is expected to grow significantly (9.6% CAGR from 2024-2031):

End users/ Stakeholders:
Food & Nutraceuticals consumers

Protein and fibre-enriched energy bars

Salient features of the technology:

- Ready to eat food with 150-200Kcal energy and 6-8g protein per 40g serving
- Developed using 100% natural ingredients like wholegrains, millets, pulses, dehydrated fruits, and nuts
- Preservative and additive-free
- 4g fibre perserving
- Low saturated to unsaturated fat ratio (1:4);Low sugar content(<7g)
- Shelf life upto 4 months

Market potential:
The global protein and energy bars market is currently $2.3 billion, growing annually at 8.4%.

End users/ Stakeholders:
Food and nutraceuticals consumers

Multigrain protein mixes

Salient features of the technology:
Developed using 100% natural and nutrient-dense ingredients (whole grains: millets, cereals, pseudo-cereals, and pulses).
Provides 200-250 Kcal energy and 10g protein per 50g serving.
Meets 20% of the recommended dietary allowances (RDA) of proteins, 10% of the RDA of dietary fibre, 15% of the RDA of iron, and calcium.
Free from preservatives, maltodextrin, and thickeners.
Non- hygroscopic and free flowing.
Shelf life of the product is up to 10 months.

Market potential:
Indian protein foods and supplements market is $12 billion & 5.9% CAGR

End-user/Stakeholder: Food and nutraceuticals consumers

High protein millet cookies

Salient features of the technology:
These cookies are free from chemicals and preservatives
Shelf life of 6-8 months.
Less processed, highly nutritious
No harmful ingredients: No maida, sugar, baking soda, and artificial flavours/colours,
No bakery fats/ hydrogenated/ vegetables/ palm oil, No trans-fat &cholesterol.

Market potential:
The cookies market stood at $29.62 billion in 2025, eventually reaching $42.87 billion by 2033, driven by a CAGR of 4.3%.

Key industry partners supplying technology materials in Kangra district

S. No.	Industry Details	Product
1.	M/s Unati Cooperative Marketing cum Processing Society, Talwara, Hoshiarpur	Multigrain Protein Mixes
2.	M/s Daziran Health Products, Tamil Nadu	Iron-Enriched Spirulina Bars
3.	M/s SS Vitran Health Care Pvt. Ltd., Haridwar	Protein and Fibre-EnrichedBars
4.	M/s Deccan Health Care Pvt.. Ltd, Hyderabad	Iron-Enriched Fruit Bars
5.	M/s MAK Biotek, Sonipat, Haryana	Peanut Butter Bar (Protein-Enriched)
6.	M/s Yuktika Biotech and Nutraceuticals Pvt. Ltd. Palampur, Kangra	Protein-Enriched Millet Cookies

Health impact of the products in a pilot study

The special supplementation program was a pilot study to evaluate the bioefficacy of the product in real time conditions. The program involved regular supplementation of products for six months, followed by frequent interaction with beneficiaries for feedback and measurement of anthropometry parameters such as weight gain, BMI, and subjective parameters such as feel of fatigue, hunger, and overall wellbeing. In addition, several interactive and training sessions were conducted for Anganbadi workers and target beneficiaries highlighting the importance of balanced diet and hygiene. The supplementation of CSIR-IHBT food products increased the nutrient intake among the beneficiaries. In case of PW&LM , the intake values increased by 25.5% for energy, 30.3% for protein, 23.20% for calcium and 52.7% for iron while in children, there was an increase by 40.4% for energy, 60.3% for protein, 38.8% for calcium and 25.9% for iron. The supplementation improved the health of the beneficiaries, with 44% showing improvement. Specifically, the number of severely malnourished (SAM) children decreased from 8 to 0, and 14 children moved from moderately acute malnourished (MAM) to normal status. In case of PW&LM, there was improvement in the body weight gain and body mass index (BMI) levels when compared to the reference values for the age group.

Outcomes of Mission Bharpoor

68% of the target beneficiaries (SAM and MAM children) showed significant improvement in health, mainly growth milestones and BMI, in Phase 1 of the supplementation, and the District Administration recommended the continuation of the nutrition supplementation program from December 2024 to May 2025.

National Health Mission

Under the National Health Mission, CSIR-IHBT has integrated the following fortified food products, particularly ready-to-eat energy bars such as

- Iron-enriched Spirulina-based bars
- Iron-enriched fruit bars
- Protein and fibre-enriched energy bars

Under the "**Janani Shishu Suraksha Karyakram (JSSK)**" scheme in collaboration with the Civil Hospital, Palampur. The target beneficiaries are post-natal women receiving health care support in the hospital.

Similar to the above program, another initiative, "**Mission Jeevan Uphaar**," has been approved in collaboration with the District Administration, Chamba. An agreement was signed with the District administration of Chamba for improving the health status of malnourished children and high-risk pregnant and lactating women in Chamba.

The total number of target beneficiaries in Chamba is 6500, covering stunted, underweight, low BMI, high-risk pregnant and lactating women.

The following selected products will be supplied in the district:

- Multigrain Protein Mixes
- Iron-Enriched Spirulina Bars
- Protein- and Fiber-Enriched Energy Bars
- Iron-Enriched Fruit Bars
- Herbal Cookies
- Peanut Butter Bars

The supply of products is yet to start in Chamba after the completion of tendering formalities.

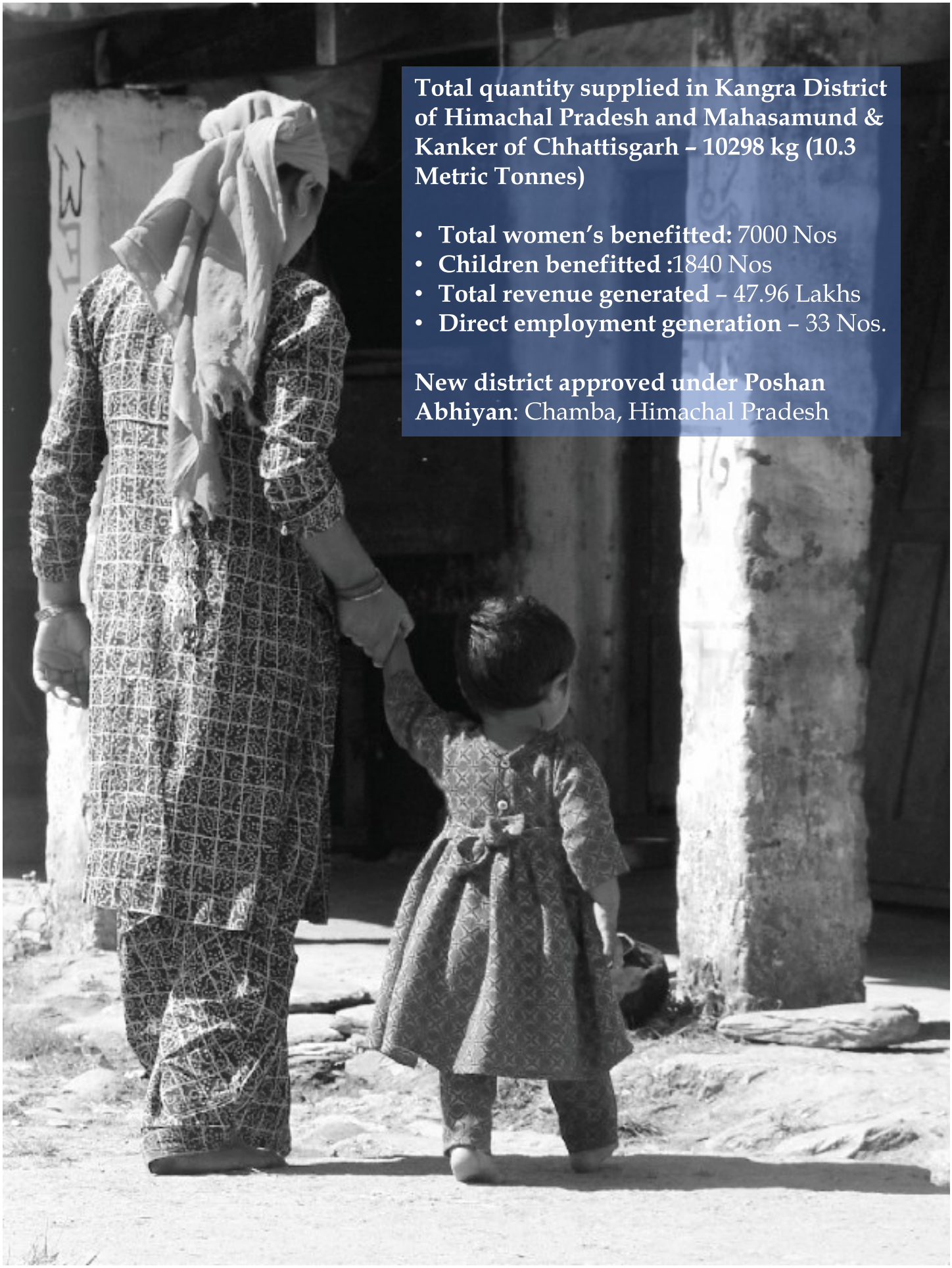
Socio- economic impact of CSIR-IHBT technology-based products integrated in Poshan Abhiyan

S. no.	Product	Year wise Quantity Supplied (in Kg)		Revenue generation from sale (In Lakh ₹)		Women's Benefitted (No's)		Children's Benefitted (No's)		Area coverage, Anganbadi centres covered		Benefits (protein intake, iron deficiency improved, weight improved, height increased
		2024	2025	2024	2025	2024	2025	2024	2025	2024	2025	
1.	Multigrain Protein Mixes	1862	1141	6.21	4.24	5000	2000	920	920	Kangra Chhattisgarh	Kangra	• Enhanced growth • Improved BMI • Reduction in MAM & SAM prevalence
2.	Iron-enriched Spirulina Bars	1242	761	6.52	4.00	5000	2000	920	920	Kangra Chhattisgarh	Kangra	• Enhanced growth • Improved BMI • Reduction in MAM & SAM prevalence
3.	Protein and fibre-enriched energy bars	1242	761	6.21	3.82	5000	2000	920	920	Kangra Chhattisgarh	Kangra	• Enhanced growth • Improved BMI • Reduction in MAM & SAM prevalence
4.	Iron-enriched fruit bars	1242	761	6.21	3.82	5000	2000	920	920	Kangra Chhattisgarh	Kangra	• Enhanced growth • Improved BMI • Reduction in MAM & SAM prevalence
5.	Herbal Cookies	442	201	2.21	1.02	-	-	920	920	Kangra	Kangra	• Enhanced growth • Improved BMI Reduction in MAM & SAM prevalence
6.	Peanut butter bars	442	201	2.54	1.16	-	-	920	920	Kangra	Kangra	• Enhanced growth • Improved BMI Reduction in MAM & SAM prevalence

Details of Food Products Supplied in District Kangra (H.P.) and Mahasamund & Kanker (Chhattisgarh)

Year	Products	Supply in Kangra		Supply in Chhattisgarh	
		Qty (in Kg)	Amount (₹)	Qty (in Kg)	Worth Amount (₹)
2024	Multigrain protein mixes	662.4	2.21	1200	4.00
2025	Multigrain protein mixes	301.0	1.02	840	3.22
2024	Iron-enriched Spirulina Bars	441.6	2.32	800	4.20
2025	Iron-enriched Spirulina Bars	201.0	1.06	280	2.94
2024	Protein and fibre-enriched energy bars	441.6	2.21	800	4.00
2025	Protein and fibre-enriched energy bars	201.0	1.02	280	2.80
2024	Iron-enriched fruit bars	441.6	2.21	800	4.00
2025	Iron-enriched fruit bars	201.0	1.02	280	2.80
2024	Herbal cookies	441.6	2.21	-	-
2025	Herbal cookies	201.0	1.02	-	-
2024	Peanut butter bars	441.6	2.54	-	-
2025	Peanut butter bars	201.0	1.16	-	-
	Total	4176.4	20.00	5280	27.96

In Chhattisgarh, material supplied by UNISED Research Consultants Pvt. Ltd., Kanpur

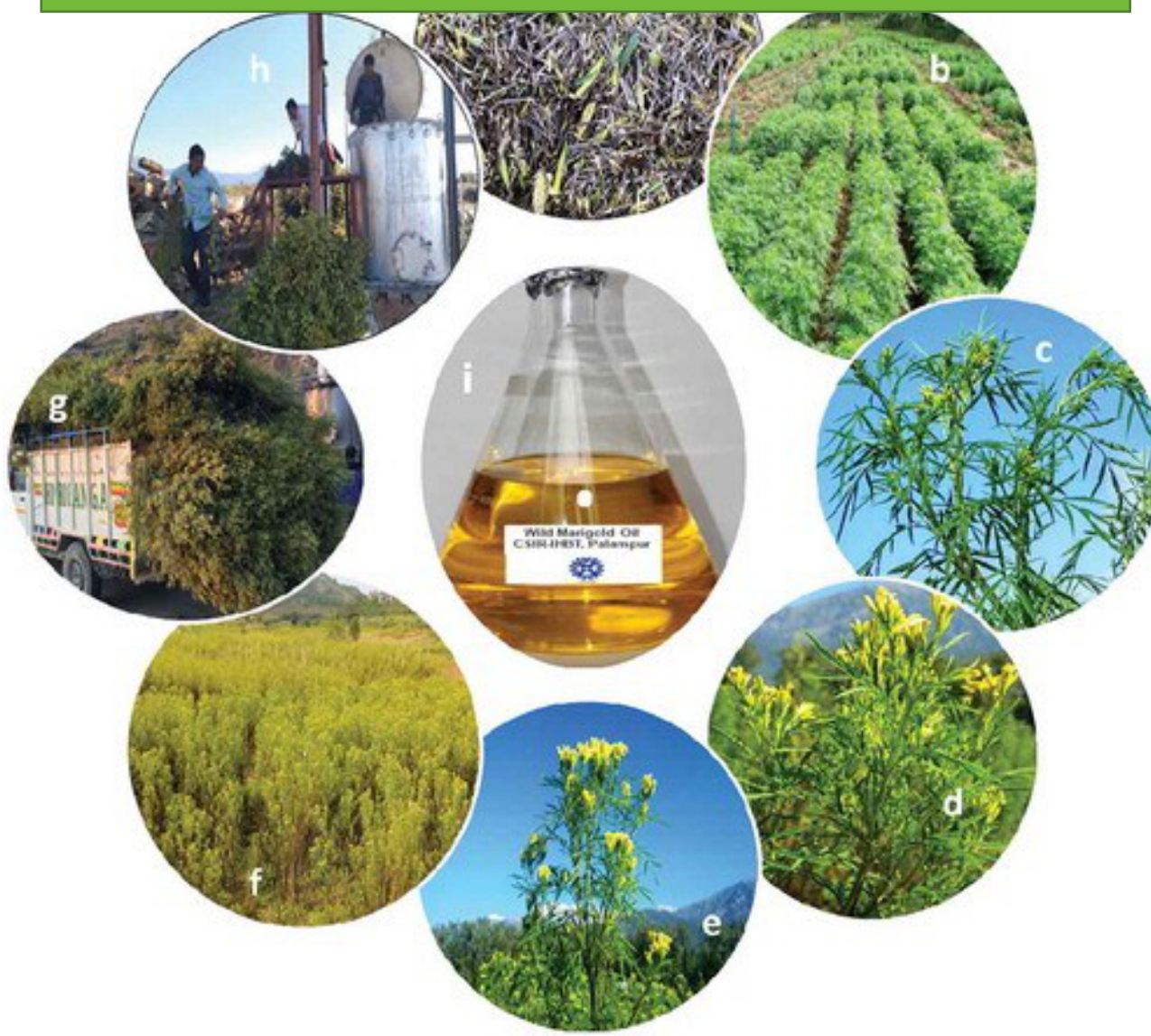


Total quantity supplied in Kangra District of Himachal Pradesh and Mahasamund & Kanker of Chhattisgarh – 10298 kg (10.3 Metric Tonnes)

- **Total women's benefitted:** 7000 Nos
- **Children benefitted :**1840 Nos
- **Total revenue generated** – 47.96 Lakhs
- **Direct employment generation** – 33 Nos.

New district approved under Poshan Abhiyan: Chamba, Himachal Pradesh

Economic impact of aromatic crops



Background-CSIR Aroma Mission

Aromatic plants have been used as natural medicines since prehistoric times. They are mainly utilized for the extraction of essential oil and are extensively used in flavouring, cosmetics, fragrance, spices, and various other herbal beverages. Several medicinal plants have been used for the treatment of various diseases. Aromatic plants contain aromatic compounds – basically, essential oils. These essential oils are odorous, volatile, and highly concentrated compounds. They can be obtained from various plant parts, viz. flowers, buds, seeds, leaves, twigs, bark, wood, fruits, and roots. With the use of fragrances in daily life and increased awareness about health benefits pertaining to aromatic plants, consumers are attracted to naturals, fuelling the growth and demand for essential oils.

The therapeutic use of essential oils in various ailments and the increasing popularity of spa and aroma therapy have increased their consumption tremendously. The demand for essential oils is consistently increasing. Its robust growth may be attributed to ready-to-eat meals, various flavours of food/cuisines, and beverages, safe personal hygiene, and cosmetic products, apart from their extensive use in the pharmaceutical industry. With an increase in household incomes and consumers' tilt towards nature, the growth in this sector could be significant. To reap this opportunity of the growing global market, it is essential to exploit the strengths of CSIR in the aroma sector, like superior varieties of aroma crops, their agro and processing technologies, and processes/technologies for value-added products based on essential oils. These technologies must be deployed in the specific regions for the cultivation of these crops, and their post-harvest processing must be popularised to make India a hub of various essential oils to capture global markets. India, possessing different agro-climates, can support different kinds of crops, which could be a source of important essential oils. India has a distinctive presence in the trade of several essential oils like mints, basil, clove, citronella, lemongrass, jasmine, and tuberose, being exported to the USA, Russia, France, Germany, Britain, the Netherlands, Gulf countries, Australia, etc. Our domestic requirements with respect to lemongrass, basil, mints, davana, jasmine, etc., are fully met from indigenous production, and a considerable amount of these oils is exported to various countries. However, the essential oils of patchouli, geranium, lavender, rose, etc. are still imported in considerable amounts to meet the requirements of our domestic industries. The principal consumption of these oils is in food and flavours (> 50%), fragrance, perfumery, and cosmetics (~20%), apart from its usage in pharmaceutical and pesticide industries (10-20%). USA, France, and Germany are at the forefront of the essential oil trade.

Market potential of aromatic crops under Aroma Mission

Overview

CSIR-Aroma Mission, apart from immensely benefitting farmers and indigenous essential oil-based industries, could generate rural employment worth 60 lakh man-days and produce more than 2000 tonnes of high-quality essential oil worth more than 300 crores, considerably reducing the import burden and dependence on other countries for raw material significant among these being lavender, vetiver, etc. The demand for essential oils is consistently increasing. This market segment is valued at $21.79 billion in 2022 and is anticipated to expand at CAGR of 7.9%, estimated to be $40.12 billion in 2030.

Domestic market trends

The Indian domestic market for aromatic crops exhibits a growing trend in area under cultivation and production, driven by increasing demand for essential oils, perfumes, and flavours. The market value is projected to increase significantly in the coming years. Urban areas are a significant source of demand for aromatic crops, with their usage in various industries. In India, Rajasthan is the leading state for aromatic crop cultivation, followed by Uttar Pradesh. Other states with significant aromatic crop cultivation include Maharashtra, Madhya Pradesh, and Assam. The Western Ghats, Konkan, and Satpura hills in Maharashtra are known as hotspots for aromatic plants, and Assam is a major producer of citronella. The cultivation of aromatic plants can occur in both open and protected conditions. Protected cultivation methods offer advantages like controlled environments, improved crop quality, and reduced pest and disease issues. Open field cultivation is simpler and less expensive but can be more susceptible to environmental factors.

Global and National scenario of aromatic plants marketing

Global scenario

Aromatic crops and chemical market size was valued at $6 billion in 2024. The Aroma chemicals industry is projected to grow from $6.27 billion in 2025 to $9.32 billion by 2034, exhibiting a CAGR of 4.50% during the forecast period (2025 - 2034). Increasing consumer preferences for natural and organic fragrance ingredients are the key market drivers enhancing the market growth. The rising demand for sustainable and natural fragrance compounds is one significant development in the aroma chemical market and boosting the market CAGR. The effects of synthetic chemicals on the environment and human health are coming to consumer attention. An increase in interest in aroma compounds made from natural sources, such as essential oils, plant extracts, and biodegradable materials, has resulted from this preference change. To address this expanding customer demand, businesses invest in R&D to produce novel, sustainable fragrance compounds.

North America has the greatest market for scent chemicals. A robust fragrance sector, high demand for natural and environmentally friendly fragrance ingredients, and technological developments in the synthesis of aroma chemicals are factors promoting regional prosperity. The growth of aroma compounds into several applications and customer demands for customized fragrances further support North America's industry dominance.

Further, the major countries studied in the market report are the US, Canada, Germany, France, the UK, Italy, Spain, China, Japan, India, Australia, South Korea, and Brazil.

The international aroma trade is influenced by several factors, including global demand, production costs, trade regulations, and cultural preferences. Specifically, the rise of natural and organic products, the increasing global focus on wellness and sustainability, and the influence of key exporters and importers all play a significant role. Additionally, trade protectionism and fluctuating market prices can impact the sector's growth.

National scenario – India

The Indian aromatic crops market is experiencing growth. From 2020 to 2028, production of aromatic plants increased from 140.63 million to 239.85 million $. The area under aromatic plant cultivation in India is reported to be 650,000 hectares, with production around 7,79,000 MT. The average annual growth rate of production is 2.76% per annum.

India has a significant national scenario for aromatic crops, including being a major producer and exporter of aromatic plants and essential oils. Several states, like Rajasthan and Madhya Pradesh, are key players in production. India is also known for traditional trade in essential oils like lemongrass and palmarosa, and is the second-largest exporter of aromatic plant-based commodities

Export and import data of aromatic crops

Export Scenario

In 2023, India exported $657 million worth of essential oils, making it the second-largest exporter worldwide. India is a major exporter of essential oils derived from aromatic crops, producing approximately 19% of the global supply

Major export items: leaves, flowers, roots, barks, and planting material.

Top export destinations: USA, Germany, Hong Kong, Japan, and China. Dry flowers contribute 67% of the export value.

India's share in global floriculture trade: - 12.4%

Ranking in exports: second in global exports, with a global export value is approximately 10.54%,

Top exporters globally: China (23.3 %), India (12.4 %), Germany (5.09 %)

China led global exports with 23.3%, followed by India (12.4%), Germany (5.09%), Egypt (3.65%), the United States (3.17%), and Canada (3.9%). Among importing countries, the United States (13.6%), Germany (12.1%), Japan (6.47%), China (5%), and South Korea (3.82%) were the top importers globally

Import scenario
Aromatic crops worth ₹600 crores are imported annually.

Main imports: Perfumes, essential oil, and rosemary

Major suppliers: Singapore, Japan, Germany, Malaysia, and the United States
According to a study published in2025in the Journal of Agriculture and Food Research, it was found that from 2010 to 2023, global export and import values of medicinal and aromatic plants surged by 97.8% and 98.1%, reaching $4.18 billion and $4.25 billion, respectively, in 2023. China and India emerged as key exporters, with India achieving a 240% growth in export value, while the United States, Germany, and Japan were leading importers due to high domestic demand and advanced processing infrastructure.
CSIR-Aroma Mission was launched in 2017 with the objectives to bring about 530 hectares of area under captive cultivation of aromatic cash crops, particularly targeting rain-fed/degraded land across the country. New technology adoption with modernisation of farms and shifting to high-value crops could be useful for overcoming the challenges faced by farmers. Technology intervention under CSIR Aroma Mission, with best practices of aroma crop cultivation combined with improved distillation unit and value addition, has made a remarkable impact on the livelihood of farmers across the country. CSIR Aroma Mission has focused on the sources of growth as per NITI Aayog policy that include (i) improvement in productivity of crops, (ii) improvement in efficiency of input use (cost saving), (iii) increase in crop intensity, and (iv) diversification towards high-value crops.

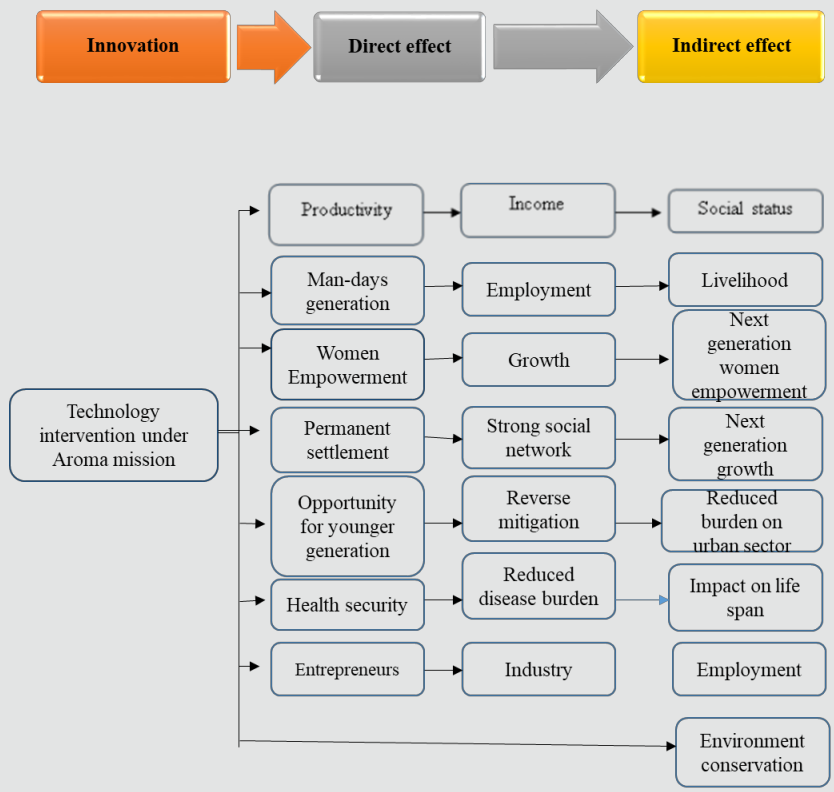


Figure 1.2 Direct and indirect impact made by CSIR Aroma Mission

Training and awareness programmes:

2021-2022			
Sr. No.	Date	Location	Number of Farmers/Growers Participated
1.	4-06-2021	Palampur, Himachal Pradesh	18
2.	4-13-2021	Palampur, Himachal Pradesh	6
3.	4-11-2021 to 4-13-2021	Palampur, Himachal Pradesh	2
4.	4-19-2021	Palampur, Himachal Pradesh	4
5.	7-29-2021	Palampur, Himachal Pradesh	9
6.	7-30-2021	Palampur, Himachal Pradesh	30
7.	8-04-2021	Parwai , Himachal Pradesh	18
8.	8-07-2021	Leh	53
9.	8-24-2021	Palampur, Himachal Pradesh	16
10.	08-31-2021	Palampur, Himachal Pradesh	7
11.	09-01-2021	Lag Baliyana , Himachal Pradesh	19
12.	09-09-2021 to 09-10-2021	Palampur, Himachal Pradesh	2
13.	09-10-2021	Palampur, Himachal Pradesh	6
14.	09-13-2021	Palampur, Himachal Pradesh	4
15.	09-25-2021	Garsari, Uttarakhand	27
16.	09-26-2021	Mara, Uttarakhand	16
17.	09-27-2021	Tyarshu,Uttarakhand	6
18.	10-05-2021	Tapnipal, Uttarakhand	78
19.	10-06-2021 to 10-07-2021	Ghallour, Himachal Pradesh	09
20.	10-14-2021	Bhatera, Himachal Pradesh	12
21.	11-14-2021	Gondpur, Himachal Pradesh	170
22.	11-18-2021	Palampur, Himachal Pradesh	81
23.	11-24-2021	Bilaspur, Himachal Pradesh	13
24.	11-25-2021	Palampur, Himachal Pradesh	09
25.	12-06-2021	Sukairi, Himachal Pradesh	28
26	12-30-2021	Palampur, Himachal Pradesh	142
26.	02-24-2022	Bhattiyat, Chamba, Himachal Pradesh	60
27.	03-07-2022	Palampur, Himachal Pradesh	33
28.	03-09-2022	Patari, Himachal Pradesh	14
29.	03-09-2022	Khowa, Himachal Pradesh	48
30.	03-10-2022	Palampur, Himachal Pradesh	23
31.	03-21-2022	Salooni, Chamba, Himachal Pradesh	139
32.	03-23-2022 to 03-24-2022	Palampur, Himachal Pradesh	26
Total			1128

Table1. Awareness cum training programs conducted during April, 2021-March, 2022 on cultivation and process technologies of aromatic crops

2022-2023			
Sr. No.	Date	Location	Number of Farmers/Growers Participated
1.	05/07/2022	Palampur, Himachal Pradesh	50
2.	13/07/2022	Dharamshala, Himachal Pradesh	51
3.	14/07/2022	Palampur, Himachal Pradesh	06
4.	22/07/2022	Palampur, Himachal Pradesh	02
5.	23/07/2022	Dhwali, Mandi	90
6.	26/07/2022	Palampur, Himachal Pradesh	15
7.	23/08/2022	Kalimpong, West Bengal	150
8.	24/08/2022	Palampur, Himachal Pradesh	15
9.	24/08/2022	Sumbhuk, Sikkim	100
10.	30/08/2022	Palampur, Himachal Pradesh	30
11.	19/10/2022	Palampur, Himachal Pradesh	08
12.	09/11/2022	Saniya and Mara, Uttarakhand	10
Total			527

Table2. Awareness cum training programs conducted during April, 2022-March, 2023 on cultivation and process technologies of aromatic crops

2023-2024			
Sr. No.	Date	Location	Number of Farmers/Growers Participated
1.	22/06/2023	CSIR-IHBT, Palampur	3
2.	05/07/2023	CSIR-IHBT, Palampur	6
3.	20/07/2023	Lag Baliana, Palampur	8
4.	20/07/2023	ChowkiManiar, Una	13
5.	02/08/2023	CSIR-IHBT, Palampur	3
6.	07/08/2023	CSIR-IHBT, Palampur	2
7.	17/10/2023	CSIR-IHBT, Palampur	30
8.	12/10/2023	CSIR-IHBT, Palampur	15
9.	12/12/2023	CSIR-IHBT, Palampur	20
10.	13/12/2023	CSIR-IHBT, Palampur	15
11.	15/12/2023	CSIR-IHBT, Palampur	10
12.	09/01/2024	CSIR-IHBT, Palampur	10
13.	17/01/2024	CSIR-IHBT, Palampur	6
14.	02/02/2024	Chitkara University, Baddi,Himachal Pradesh	29
15.	07/02/2024	CSIR-IHBT, Palampur	10
16.	12/03/2024	CSIR-IHBT, Palampur	9
17.	15/03/2024	CSIR-IHBT, Palampur	13
18.	26/03/2024	CSIR-IHBT, Palampur	2
Total			194

Table3. Awareness cum training programs conducted during April, 2023-March, 2024 on cultivation and process technologies of aromatic crops

2024-2025			
Sr. No.	Date	Location	Number of Farmers/Growers Participated
1.	24/04/2024	CSIR-IHBT, Palampur	3
2.	2/5/2024	CSIR-IHBT, Palampur	1
3.	9/5/2024	CSIR-IHBT, Palampur	4
4.	13/06/2024	IIT Kamand, Mandi	22
5.	26/06/2024	CSIR-IHBT, Palampur	2
6.	28/06/2024	Chailchowk, Mandi	27
7.	3/7/2024	CSIR-IHBT, Palampur	25
8.	8/7/2024	CSIR-IHBT, Palampur	17
9.	10/7/2024	CSIR-IHBT, Palampur	29
10	12/7/2024	CSIR-IHBT, Palampur	8
11.	18/07/2024	CSIR-IHBT, Palampur	5
12.	29/07/2024	Vill. DhobarTeh. Bangana, Una, Himachal Pradesh	12
13.	22/08/24	CSIR-IHBT, Palampur	16
14.	30/08/2024	Chitkara University, Baddi, Himachal Pradesh	24
15.	30/09/2024	CSIR-IHBT, Palampur	6
16.	1/10/2024	Vill. Kandkosri, Baijnath, Kangra	12
17.	16/10/2024	Vill. ChowkiManiar, Bangana, Una	6
18.	18/10/2024	CSIR-IHBT, Palampur	5
19.	21/11/2024	CSIR-IHBT, Palampur	5
20.	29/01/2025	CSIR-IHBT, Palampur	4
Total			233

Table4. Awareness cum training programs conducted during April, 2024-March, 2025 on cultivation and process technologies of aromatic crops

Economic impact of Damask rose

Introduction

The Damask rose is a deciduous shrub densely packed with stems and pinnate leaves. It has a unique and captivating fragrance, often described as floral, slightly sweet, and with a honey aspect. The rose is mainly cultivated for its flowers. It is also an important source of rose products like rose oil, rose concrete, absolute, and rose water. Damask rose originated in the Damascus region of Asia Minor and occupies one of the most important positions as an aromatic plant for the extraction of essential oil. It is cultivated in Bulgaria, France, Italy, Turkey, Iran, Morocco and India for the production of attar (otto) of rose or oil of roses used in perfumery, to make rose water, "rose concrete", and "gulkand"and is suitable for cultivation under sub-tropical and is suitable for cultivation under sub-tropical and temperate conditions. It belongs to the *Rosaceae* family and is an erect, perennial, hermaphrodite shrub possessing multiple green prickly stems up to 1-2 m in height, compound leaves with oval, serrated leaflets. Flowering occurs during the onset of the summer season and continues for 30-35 days.

Cultivation area and production:

Damask rose cultivation primarily occurs in countries like Turkey, Bulgaria, Iran, and India, with significant commercial production in Turkey (Isparta) and Bulgaria (Kazanlik). Mild temperate climates, like those in the western Himalayas (including the Shivalik hills), are ideal for Damask rose cultivation. In India, the plant is grown in regions like Uttar Pradesh, Rajasthan, Jammu & Kashmir, and in Himachal Pradesh (CSIR-IHBT, Palampur), where it is introduced for commercial cultivation. In India, about 4,000 hectares are under cultivation. Bulgaria and Turkey are major producers of rose oil. Brazil is currently the largest exporter.

The indigenous tobacco industry is the largest consumer of rose water and rose attar. Realising the vast potential for its cultivation, a programme to develop suitable varieties for sub-tropical and temperate regions was undertaken. CSIR-IHBT, Palampur, introduced Damask rose cultivation in Himachal Pradesh and developed cultivation and distillation practices, recognizing the suitability of the region's climate.

Market survey: Damask rose

Export and import data of Damask rose

The damask rose has a significant economic impact, primarily due to its use in the production of rose oil and rose water, which are highly valued in the fragrance and cosmetics industries. The market for damask rose products is growing, with the global damask rose water market size valued at $109.10 million in 2024, and projected to grow at a CAGR of 7.4% from 2025 to 2032. It oil has a global market value of approximately $278.7 million in 2018 and is anticipated to increase at a CAGR of 6.8% between 2019 and 2025 (Source: Grand View Research, 2019). The essential oils are renowned for their exquisite perfumery applications and usage in pharmaceutical formulations. The most expensive essential oils in the world market is rose oil owing to low oil content and lack of natural and synthetic substances. Annually, the world production of rose oil and rose concrete is 15-20 tons. The major producers and suppliers of the rose oil in the world market are Bulgaria and Turkey their share is 80-90% of the world production. The rest of the world production comes from France, Italy, Lebanon, Iran, Russia, India, China, Morocco, and Mexico.

Chronological account of the intervention by CSIR Lab

CSIR-IHBT has developed CSIR-IHBT-RD-04 variety of damask rose for different agro-climatic zones of Himachal Pradesh. These varieties give consistent flower yield and oil quality in different locations. Standards for rose oil have been developed by CSIR-IHBT. The success of damask rose cultivation in these regions can be attributed to several factors. The distillation unit infrastructure ensured proper extraction of essential oil, while the Western Ghats climate naturally minimized pests and increased yield. Improved market linkages to major cities like Delhi, Gujarat, and Punjab further enhanced profitability. By reducing dependence on imports and providing farmers with a high-income alternative, damask rose farming has emerged as a transformative opportunity for agriculture in India's Western Ghats regions. With continued support and expansion, it has the potential to strengthen India's position in the global aromatic market.

The large quality planting material (rooted cuttings) of damask rose has been further generated to support the farmers and growers during CSIR Aroma Mission Phase-III. Total Production was (Produce/essential oil) (Kg oil) 2600 Litre (Rose Water) and 700 g (oil). Therefore, the intervention of IHBT can be summarized as follows:

(a) Varietal improvement - CSIR-IHBT-RD-04
(b) Agronomic practices – Varietal improvement and cultivation practices
(c) Generation of QPM - 50,000 rooted plants
(d) Geographical spread of the technology 6 hectares area has been covered

Generation of planting material of the Damask rose

Year	Planting material generated
2021-2022	104050 plants
2022-2023	5,500 plants
2023-2024	50,000 rooted plants
2024-2025	70000 rooted plants

Number of MTA:
From January 2020 to March 2025, a total of 11MTAs have been signed to provide the seed and planting material of Damask rose to the Farmers in the states of Himachal Pradesh, Punjab, Delhi, Chhattisgarh, Maharashtra, Orissa, Uttarakhand, and Assam as shown in fig 1.1

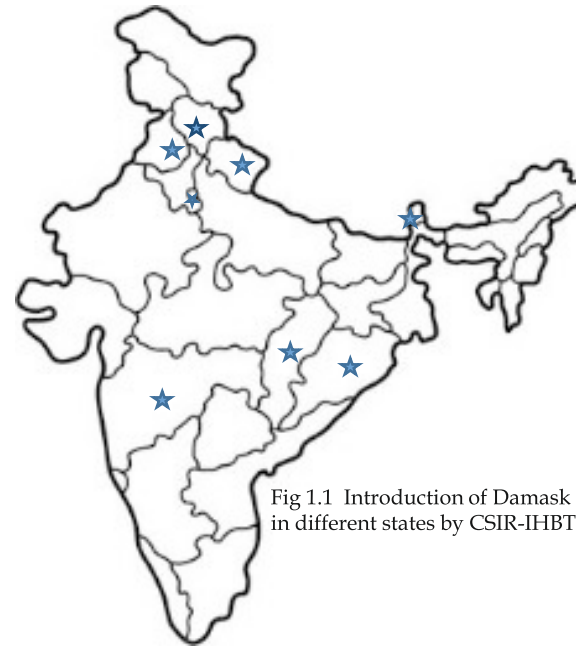


Fig 1.1 Introduction of Damask rose in different states by CSIR-IHBT

Agrotechnology:
The cultivar 'Him Basant' (CSIR-IHBT-RD-04) of Damask rose has been developed by CSIR- IHBT, Palampur, through a half-sib selection approach. The cultivar has high flower yield (3.30-4.10 tons/ha) and essential oil content of 0.025-0.031 % and was selected from clonal breeding lines developed from breeding lines through half-sib family selection. The cultivar was evaluated over four years and found to be vigorous in growth with good adaptability.

Process Technology:

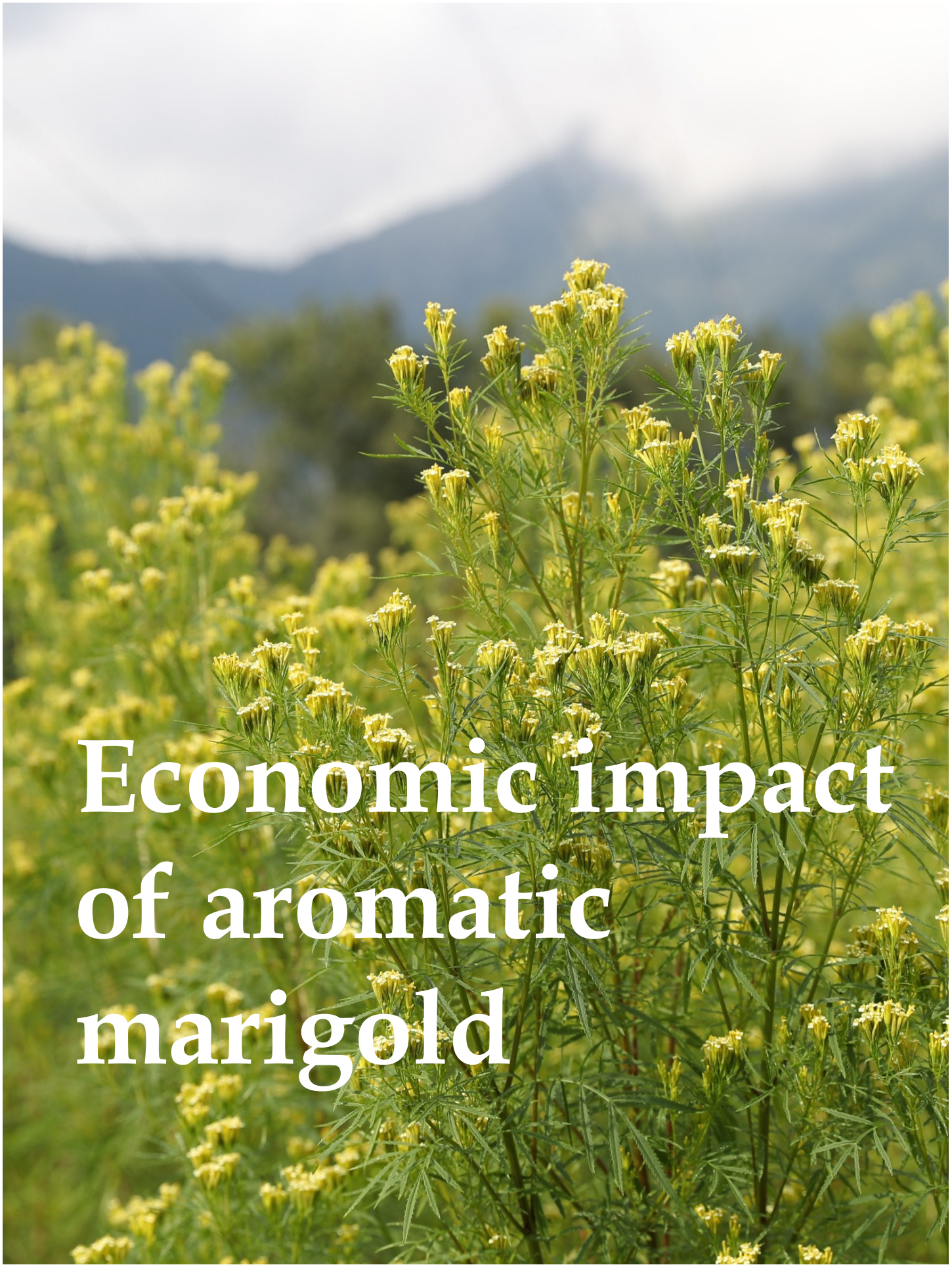
Essential oil is present in the flowers of Damask rose. The essential oil is highly volatile; therefore, the flowers are plucked in the early morning to avoid the loss of essential oil content in the flowers. The essential oil extraction from the crop is done through steam distillation.

Impact evaluation of Damask rose cultivation:

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	4	4	4	4	4	20
Gross Return (Sale Price * Total Produce) in Lakhs	2244000	2244000	2244000	2244000	2244000	11220000
Cost of Production (INR):Operational Cost + Fixed Cost	690792	690792	690792	690792	690792	3453960
Net return/per year per season (INR)	1553208	1553208	1553208	1553208	1553208	7766040
Employment generation (Direct + Indirect): Total man-days generated/ season	1000	1000	1000	1000	1000	5000

Socio-economic impact of Damask rose cultivation through CSIR-IHBT's Damask rose agrotechnology intervention from 2020-21 to 2024-25:

- Total Area covered under Crop: 20 hectares
- Revenue generation/ Gross returns from sale of essential oil: INR 11220000
- Net returns (after deducting cost of production): INR 7766040
- Employment generation (man-days): 5000
- Benefit-cost ratio: 3.25



Economic impact of aromatic marigold

Introduction

Aromatic marigold (*Tagetesminuta* L.) is a highly demanded aromatic plant, having great industrial value. Aromatic marigold , a plant native to South America, has become a global species, with a significant presence in India, particularly in the Western Himalayas. Recently, farmers are more interested in its cultivation and are opting for it in their cropping system. Major constituents of its essential oil are β-ocimene, dihydrotagetone, tagetone, tagete-none, and limonene. The Current market demand for aromatic marigold oil is increasing at a faster rate due to its large use in the flavor and perfumery industry. Its oil and plant extract have potential bioactive and therapeutic properties. The Integration of this species in agricultural production systems still relies on thorough information and the agronomic potential of this plant. Understanding its biology, chemistry, biological activity, and agrotechnology will allow better utilization of this crop.The genus *Tagetes* alludes to 'Tages', which means an Etruscan God related to farming, and is composed of 56 species, 27 annuals and 29 perennials. Most of the species of this genus are grown as a multipurpose new crop in different agro-ecological zones. Out of these species, aromatic marigold (*Tagetes minuta* L.) is the most examined and broadly cultivated species. It is an important aromatic crop of temperate regions that is commercially grown and harvested in several countries for its high-grade essential oil extracted from its leaves and flowers. The major constituents of its essential oil are limonene, (Z)-ocimene, dihydrotagetone, (E) and (Z)-tagetone, and (E) and (Z)-tagetenone. It is used as a part of the flavor and perfumery industry. Likewise, it has its application as drugs and as a part of food products, including cola and mixed refreshments, frozen dairy pastries, baked products, gelatins, puddings, toppings, and so on. It's oil and plant extract exhibits properties like bronchodilatory, tranquilizing, hypotensive, spasmolytic, anti-inflammatory, antiseptic,anticancerous, and antioxidant. It also has weedicidal, antiprotozoal, antibacterial, nematocidal, insecticidal, antifungal, antiviral, and other antimicrobial activities.

Market survey: aromatic marigold

Global and National scenario of aromatic marigold

India stands third in the world's total essential oil production with a share of 16–17% and stands second in terms of value with the share of 21-22%. Essential oil is used in the food industry (55-60%), the perfumery/cosmetic industry (15-21%), as a base material (10-20%), the pharmaceutical industry (5-10%), and natural products (2-5%). Economically important essential oils are being biosynthesized from approximately 3000 plant speciesfrom around 60 families, with 300 plants being the basis for world production. However, the majority of these plant species are not completely being used at subsistence and business levels to understand their incentive to humankind. Literature reviews are available on very few aspects of *T. minuta*, e.g., bioactive properties, chemistry, and biology, but there is no review covering all the aspects, including biological, chemical, pharmaceutical, agrotechnology, and commercial aspects.

Global scenario

The size of the global market for marigold flower extract was estimated at $100.12 million in 2024 and is expected to increase at a CAGR of 8% from 2026 to 2032, reaching $186.2 million. The global market for marigold-derived products is experiencing significant growth, driven by increasing demand across various industries. Among the leading exporters of marigold flowers, India stands at the forefront with 4,758 shipments, followed by Thailand with 1,718 and China with 579, highlighting their critical roles in supplying raw materials for this growing market. **(Source:**https://www.snsinsider.com/reports/marigold-oleoresin-market-4032 https://www.volza.com/p/marigold-flower/export/export-from-india/).

Production & cultivation:

The cultivation of aromatic marigolds is still relatively new in India, although it is expanding, especially in Maharashtra, Karnataka, Gujarat, Andhra Pradesh, Tamil Nadu, Madhya Pradesh, and Himachal Pradesh (particularly for the CSIR-IHBT-developed 'Him Gold' variety), where temperate weather facilitates production. Native to the Western Himalayas, aromatic marigold (*Tagetes minuta*) is grown for its essential oil, especially in the mid-hills. Direct sowing and transplanting are two techniques of cultivating this crop, which is rather simple. Harvest takes place in October or November, when the seeds are mature, and the crop season normally lasts from June to November.

Production: The CSIR-IHBT, Palampur, has made significant advances in the genetic improvement and varietal development of *Tagetes minuta* to meet the increasing demand for high-quality essential oil and to enhance cultivation prospects in the Western Himalayan region. Through systematic breeding, characterization, and multi-location evaluation, two superior cultivars have been developed and are available for commercial cultivation.

1. 'Him Gold'

'Him Gold' is an improved variety developed through a rigorous recurrent selection approach using germplasm collected from Kangra, Mandi, and Kullu districts of Himachal Pradesh. The variety exhibits synchronized seed germination (within 10–15 days), uniform flowering (initiating in mid-September), and consistent seed maturity (by mid-October) when sown in June under mid-hill conditions.

2. 'Him Swarnima' (CSIR-IHBT-TM-09)

'Him Swarnima' (CSIR-IHBT-TM-09) has been developed through a half-sib progeny selection approach from advanced breeding lines derived from CSIR-IHBT's germplasm core collections. The variety has undergone extensive multi-location evaluations across diverse agro-ecological zones in Himachal Pradesh.

This cultivar is characterized by its vigorous growth habit, high adaptability, and superior biomass productivity. It consistently produces fresh biomass yields ranging from 18.0 to 23.0 tonnes per hectare, coupled with an essential oil content of 0.30 to 0.34%. The variety's robust performance across locations highlights its potential for wide-scale cultivation under variable environmental conditions, particularly in the mid-hills and lower elevations of the Western Himalayan region.

Flower yield: A hectare of aromatic marigold crop can potentially yield 18-23 tonnes of biomass, translating to around 25 litres of Tagetes oil, with a potential income of Rs 1,00,000 in a single season, based on a market price of about Rs 10,000.00 per litre.
Duration of crop: 5 months
Key players: Farmers, research institutions, and essential oil industries. Farmers in regions like Himachal Pradesh and Uttarakhand are actively cultivating aromatic marigold for essential oil production. Research institutions like CSIR-IHBT are involved in developing improved varieties and cultivation technologies and promoting its cultivation under CSIR Aroma Mission.

India: Imports & exports of aromatic marigold

According to Volza's India Export data, India exported 13 shipments of marigold flower from Oct 2023 to Sep 2024. Globally, the top three exporters of marigold flower are India, Thailand, and China . India leads the world in marigold flower exports with 1,345 shipments, followed by Thailand with 638 shipments, and China taking the third spot with 328 shipments.
Sources: https://www.volza.com/p/marigold-flower/export/export-from-india/

Presence in Indian states

Number of MTAs:

From April 2021 to March 2025, a total of 62 MTAs have been signed to provide the planting material of aromatic marigold to the Farmers in the state of Himachal Pradesh, Uttarakhand, Madhya Pradesh, Maharashtra, Karnataka, Gujarat, and Andhra Pradesh as shown in fig 2.1.

Fig 2.1 Introduction of aromatic marigold in different states by CSIR-IHBT

Impact evaluation of aromatic marigold cultivation

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	671	730	1370	267	345	3383
Gross Return (Sale Price * Total Produce) in Lakhs	217404000	236520000	443880000	86508000	111780000	1096092000
Cost of Production (INR) :Operational Cost + Fixed Cost	162808085	177123550	332409950	64783545	83709075	820834205
Net return/per year per season (INR)	54595915	59396450	111470050	21724455	28070925	275257795
Employment generation(Direct + Indirect): Total man-days generated/season	200	200	190	210	200	1000

Socio-economic impact of aromatic marigold cultivation through CSIR-IHBT's intervention from 2020-21 to 2024-25:

- Total Area covered under Crop: 3383 hectares (open field cultivation)
- Revenue generation/ gross returns from sale of essential oil: INR1096092000
- Net returns (after deducting cost of production): INR 275257795
- Employment generation (man-days): 1000
- Benefit-cost ratio: 1.34

Economic impact of lemongrass

Introduction

Lemongrass is widely cultivated in India, with an estimated area of 4000 hectares producing about 250-300 tonnes of oil annually. India is a significant exporter of lemongrass oil, with roughly 80% of the produce being exported. The oil is used for various purposes, including fragrance, flavoring, and as a source of citral. It is grown on approximately 16,000 hectares globally, producing around 1000 tons of oil annually. Major cultivation areas in India include Kerala, Karnataka, Tamil Nadu, Uttar Pradesh, Uttaranchal, and Assam. It can grow in various soil types, including poor, marginal, alkaline, and even in wasteland. It thrives in warm and humid climates with sufficient sunlight and rainfall. India is a major exporter of lemongrass oil, with around 80% of its production exported. Key import destinations include the USA, China, Germany, and other countries in North America, Europe, and the Asia-Pacific regions. The global market for lemongrass oil is significant and growing, with projections indicating a substantial increase in demand in the coming years. The COVID-19 pandemic actually increased the demand for lemongrass due to its antibacterial and antifungal properties, leading to its use in hand sanitizers and other products. The cultivation can be economically viable, with potential profits of around $300 per hectare per year. In local markets, the oil can be sold at prices ranging from INR 1500-2000 per liter. The export of lemongrass oil contributes significantly to India's economy, with the export value increasing considerably over the years. The cultivation of lemongrass can provide a significant source of income for farmers, with potential earnings of up to INR 80,000 per acre per year. It has the potential to be a sustainable and economically viable crop for farmers, especially in regions with suitable climatic and soil conditions.

Market survey

Global and National scenario of lemongrass

The global lemongrass oil market size was estimated at $56.3 million in 2024 and is projected to grow at 9.7% CAGR from 2025 to 2034. The expansion of the market relies greatly on oil extraction for cosmetics and personal care products such as lemongrass oil (Global Market Insights).

Source: https://www.gminsights.com/industry-analysis/lemongrass-oil-market

India: Imports & exports of lemongrass

Exports

According to Volza's India export data, India exported 1,023 shipments of lemongrass oil from October 2023 to September 2024. Within this period, in September 2024 alone, 91 lemongrass oil export shipments were made from India. Most of the lemongrass oil exports from India go to the United States, Vietnam, and Australia. Globally, the top three exporters of lemongrass oil are India, Vietnam, and Germany. India leads the world in lemongrass oil exports with 8,701 shipments, followed by Vietnam with 579 shipments, and Germany taking the third spot with 491 shipments.

Imports

World imports most of its lemongrass oil from India, Vietnam, and Germany. Globally, the top three importers of oil are the United States, Vietnam, and India. The United States leads the world in lemongrass oil imports with 2,316 shipments, followed by Vietnam with 1,297 shipments, and India taking the third spot with 568 shipments.

Source: https://www.volza.com/p/lemongrass-oil/import/coo-india/

Chronological account of the intervention by CSIR Lab

The success of lemongrass cultivation in these regions can be attributed to several factors. The cold-chain infrastructure ensured proper storage and transportation, while the Western Ghats' climate naturally minimized pests and increased yield. Improved market linkages to major cities like Delhi, Gujarat, and Punjab further enhanced profitability. By reducing dependence on imports and providing farmers with a high-income alternative, aromatic marigold farming has emerged as a transformative opportunity for agriculture in India's Western Ghats regions. With continued support and expansion, it has the potential to strengthen India's position in the global aromatic market.

The large quantity of planting material, about 10 lakh slips of lemongrass, has been further generated to support the farmers and growers. Therefore, the intervention of IHBT can be summarized as follows:

Varietal improvement - under process

(b) Agronomic practices – Improvement and cultivation practices

(c) Generation of quality planting material – 10 lakh slips

(d) Geographical spread of the technology – 15 hectare

Currently, lemongrass is being grown in the following parts of the country: In the states of Himachal Pradesh, Uttarakhand, Haryana, and Jammu and Kashmir

Presence in Indian states

Number of MTAs:

From April 2021 to March 2025, a total of 11 MTAs have been signed to provide the planting material of lemongrass to the Farmers in the state of Himachal Pradesh, Punjab, and UT of Ladakh (Fig. 3.1).

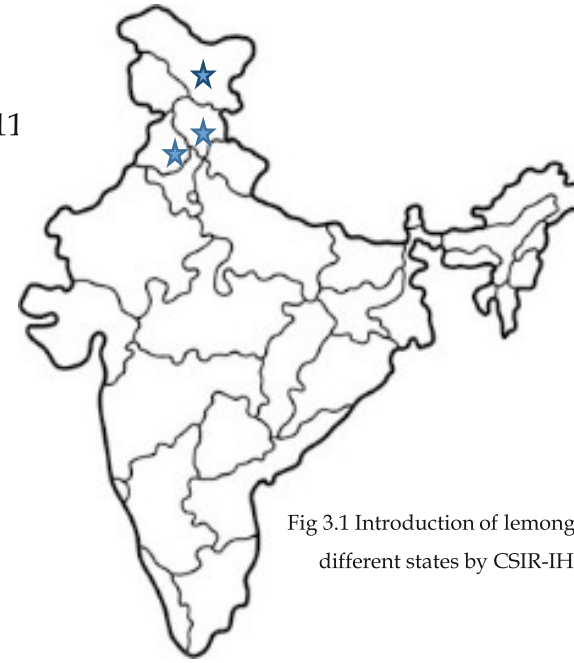


Fig 3.1 Introduction of lemongrassin different states by CSIR-IHBT

Stakeholder mapping

IHBT developed the agro technology for lemongrass over a period of about 4-5 years. Five scientists have been engaged in the development of this agrotechnology.

Agrotechnology:

The CSIR-IHBT has developed the agrotechnology of lemongrass for quality production and multiplication of slips. CSIR-IHBT has developed a package of practices on Lemongrass cultivation, which includes all aspects regarding soil, climate, soil preparation, propagation techniques, time of planting, planting density, planting depth, irrigation, and nutrition. The CSIR-IHBT has been promoting lemongrass cultivation and supporting the farmers by providing bulbs to the interested cultivars.

Initial remarks on assessment of technology

Based on the interaction with the farmers and cultivators, it was evident that the agrotechnology of lemongrass is at TRL 9, indicating it is fully developed. Most of the farmers had started growing lemongrass only 4 years ago and if market access and price stability continue to improve, it has the potential to contribute to enhanced livelihoods, job creation, particularly for women in post-harvest processing and overall rural development.. However, the following was the summary of discussions:

The planting material generated from IHBT was of better quality and at a lower price than that available from private nurseries. IHBT helped in setting up the farms and is providing continuous support in the management of weeds/pests, etc.

On an average annual yield of essential oil of 100 kg/ha and sold at a price of INR 1000/kg during CSIR Aroma Mission Phase-III.

There is a large demand for lemongrass from the pharmaceutical and cosmetic markets, and hence it is lucrative to enter into the business.

Impact evaluation of lemongrass cultivation

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	68	81.25	239	50	15	453.25
Gross Return (Essential oil + planting material) Total (in INR)	12852000	15356250	45171000	9450000	2835000	8566425
Cost of Production (Operational Cost+ Fixed Cost) (INR)	6596000	7881250	23183000	4850000	42510250	8502050
Net return/per year per season (INR)	6256000	7475000	2544000	2544000	2274000	21093000
Employment generation(Direct+Indirect): Total man-days generated season	2700	2700	2700	2700	2700	13500

Socio-economic impact of lemongrass cultivation through CSIR-IHBT's Intervention from 2020-21 to 2024-25:

- Total Area covered under Crop: 453.25 hectares
- Revenue generation/ gross returns from sale of essential oil: INR 85664250
- Net returns (after deducting cost of production): INR 21093000
- Employment generation (man-days): 13500
- Benefit-cost ratio: 1.94

Economic impact of chamomile

Introduction

Chamomile is a popular medicinal and aromatic herb. It is a globally important crop with a growing market driven by its aromatic properties. Its cultivation, particularly on small-scale farms, is widespread, and its trade involves key exporting and importing countries. The industry is also exploring ways to enhance efficiency and manage risks through technologies like mechanized harvesting and weather derivatives. Chamomile (both German and Roman varieties) is cultivated across temperate regions worldwide including Europe, Asia, and the Americas—predominantly on small, family-owned farms. Key producing nations include Egypt, Germany, Hungary, Argentina, and the United States, with Germany supplying around 20% and Egypt about 60% of global chamomile output. The crop is significant in countries such as India especially in the Northern hills and plains of Himachal Pradesh, Uttar Pradesh, Haryana and Uttarakhand where institutions like CSIR-IHBT are promoting smallholder cultivation to bolster rural livelihoods. On the international trade front, Egypt, Germany, and Argentina are the foremost exporters, while Ukraine, the United States, and Russia lead in imports. The global chamomile industry is expanding steadily, fueled by rising demand for herbal raw materials, teas, essential oils, and natural extracts Mechanized harvesting has revolutionized efficiency in major growing regions. Since the 1960s in Germany and subsequent adoption in Argentina and Hungary, self-propelled and tractor-drawn picking machines now achieve harvesting rates of 200–300 kg per hour—covering approximately 3.5 hectares per day and capturing up to 90% of flower heads—vastly reducing labor intensity compared to manual methods.

(Source:pmarketresearch.com; essfeed.com; ebook.icar.gov.in; fr.scribd.com; researchgate.net).

Weather derivatives can be used to mitigate the risk associated with weather impacts on chamomile production. The economics of chamomile processing plants involve various factors, including capital costs, operational expenses and income projections. The horticulture sector, including chamomile, is experiencing growth in various countries, including India, with initiatives supporting farmer development and quality seed production. Dried chamomile powder offers a longer shelf life and flexibility for various applications, including new therapeutic formulations.

Chronological account of the intervention by CSIR Lab

The success of chamomile cultivation in these regions can be attributed to several factors. The distillation ensured proper extraction of oil, and the cold chain infrastructure ensured proper storage and transportation, while the Western Ghats climate naturally minimized pests and increased yield. Improved market linkages to major cities like Delhi, Gujarat, and UP further enhanced profitability. By reducing dependence on imports and providing farmers with a high-income alternative, chamomile farming has emerged as a transformative opportunity for agriculture in India's Western Ghats regions.

With continued support and expansion, it has the potential to strengthen India's position in the global aromatic market.
QPM (10 kg) of chamomile seed has been further generated to support the farmers and growers. Therefore, the intervention of IHBT can be summarized as follows: As per CSIR- Aroma Mission Phase-III
a) Varietal improvement - Him Kanti
b) Agronomic practices – Improvement and cultivation practices
c) Generation of QPM – 10 kg
d) Geographical Spread of the Technology – A 155 hectares area has been covered

Currently, chamomile is being grown in states of Himachal Pradesh, Uttarakhand, Haryana, and Jammu and Kashmir.

Stakeholder mapping CSIR-IHBT developed the agrotechnology for chamomile over a period of about 4-5 years. Five scientists have been engaged in the development of this agro-technology.
Number of MTA - 7

Initial remarks on assessment of technology: Based on the interaction with the farmers and cultivators, it was evident that the agro-technology of chamomile is a

TRL 9, indicating it is fully developed. Most of the farmers had started growing chamomile only 4-5 years ago and if market access and price stability continue to improve, chamomile has the potential to contribute to enhanced livelihoods, job creation, particularly for women in post-harvest processing and overall rural development. However, the following was the summary of discussions:
The planting material generated from IHBT was of better quality and at a lower price than that available from private nurseries.
IHBT helped in setting up the farms and is providing continuous support in the management of weeds/pests, etc.
On an average annual yield (4.08 t/ha), essential oil content (3.49 g/kg), and price (45000/kg) during CSIR Aroma Mission Phase-III
There is a large demand for chamomile flowers from the tea and pharmaceutical market, and hence, it is lucrative to enter into the business.

Impact evaluation of chamomile cultivation

Particulars	2020-21	2021-22	2022-23	2023-24	2024-25	Total
Area expansion (ha)	25	40	0	45	45	155
Gross Return (Sale Price * Total Produce) in Lakhs	6125000	9800000	0	11025000	11025000	37975000
Cost of Production (INR) :Operational Cost + Fixed Cost	3990100	6384160	0	7182180	7182180	24738620
Net return(INR) /per year per season	2134900	3415840	0	3842820	3842820	13236380
Employment generation (Direct + Indirect): Total man-days generated/year or season)	200	200	0	190	180	770

Socio-economic impact of chamomile cultivation through CSIR-IHBT's Intervention from 2020-21 to 2024-25:

- Total area covered under crop: 155 hectares
- Revenue generation/ gross returns from sale of essential oil: INR 37975000
- Net returns (after deducting cost of production): INR 13236380
- Employment generation (man-days):770
- Benefit-cost ratio: 1.53