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An analysis of export performance and market potential of India's floriculture sector

[1]Niranjan Reddy P, [2]Jagadeesh MS, [3]Abhijeet Mudhle and [4]Boya Vaishnavi

[1]PGDM (ABM), National Institute of Agricultural Extension Management (MANAGE), Rajendranagar, Hyderabad, Telangana, India

[2]Government First Grade College, Hebbur, Karnataka, India

[3]Indian Agricultural Research Institute, New Delhi, India

[4]Bharatiya Engineering Science & Technology Innovation University (BESTIU), Gownivaripalli, Andhra Pradesh, India

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Corresponding Author: Niranjan Reddy P

Abstract

Floriculture has emerged as a dynamic sector in India's agricultural economy, offering high-value opportunities for export diversification, employment generation, and sustainable rural development. Despite India's favourable agro-climatic conditions and rich varietal diversity, its share in global floriculture trade remains marginal. This study examines India's production performance, trade competitiveness, and export potential of floricultural products. Utilizing secondary data from sources such as FAOSTAT, ITC Trade Map, and UN Comtrade, the research analyses competitiveness using Revealed Comparative Advantage (RCA) and Revealed Symmetric Comparative Advantage (RSCA) indices, while export potential is estimated through the Panel Gravity Model employing the Poisson Pseudo Maximum Likelihood (PPML) approach. The results reveal that India's total production of floricultural crops reached 695.8 thousand tonnes of cut flowers and 2,160.33 thousand tonnes of loose flowers in 2023–24, with major contributions from West Bengal, Tamil Nadu, Andhra Pradesh, and Karnataka. The global floriculture market is dominated by the Netherlands (47.7%), followed by Colombia (8.8%) and Italy (5%), whereas India's share remains modest at 0.3% of total exports. The RCA and RSCA values indicate that India currently experiences a comparative disadvantage in international trade. However, the PPML gravity results suggest strong positive effects of GDP, EU membership, and trade agreements on export potential, while exchange rate volatility and population size of importing countries negatively influence exports. The findings emphasize that India holds considerable untapped potential in high-value European and Asian markets. Strategic policy interventions—focused on infrastructure, quality certification, and market diversification—can strengthen India's competitiveness, enhance export revenues, and transform floriculture into a globally competitive agri-business segment.

Keywords: Floriculture, comparative advantage, export competitiveness, gravity model, trade potential

1. Introduction

The floriculture domain, from a global perspective, represents one of the most vibrant and rapidly growing segments within agricultural trade, characterized by its high value-addition and significant contribution to agrarian economies. Valued at over USD 50 billion worldwide, the industry encompasses the cultivation and trade of cut flowers, potted plants, decorative plants, and flower seeds. Owing to its rich biodiversity, diverse agro-climatic conditions, and availability of skilled yet cost-effective labour, India enjoys a natural comparative advantage in this field. Over the past few decades, Indian floriculture has transformed from a traditional, small-scale domestic activity into a dynamic, export-oriented enterprise generating substantial foreign exchange and rural employment. Recognizing its potential, India has identified floriculture as a "sunrise industry" and granted it 100 percent export-oriented status.

The liberalization of trade and investment policies has further accelerated this transformation, enabling the establishment of modern, export-oriented floriculture units equipped with greenhouse technology and controlled climatic conditions. The introduction of an innovative seed policy has facilitated the import of high-quality planting materials and global varieties, enhancing productivity and competitiveness. Commercial floriculture has demonstrated significantly higher returns per unit area compared to most field crops, making it one of the most profitable agricultural ventures. India's production pattern is shifting from traditional loose flowers to high-value cut flowers aimed at international markets. Key floricultural crops include roses, carnations, chrysanthemums, gerberas, gladiolus, orchids, anthurium, tulips, and lilies.

The retail flower market in India is estimated to exceed USD 400 million, while the country's international flower trade is worth around USD 100 million. Exports, predominantly consisting of roses and dried flowers, account for approximately USD 30 million annually (Vahoniya, Pangrahy, Patel, and Patel) [1]. The steady rise in demand for floricultural products, driven by increasing living standards and environmental awareness, has made this sector not only economically significant but also

socially and aesthetically valuable. Beyond cultivation, floriculture includes value-added activities such as processing, drying, pigment extraction, and essential oil production for use in the cosmetic, food, and handicraft industries.

Although India possesses substantial natural advantages for efficient flower production, its share in the global flower trade remains a modest 0.6 percent (Patil *et al*.,) [2] Hence, there is a compelling need to analyse India's export performance and explore its untapped market potential. Such an evaluation will provide critical insights into trade dynamics, destination patterns, and value realization, thereby aiding in policy formulation and strategic planning for enhancing India's competitiveness in global floriculture markets.

2. Materials and Methods

This study is entirely based on secondary data collected for the period 2013–2024 from multiple authentic sources, namely the World Integrated Trade Solution (WITS) database, ITC Trade Map, CEPII database, and FAOSTAT. The analysis focuses on evaluating the trade competitiveness and export potential of major flower-exporting countries using both descriptive and econometric techniques.

2.1. Measurement of Trade Competitiveness

To assess the trade competitiveness of flower exports, the Revealed Comparative Advantage (RCA) Index developed by Balassa [3] was employed. The RCA index is one of the most widely used indicators to measure a country's export competitiveness in international trade. It quantifies how competitive a particular product is in a country's export basket relative to its share in global trade. A higher RCA value indicates greater competitiveness, implying that the country has a comparative advantage in exporting that product. The RCA index is calculated using the following formula:

$$RCA = \frac{\left(X_{ij} / X_{ik}\right)}{\left(X_{nj} / X_{nk}\right)} \quad (1)$$

Where,

X_{ij} = Exports by 'ith' country of 'jth'commodity, i.e. floricultural products

X_{ik} = Exports by 'ith' country of a set of 'commodities, i.e. agricultural commodities

X_{nj} = Exports by a set of 'n' countries of 'jth'commodity and

X_{nk} = Exports by a set of 'n' countries of a set of 'k' commodities

However, the RCA index suffers from the problem of asymmetry, as its values are not comparable on both sides of unity. To address this issue, the Revealed Symmetric Comparative Advantage (RSCA) Index proposed by Dalum *et al*. [4] was used. The RSCA index transforms RCA values into a symmetric range between –1 and +1, thereby minimizing skewness and improving comparability across countries and commodities. The RSCA index is computed as follows:

Mathematically,

$$RSCA = \frac{(RCA-1)}{(RCA+1)} \quad (2)$$

2.2. Analysis of Export Potential Using the Gravity Model

To estimate India's export potential and analyze the determinants of bilateral trade flows, the Gravity Model of Trade was employed. Originally introduced by Tinbergen [5] and Pöyhönen [6], and later refined by Anderson [7], Bergstrand [8], and Helpman and Krugman [9], the model is conceptually based on Newton's law of gravitation. It posits that trade flows between two countries are directly proportional to their economic size—measured by GDP—and inversely proportional to the geographical distance between them.

In the model, GDP reflects the market size and economic capacity of trading partners, thus positively influencing trade, while distance captures transport costs and cultural barriers that negatively affect trade flows. To incorporate qualitative aspects of trade, dummy variables such as common borders, shared languages, and colonial ties were included. These variables account for reduced transaction costs and enhanced trade relations, particularly among countries engaged in Free Trade Agreements (FTAs), Melitz, [10].

In this study, the traditional gravity model was augmented following the approach of Irshad *et al*. [11], to better capture the structural and institutional determinants influencing India's floral export potential across major importing destinations.

$$Mexp_{ijt} = \alpha_1 + \alpha 2 \ln Y_{jt} + \alpha_3 \ln(Dist_{ijt}) + \alpha_3 \ln(Exr_{ijt}) + \alpha_4 Entryproc_{ij} + \alpha_5 Popu_{jt} + \alpha_6 EU_{jt} + \alpha_6 \ln(Trade\_Flow)_{ijt} + \alpha_7 Comrelig_{ij} + \alpha_8 Comlong_{ij} + \alpha_9 Comcol_{ij} + \alpha_{10} WTO_{ijt} + \alpha_{11} TA_{ijt} + \varepsilon_{ijt} + \mu_t$$

Where,

Mexpijt = India's millets export to country j in year t

Yjt = GDP of partner country j

Dist ijt = distance between India and partner country

Exr ijt = bilateral exchange rates of India and the partner country.

Entryprocij = Number of start-up procedures to register a business

Popujt = Population of partner country

EUjt = 1 if country currently is a EU member

Trade_Flowijt = Bilateral trade flow (in thousands current US$)

Comreligij = Religious proximity index

Comlongij = 1 if countries share a common language spoken by at least 9% of the population

Comcolij = 1 if countries share a common colonizer post 1945

WTOijt = 1 if country currently is a WTO member

TAijt = dummy variable for trade agreements.

3. Results and Discussion

3.1 Production of Cut and Loose Flowers in India

The production scenario of floriculture in India reveals notable regional variations, reflecting agro-climatic

diversity and market orientation across states (Table 1). The total production of cut flowers in India was 695.8 thousand tonnes, while loose flower production stood significantly higher at 2,160.33 thousand tonnes. Among the major producing states, West Bengal dominated cut flower production with 39.6% share, followed by Andhra Pradesh (13.8%), Chhattisgarh (15.3%), and Uttar Pradesh (10.7%). Tamil Nadu, though ranking lower in cut flower output (6.2%), emerged as a leading producer of loose flowers, accounting for 26.8% of national output.

Similarly, Madhya Pradesh (19.2%) and Karnataka (18.7%) contributed substantially to loose flower production, indicating the rising prominence of these states in the floriculture sector. The dominance of these regions may be attributed to their favourable climatic conditions, improved infrastructure, and proximity to metropolitan markets. The relatively lower share of states like Gujarat (6.3%) and Telangana (2.5%) suggests the potential for expansion through improved varietal introduction, cold chain development, and export-oriented production systems.

The dual production pattern—cut flowers for export markets and loose flowers for domestic consumption—highlights India's diversification within the floriculture segment. Similar to the findings of Jagadeesh *et al.* [12] in millet trade analysis, where regional specialization enhanced competitiveness, the state-wise concentration in specific flower types reflects a comparable trend of production specialization in the Indian floriculture industry.

Table 1: Production of cut and lose flower in India

State	Cut value in (000) tonnes	% share	Lose value in (000) tonnes	% share
Grand Total	695.8	100	2160.33	100
Tamil Nadu	43.2	6.2	579.7	26.8
Madhya Pradesh	0.0	0.0	414.9	19.2
Karnataka	1.1	0.2	404.0	18.7
Andhra Pradesh	95.7	13.8	270.7	12.5
Gujarat	0.0	0.0	136.0	6.3
West Bengal	275.5	39.6	73.4	3.4
Orissa	36.0	5.2	57.0	2.6
Telangana	3.2	0.5	54.8	2.5
Uttar Pradesh	74.4	10.7	54.4	2.5
Chhattisgarh	106.2	15.3	54.2	2.5

Source: National horticulture Board.

3.2 Major Exporters and Importers of Floricultural Products

The global floriculture trade is dominated by a few major exporting and importing nations (Table 2). The Netherlands remained the largest exporter of floricultural products, accounting for 47.7% of world exports in 2023, followed by Colombia (8.8%), Italy (5.0%), Germany (3.8%), and Ecuador (3.8%). India ranked relatively low, contributing 0.3% to global exports. However, its export growth rate of 5% between 2023 and 2024 indicates a steady upward trajectory.

On the import side, the United States continued as the dominant player with 16.9% of world imports, followed by Germany (13.6%), Netherlands (10.5%), and the United Kingdom (7.6%). India's import share was minimal (0.2%) but recorded a remarkably high import growth rate of 61%, reflecting increasing domestic demand for high-value ornamental species and inputs.

The global export pattern signifies Europe's stronghold in both production and trade of floriculture, while the emerging economies—including India—are in the process of building capacity. The Netherlands' high share and consistent growth indicate its advanced logistics, auction systems, and quality standards. Similar to the global tea trade pattern noted by Jagadeesh *et al.* [13], where India led in production but lagged behind in unit value realization, India's low share in floriculture exports underscores the need for value addition, quality certification, and better integration with global value chains.

Table 2: major exporter and importers of floricultural products

Exporters	Exported value (in USD)	% share	Export growth in value *	Importers	Imported value (in USD)	% share	Import growth in value *
World	27.10	100	NA	World	24.65	100	NA
Netherlands	12.91	47.7	4	United States of America	4.16	16.9	4
Colombia	2.39	8.8	13	Germany	3.35	13.6	1
Italy	1.37	5.0	4	Netherlands	2.59	10.5	4
Germany	1.04	3.8	1	United Kingdom	1.86	7.6	3
Ecuador	1.04	3.8	3	France	1.30	5.3	-6
Canada	0.85	3.1	4	Italy	0.95	3.8	-2
Kenya	0.80	2.9	9	Switzerland	0.68	2.8	3
Spain	0.72	2.7	11	Poland	0.66	2.7	12
Belgium	0.69	2.6	9	Canada	0.56	2.3	3
China	0.61	2.2	15	Belgium	0.53	2.1	5
India	0.09	0.3	5	India	0.06	0.2	61

Note: * growth from 2023 values

Source: Computed from ITC Trade map dataset.

3.3 Trade Competitiveness

The trade competitiveness of the world's leading floriculture exporters was evaluated using Revealed Comparative Advantage (RCA) and Revealed Symmetric Comparative Advantage (RSCA) indices (Table 3). The Netherlands consistently maintained a high RCA value of around 7.2 to 8.0 and RSCA values close to 0.76–0.78, confirming its dominant global competitiveness in floriculture. Colombia, a key supplier of cut flowers, exhibited moderate competitiveness (RCA ≈ 0.92; RSCA ≈ -0.04), suggesting a stable but less diversified export portfolio.

India's RCA values ranged between 0.11 and 0.18 throughout 2013–2024, with RSCA values remaining negative (around -0.70 to -0.80). This indicates a persistent comparative disadvantage for India in the international floriculture market. However, the gradual improvement in export growth (5% annually) points to emerging competitiveness, particularly in loose flowers and tropical ornamental plants.

Italy and Germany displayed modest RCA values (1.3–1.5) and RSCA values (0.13–0.21), highlighting a relatively balanced trade position with niche export potential. The consistent leadership of the Netherlands mirrors India's position in the millet sector (Jagadeesh *et al*., 2024), where competitive advantage was sustained through efficient logistics, innovation, and high export quality. For India, improving competitiveness requires investment in post-harvest handling, cold chain logistics, and targeted export incentives to penetrate global markets.

Table 3: Trade competitiveness of major floriculture exporters

Year	India		Netherland		Columbia		Italy		Germany	
	RCA	RSCA	RCA	RSCA	RCA	RSCA	RCA	RSCA	RCA	RSCA
2013	0.13	-0.77	7.20	0.76	0.92	-0.04	1.37	0.16	0.85	-0.08
2014	0.14	-0.75	7.30	0.76	0.92	-0.04	1.31	0.13	0.84	-0.09
2015	0.18	-0.70	7.71	0.77	0.92	-0.04	1.34	0.15	0.88	-0.06
2016	0.18	-0.69	7.45	0.76	0.92	-0.04	1.36	0.15	0.90	-0.05
2017	0.17	-0.70	7.45	0.76	0.92	-0.04	1.43	0.18	0.87	-0.07
2018	0.16	-0.72	7.37	0.76	0.92	-0.04	1.43	0.18	0.91	-0.05
2019	0.18	-0.70	7.28	0.76	0.92	-0.04	1.35	0.15	0.88	-0.06
2020	0.16	-0.72	7.47	0.76	0.92	-0.04	1.40	0.17	0.89	-0.06
2021	0.11	-0.80	7.91	0.78	0.92	-0.04	1.50	0.20	0.85	-0.08
2022	0.16	-0.72	8.02	0.78	0.92	-0.04	1.54	0.21	0.89	-0.06
2023	0.16	-0.72	7.54	0.77	0.92	-0.04	1.43	0.18	0.75	-0.14
2024	0.14	-0.76	7.42	0.76	0.92	-0.04	1.38	0.16	0.74	-0.15

Source: Author's Computations.

3.4 Export Potential Analysis

The **Panel Gravity Model with Poisson Pseudo Maximum Likelihood (PPML)** estimation was employed to assess India's export potential in the global floriculture market (Table 4). Most variables in the model were statistically significant and consistent with theoretical expectations.

The coefficient for distance (ln_dist) was 0.82 and statistically significant ($p<0.001$), implying that India's floriculture exports are positively related to trade distance—contrary to conventional gravity expectations. This suggests that India's exports are more oriented towards high-value distant markets, possibly due to air freight specialization and limited regional demand.

The GDP of destination countries (ln_gdp_d) exhibited a positive and significant effect (0.60; $p<0.001$), indicating that economically advanced nations import more floricultural products, consistent with global trade trends. Conversely, the population of the importing country (ln_popu_d) showed a negative relationship (-0.58; $p<0.001$), implying that smaller, high-income countries constitute the major markets for floriculture.

The dummy for EU membership (eu_d) was positive and highly significant (1.26; $p<0.001$), underscoring Europe's central role in global flower trade networks. Similarly, common language and ethnicity (comlang_ethno) and trade agreements (fta_and_eia) positively influenced exports, highlighting the benefits of cultural and institutional linkages. The WTO membership (wto_d) variable was negative (-2.09; $p<0.001$), suggesting that India's floriculture exports are not strongly driven by WTO-aligned trade partners, possibly due to non-tariff barriers and quality standards.

Exchange rate volatility had a small but significant negative effect (-3.02; p=0.003), indicating that currency fluctuations reduce export competitiveness. Overall, the results mirror the findings of Jagadeesh *et al*. (2024) for millets, where economic mass and institutional connectivity were key determinants of export potential, while distance and exchange volatility constrained trade expansion.

The positive influence of EU markets, free trade arrangements, and shared language indicates that India's export potential lies in high-income European destinations, while infrastructural improvements and compliance with phytosanitary norms could unlock further opportunities in East Asia and the Middle East.

Table 4: Panel gravity model with PPML results

Variables	Coefficient	std. err.	z	P>z
ln_dist	0.82	0.20	4.03	0.000
ln_gdp_d	0.60	0.08	7.55	0.000
ln_gdp_o	-0.22	0.34	-0.63	0.526
ln_popu_d	-0.58	0.10	-5.88	0.000
eu_d	1.26	0.13	9.32	0.000
ln_tradeflow_baci	0.79	0.12	6.86	0.000
comrelig	2.93	3.26	0.90	0.369
comlang_ethno	0.36	0.13	2.87	0.004
fta_and_eia	0.80	0.36	2.22	0.026
scaled_sci_2021_scaled	0.03	0.01	2.87	0.004
comcol	-0.43	0.29	-1.50	0.134
wto_d	-2.09	0.26	-7.94	0.000
entry_proc_d	0.01	0.02	0.32	0.748
exchange_rate	0.00	0.00	-3.02	0.003
FTA	-0.06	0.30	-0.20	0.839
Constant	-19.49	7.71	-2.53	0.011

Source: Author's Computations.

4. Conclusion

The analysis of India's floriculture sector underscores its rising importance within the agricultural export portfolio, combining both economic and environmental benefits. India's total floriculture production reached 695.8 thousand tonnes of cut flowers and 2,160.33 thousand tonnes of loose flowers, reflecting the country's diverse agro-climatic suitability and growing domestic demand. West Bengal, Andhra Pradesh, Chhattisgarh, and Tamil Nadu have emerged as leading production hubs, while newer entrants like Madhya Pradesh and Karnataka show substantial promise.

Globally, the Netherlands remains the undisputed leader in floricultural exports, commanding nearly 48% of global trade, followed by Colombia, Italy, and Germany. India's contribution, though modest at 0.3%, demonstrates steady improvement, with a 5% annual export growth between 2023 and 2024. This upward trend indicates India's growing foothold in the international market, driven by rising investment, technological adoption, and market diversification.

The Revealed Comparative Advantage (RCA) and Revealed Symmetric Comparative Advantage (RSCA) indices, however, reveal that India's floriculture industry remains comparatively disadvantaged in global trade, with RCA values below unity and consistently negative RSCA scores. This highlights the need for structural reforms to improve competitiveness through quality enhancement, varietal improvement, and greater participation in international value chains.

Findings from the gravity model analysis further indicate that GDP and trade integration with high-income countries positively influence India's floriculture exports, while factors such as distance, exchange rate volatility, and population size of importing countries impose constraints. The significance of EU membership and trade agreements suggests that India should strengthen its ties with European partners—particularly in markets like Germany, the Netherlands, and Italy—where the demand for tropical ornamental species is robust.

Overall, India's floriculture sector mirrors the developmental pattern: strong production potential but underutilized export opportunities. To bridge this gap, India must pursue the following strategies:

1. **Infrastructure Enhancement:** Expansion of cold chain, air cargo logistics, and export-oriented clusters.
2. **Quality and Certification:** Adherence to international phytosanitary, sustainability, and packaging standards.
3. **Market Diversification:** Targeting high-value but underexplored markets in East Asia, the Middle East, and Africa.
4. **Policy Support:** Incenti*viz*ing export-oriented production, promoting farmer–exporter linkages, and facilitating access to global flower auctions.

By aligning production efficiency with market intelligence, India can transition from a low-share participant to a globally competitive exporter of floricultural products. Strengthening export competitiveness, ensuring sustainable production, and enhancing trade facilitation will enable India to realize its vast potential in the global floriculture industry—fostering rural livelihoods, generating foreign exchange, and contributing to sustainable agricultural diversification.

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