International Journal of Accounting and Economics Studies, 12 (6) (2025) 1-17

International Journal of Accounting and Economics Studies

Website: www.sciencepubco.com/index.php/IJAES
https://doi.org/10.14419/ab2ax223
Research paper

Economic and Financial Dimensions of Floriculture in Northeast India: Growth, Structure, and Viability

Alorika Deb [1] *, Dr. Durba Dutta [2], Dr. Rabinjyoti Khataniar [3]

[1] Ph.D. Research Scholar, Department of Economics, The Assam Royal Global University, India,
ORCID: https://orcid.org/0009-0005-7217 4215
[2] Associate Professor, Department of Economics, The Assam Royal Global University, India,
ORCID: https://orcid.org/0009-0007-9492-1757
[3] Associate Professor, Department of Economics, B.H. College Howly, Barpeta, India,
ORCID: https://orcid.org/0000-0002-8004-3873
**Corresponding author E-mail: alorika199720deb@gmail.com*

Received: September 11, 2025, Accepted: September 20, 2025, Published: October 1, 2025

Abstract

Northeast India's floriculture sector exhibits uneven growth across states, signaling the need for a deeper examination of its development trajectory. This study analyzes inter-state production trends, market structure, and the financial viability of major floricultural crops in the North Eastern Region (NER) of India. Using panel data from 2011–12 to 2024–25 and indicators such as the Compound Annual Growth Rate (CAGR) and the Herfindahl-Hirschman Index (HHI), the research highlights the growth trend and the balance between cut- and loose-flower production. A qualitative review of secondary sources further explores the financial viability of key flowers, marigold, rose, orchid, anthurium, and gerbera. The results reveal stark disparities: Assam has emerged as the leading state with sustained expansion in both cut and loose flowers, whereas Arunachal Pradesh, Mizoram, and Sikkim have experienced stagnation or decline. A regional shift from loose to cut-flower dominance is evident, driven by targeted initiatives but raising concerns about over-specialization. Economic analyses indicate strong profitability potential, with marigold cultivation in particular capable of generating substantial returns when supported by adequate investment and infrastructure. These findings fill an empirical gap and underscore the need for tailored policies to foster balanced, sustainable floriculture growth across all Northeastern states.

Keywords: *Compound Annual Growth Rate (CAGR); Cut and Loose Flowers; Financial Viability; Floriculture; Herfindahl-Hirschman Index (HHI); Market Structure; Northeast India.*

1. Introduction

Floriculture, though relatively a small subset of global agriculture, has evolved over the years as a fast-growing industry through the adoption of many sustainable practices. Currently, the industry is expanding at an estimated annual rate of 8 to 10 percent on an aggregate level and has reached a market value of USD 60 billion (Kalita, 2019). As per the official data of FY 2023–24, the floriculture sector in India covered approximately 285 thousand hectares, which produced about 2.284 million tonnes of loose flowers (APEDA, n.d.). This growth has clearly demonstrated a positive directional shift by gaining the national prioritization of commercial horticulture.

In India, flower cultivation is predominantly practiced in Tamil Nadu, Karnataka, Madhya Pradesh, and West Bengal, which collectively account for 60 percent of the total production (APEDA, n.d.). These states, forming part of the Indian mainland, have benefited from consistent policy attention and government-led horticultural programmes.

In this contrasting scenario, the North Eastern Region (NER), which comprises Assam, Arunachal Pradesh, Manipur, Meghalaya, Mizoram, Nagaland, Sikkim, and Tripura, is just at its preliminary stage of floriculture. They collectively contribute a marginal share to the country's production. Considering the magnitude of the production, Assam has shown promising results and simultaneously generated rural employment, providing varied avenues of earning, and empowering the women (Rampal & Prasad, 2024). However, variation in production levels across the region raises pertinent questions regarding uneven geographic distribution and the limited harnessing of floriculture resources in multiple North Eastern states.

From an ecological viewpoint, the North Eastern Region (NER) is blessed with its exceptional floral biodiversity and a wide range of agro-climatic zones, stretching from the tropical lowlands to alpine highlands. This natural diversity provides an ideal condition for cultivating both exotic and indigenous flowers, including orchids, anthuriums, marigolds, and roses. Seeing this potentiality, the Government of India launched the Mission for Integrated Development of Horticulture (MIDH), along with its sub-scheme, the Horticulture Mission for North-east & Himalayan States (HMNEH), launched in 2014. These programmes aim to improve infrastructure, expand the area under cultivation, promote protected farming, strengthen post-harvest facilities, and provide technical support. Responding to rising demand and sectoral

potential, the Assam government initiated a Floriculture Mission 2023, aiming to expand the cultivation area from 2,200 ha to 3,288 ha over three years (Business Northeast, 2023, February 1; Yeptho et al., 2025).

Despite these initiatives taken, disparities across the states persist. According to the reports published by the Horticulture departments, the gross value of floricultural output declined by 5–10 percent in five North Eastern states, namely, Arunachal Pradesh, Mizoram, Sikkim, Nagaland, and Manipur, between 2011–12 and 2019–20. In contrast to this, Assam's floriculture output value rose by 251 percent over the same period (Yeptho et al., 2025). Despite the growing interest in floriculture in the North Eastern Region (NER) of India, its cultivation remains unevenly distributed due to the existence of operational challenges. Addressing such challenges becomes arduous since the North-east is linked with the mainland just by one narrow route, the "Siliguri Corridor", also popularly known as the 'Chicken's Neck'.

Given this backdrop, several studies have examined the potential and challenges of floriculture in the Northeast, focusing primarily on operational constraints, supply chain management, and climate-resilient practices. However, limited attention has been paid to analyzing actual interstate growth trends. A notable gap remains in evaluating the sector's performance through empirical data that captures its growth trajectory and market structure. To address this gap, the present study undertakes a quantitative assessment using panel data sourced from statistical databases such as Indiastat (Indiastat, n.d.) and Ministry of Agriculture and Farmers Welfare (Ministry of Agriculture & Farmers Welfare, Government of India, n.d.).

The major indicators used for the assessment were the Compound Annual Growth Rate (CAGR) for studying the growth rate which signifies the trajectory of floriculture in Northeast region, Herfindahl-Hirschman Index (HHI) to gauge market structure and finally this study highlights the financial viability of floriculture in the North Eastern Region (NER) by collectively exploring the cost structures, profitability, Benefit-Cost Ratios (BCR), and Rate of Interest (ROI). The key flower types considered for the research were marigold, rose, orchid, anthurium, and gerbera. The economic-financial relevance of these floral plants was drawn from secondary sources such as journal articles, government reports, and newspaper editorial columns. This empirical investigation seeks to identify the emerging states driving floriculture growth and those that are lagging in floral production in North-East India. Through the empirical interpretation of the long-term trends of area and production and qualitative synthesis of the financial and marketing aspects of the major floral plants, it attempts to explain the entire production scenario of floricultural plants in the North Eastern states. Thus, the findings of this research lay the groundwork for crafting informed policies that foster equitable and economically viable floriculture growth across the region.

2. Literature Review

2.1. Lessons from global floriculture powerhouses

The floriculture sector of several countries provides a global context that highlights diverse industry structures, export dynamics, policy frameworks, and success factors. The Netherlands stands out as a longstanding world leader in floriculture exports. In 2023, the Netherlands exported cut flowers and buds worth approximately €4.55 billion, representing about 46–47 percent of the global floriculture export value (BDO, 2025). This dominant position is underpinned by a highly developed industry structure characterized by cooperative flower auctions (e.g., Royal FloraHolland) and a dense cluster of growers, traders, and logistics firms. The Dutch auction system centralizes distribution and trade, enabling the Netherlands to function as the trading hub of the global flower market (Weiden, 2012). Domestic production accounts for only around 10 percent of the world's flowers, but the Netherlands re-exports blooms from many countries, leveraging advanced supply chains and logistics infrastructure (BDO, 2025; Weiden, 2012). Supportive government policies and historical investments in horticultural research, technology (e.g., greenhouse innovation), and marketing have further solidified the Dutch floriculture industry's success. These factors have allowed the Netherlands to maintain a central role in global floriculture despite the rising competition. Similarly, Kenya offers a contrasting success story from the Global South. Over the past two decades, Kenya has emerged as one of the world's leading cut-flower exporters, especially of roses. Its global market share in flower exports climbed from about 8.6 percent in 2003 to 16.1 percent by 2024, making Kenya a key supplier in international markets (Chatterjee, 2025). Kenyan floriculture benefits from favourable equatorial highland climates (yielding year-round production), relatively lower production costs, and strong foreign investment. Equally important are the export-oriented policies and logistical improvements: the Kenyan government, working with the Netherlands and industry partners, has invested in cold-chain air-freight infrastructure and ensured compliance with European quality standards. Trade agreements (particularly with the EU) that lowered tariffs have enabled Kenyan flowers to compete globally, while improvements in refrigeration and cargo logistics ensure fresh flowers reach markets in Europe and beyond in prime condition (Chatterjee, 2025). These success factors have propelled Kenya to overtake some traditional exporters in terms of volume. Colombia is another floriculture powerhouse, particularly as the dominant supplier to the United States. The Colombian cut-flower industry was developed from the late 1960s and grew rapidly into a major export sector, aided by unique policy incentives. As of the late 2010s, Colombia was providing around 60 percent of all the fresh-cut flowers that the U.S. imports. Out of those flowers, about 4 billion of them were roses, and Colombia shipped that many roses to the U.S. every year (Smiley, 2019). Key success factors for Colombia include its ideal growing conditions (the savanna near Bogotá offers high altitude, consistent equatorial daylight, and fertile soil) and favourable trade frameworks. Notably, the United States granted Colombian flowers duty-free access through measures like the Andean Trade Preference Act (later ATPDEA), as part of a policy to encourage legal crop cultivation over coca production (Smiley, 2019). This policy support, combined with U.S. development aid in infrastructure and technical training, gave Colombian growers a competitive edge in the lucrative North American market. Thus, such international comparisons reveal that thriving floriculture industries share certain features: robust infrastructure and logistics (as seen in the Dutch auction and Kenyan air freight systems), supportive policies and international partnerships (trade agreements for Kenya and Colombia, government-backed innovation in the Netherlands), and leveraging of natural advantages (climate and geography in equatorial countries). These global examples provide valuable lessons and benchmarks for emerging floriculture regions, including Northeast India, to understand the requirements for competing in the floriculture market beyond local boundaries.

2.2. India's floriculture sector and conflicting evidence

Building on these global lessons, India's own floriculture sector shows both promise and points of tension. India's floriculture sector remains modest but exhibits steady growth. The main export categories under floriculture include potted ornamental plants and widely popular cut flowers such as roses, carnations, and orchids. In terms of trade partnerships, the United States, Middle Eastern nations, and European countries, notably the Netherlands and the United Kingdom, remain notable contributors to producing the exotic, high remunerative floral plants. Within India, Karnataka, Andhra Pradesh, and Tamil Nadu lead the industry, housing over 300 export-focused floriculture units (APEDA, n.d.), supported strongly by the availability of extensive greenhouse infrastructure.

Despite overall optimism in India's floriculture literature, there are also notable discrepancies observed in the reported growth rates and assessments of financial viability across different sources. A critical review of prior studies reveals conflicting findings between national-level data and localized research. On one hand, official agencies portray Indian floriculture as a high-growth, high-potential industry. For instance, the Agricultural and Processed Food Products Export Development Authority (APEDA) reports that India's floriculture exports reached about USD 86.6 million in 2023–24 (APEDA, n.d.). APEDA and allied organizations have often highlighted double-digit growth in production and the lucrative nature of floriculture, noting that commercial flower cultivation offers higher returns per unit area than many traditional crops (Misra & Ghosh, 2016). Some industry publications even cited annual growth rates of 8–10 percent for India's floriculture sector during the 2010s (Kalmegh & Singh, 2016). This narrative aligns with national horticultural databases showing a steady increase in areas under flowers and government initiatives (e.g., the National Horticulture Mission) aimed at boosting the sector. By these accounts, floriculture is a sunrise industry poised to uplift farmer incomes and export earnings.

On the other hand, independent studies and state-level data often paint a narrow picture, exposing inconsistencies in the growth story. Several researchers have found that floriculture expansion in India has been uneven and sometimes stagnant. For example, a recent analysis of flower cultivation in Haryana by Snehlata and Ahlawat (2025) found a negative growth trend in area and production of major flowers over 1999–2023. The compound annual growth rates for crops like gladiolus, tuberose, rose, and marigold were negative, contradicting the national narrative of robust growth. Notably, Haryana's floriculture output fell sharply from 76,000 metric tonnes in 2018–19 to only about 18,000 metric tonnes in 2021–22, a decline attributed partly to the COVID-19 pandemic's impact on demand (Singh et al., 2025). This state-level downturn underscores that floriculture's growth has not been uniform across India; some regions have seen contractions or only marginal gains, especially where infrastructure and market access remain limited.

Moreover, assessments of financial viability show divergence between optimistic projections and ground realities. Official sources project floriculture as financially rewarding (high return on investment and profit potential), but field studies indicate that many farmers struggle with the economics of flower cultivation. Kalita (2019), in an empirical study in Assam (Northeast India), observed that most small-scale flower growers continued traditional practices and were hesitant to adopt modern commercial floriculture due to high initial costs, lack of technical knowledge, and uncertain markets. Over one-fifth of the surveyed farmers said that floriculture has no viable future for them, citing the government's indifferent attitude and the high cost of production as the main deterrents (Kalita, 2019). Such findings stand in stark contrast to the national-level optimism. They suggest that without adequate support in the form of training, credit, market linkages, and infrastructure, the theoretical profitability of floriculture is hard to realize for many producers on the ground. Indeed, industry commentators have noted that despite floriculture export growth in recent years, many of India's early floriculture ventures (especially export-oriented units set up in the 1990s and 2000s) have shuttered operations, unable to sustain themselves amid persistent challenges in production and marketing (Kalmegh & Singh, 2016). The co-existence of rising export figures with the closure of many units highlights a contradiction: growth in aggregate metrics has not always translated into broad-based financial success for growers.

Thus, such a critical review of literature exposes clear discrepancies in how the progress of Indian floriculture is reported. National databases and promotional agencies emphasize growth and potential, whereas state studies and independent research reveal constraints and even declines in certain contexts. These conflicting findings underscore the importance of nuanced, region-specific analysis. They call attention to the need for resolving data inconsistencies (e.g., reconciling APEDA export statistics with local production data) and addressing on-the-ground challenges.

2.3. Northeast India: opportunities and initial steps

Within this national context, Northeast India presents a late-emerging but distinctive case. Northeast India's international connectivity was limited due to poor transportation and infrastructure, which made it difficult to export premium flowers from places like Sikkim and Mizoram to other South Asian countries. Until recently, the region had almost no direct international exports. This changed in 2025, when Mizoram sent its first shipment of anthurium plants to Singapore, made possible through an APEDA-supported initiative (Times of India, 2024). This shipment shows that the region's potential was ignored for a long time and that it joined the export market comparatively much later than others. To help Northeast India to connect with the international markets, it is crucial to deal with the micro-level challenges associated with small-scale farming and high transport costs. APEDA has started setting up pack-house facilities to lower air freight expenses and slowly expand the region's market reach.

According to a report published via Data.gov.in (2023), sourced from Rajya Sabha (Session 257, Unstarred Question No. 652), a total of ₹45,372.16 lakhs of financial subsidy was allocated across various Indian states under the Mission for Integrated Development of Horticulture (MIDH) from 2014–15 to 2021–22. This financial support reflected the government's intentions toward building a robust floriculture ecosystem. The highest shareholders of the subsidy were Andhra Pradesh (₹3,500.71 lakhs), Uttar Pradesh (₹5,131.20 lakhs), Maharashtra (₹4,658.23 lakhs), and Tamil Nadu (₹3,396.36 lakhs). Even Northeastern states like Assam (₹1,633.68 lakhs), Sikkim (₹3,102.07 lakhs), and Tripura (₹1,129.41 lakhs) surprisingly received significant support, demonstrating the government's dedication to ensuring balanced regional growth. Regardless of the financial aid received by the North Eastern states, systematic commercial floriculture was atypical throughout the North Eastern Region (NER) until FY 2010, when local demand, government programs, and farmers' awareness observed a substantial rise.

By putting into practice the "plantation of a specialized crop," the floriculture industry in the Northeast area can experience steady growth in production and revenue. According to Chittibomma et al. (2023), floriculture in the Northeast is gradually emerging as a dynamic entrepreneurial sector. The introduction of 700 Anthurium specialized production units through contract farming, along with the successful export of produce from Meghalaya to the UAE, shows how the North Eastern states are progressively moving towards growing high-yielding crops. The stakeholders situated in this region are deploying their household capital into specialized floral agribusiness, indicating a move away from subsidy dependency. The study also suggests promising diversification avenues, including marigold-based extraction of nutraceuticals, tissue culture propagation, and value-added products such as dried flowers. This research proposed a "Floricultural Model" that aligns with the commercial floriculture of the North Eastern Region (NER), having inclusive development goals. Findings highlight the area's preparedness to scale sustainable floriculture through innovation, self-reliance, and socially integrated practices.

2.4. Structural and logistical challenges

The North Eastern Region (NER) of India has the right climate and geography for floriculture, but still suffers from persistent logistical and infrastructural issues that exist inter-state. As highlighted by De and Singh (2016), developing the floral industry in these regions requires well-defined policies, adequate promotional activities, focused market research on locally relevant flower cultivars, and better integration within the markets. Such policies are essential due to the region's difficult terrain, limited private investment, and inadequate

logistical support. Yeptho et al. (2025) have further refined this observation by describing the logistical vulnerability as systemic rather than incidental. The condition of rural transport infrastructure is one of the core challenges. Remote and rural areas often lack proper roads and vehicles, causing delays in flower transportation. These delays are made worse by the absence of cold chain infrastructure, leading to significant harvest losses due to poor storage and a lack of pre-cooling facilities. The absence of direct cargo routes to most North Eastern airports, along with the high cost of air transport to remote rural areas, further isolates regional producers from competitive supply chains. In addition, the lack of training on proper storage, handling, and packaging of goods worsens the quality and marketability of the goods. Producers lack access to reliable market analysis, coordinated aggregation, and marketing support, which leads to fragmented and uncoordinated production.

2.5. Environmental and climate-related vulnerabilities

The floriculture industry in Northeast India faces additional difficulties brought on by environmental and climatic vulnerabilities. In the delicate hill ecosystems of the Eastern Himalayas, the process of growing flower plantations is susceptible. Research concerning climate-related issues warns of the worst outcomes concerning the harvest and even the quality of flowers due to changes in temperature and precipitation. According to an explorative study conducted by Paiva (2023), excessive heat can disrupt normal flowering cycles by dulling petal colour and restricting stem growth, ultimately reducing the commercial value of flowers. Building upon this research, an article featured in Nature India authored by Priyadarshini (n.d.) remarked that during the past decade, the Northeast region has experienced a dramatic increase in extreme temperatures and erratic monsoons. This increase in intense rainfall could lead to a higher incidence of landslides and flash flooding in vulnerable areas. Furthermore, there is a potential risk of completely isolating entire villages by cutting off the routes that would connect them with other horticultural sites. This ecological volatility poses an imminent threat to the cultivation and transportation of flowers, particularly in the hilly districts of Arunachal Pradesh, Sikkim, and Meghalaya. Nath and Datta (2022) mentioned that while the North Eastern Region (NER) is ecologically endowed with a rich diversity of ornamental plants, it is exposed to threats due to the underlying fragile ecosystems, coupled with inadequate infrastructural development (Nath & Datta, 2022; Halder & Yaseen, 2024; De & Singh, 2016). In the floriculture sector, professionals are encouraging the implementation of climate-resilient practices to mitigate growing climate concerns. Ease of operating under extreme weather conditions can be managed with the aid of rainwater harvesting systems, drip irrigation, shade nets, or polyhouses. Other advocates are also encouraging floriculture production with more tolerant varieties to diseases and climate stress. In these ways, mechanization in agricultural production can be obtained even under severe unpredictability.

2.6. Research gap

Although Northeast India offers strong natural advantages for the growth of floriculture, systematic evidence on the sector's long-term performance is still limited. Most existing studies are descriptive, focusing on climatic suitability or broad policy discussions, and provide little insight into how the industry's production and market structure have evolved. In particular, there is a lack of state-wise, longitudinal analysis of growth trends, particularly the compound growth rates, and of the financial viability of major floral crops across the North Eastern Region (NER). Without such empirical assessments, it remains difficult to gauge the region's actual productive capacity or to identify patterns of market concentration and structural change. Filling this gap is critical for informing policy and investment decisions that can transform the region's latent potential into sustained and competitive floriculture development

3. Objectives

- To assess the growth trends in floriculture production across the states of North-East India.
- To examine the market structure of cut and loose flowers across the states of North-East India.
- To explore the financial viability of major floricultural crops from a broader, region-wide perspective in North-East India.

4. Methodology

4.1. Research design

The study follows a mixed-method approach, combining quantitative trend analysis with qualitative contextualization. The first two objectives (growth trends and market structure) are addressed quantitatively using state-level data, while the third objective (financial viability) is explored qualitatively through a narrative review of secondary sources. This interdisciplinary design allows integration of economic data with insights from marketing and governance literature. The qualitative component synthesizes evidence from research studies, government reports, and case analyses to provide a context-rich understanding of the sector's economic potential.

4.2. Data source and scope

The study draws on secondary data sourced from the Ministry of Agriculture and Farmers Welfare, Indiastat, as well as peer-reviewed research papers and news reports. The timeline considered for the quantitative assessment spans from 2011-12 to 2024-25. The selection of this timeline basically relied upon the availability of the data. For the fulfilment of the first and the second objective, data on Area (measured in '000 hectares) and Production (measured in '000 MT) were retrieved from these sources. However, for most of the North Eastern states, continuous year-by-year state-level figures starting from 2011-12 to 2024-25 were not the same for all the states, i.e., some years registered zero production, while others showed an active production which differed across the two categories (cut and loose flower). Thus, to maintain analytical integrity, we treated zero-production years as non-active periods and excluded them during calculation. Specifically, the Compound Annual Growth Rate (CAGR) formula (Refer to Section 4.3) was applied using the first and last available non-zero production values, with the number of periods corresponding to the count of active production years minus one. This approach ensures that trend estimates reflect true production dynamics of the active years of production and are not skewed by intermittent zero-output years. Moreover, certain cut flower production figures reported in lakh numbers were converted into thousand metric tonnes using the conversion rates adopted in the 2012–2013 report of the Ministry of Agriculture & Farmers Welfare, Government of India, n.d., to ensure uniformity of units for calculation purposes. The production of the floricultural crops primarily focuses on two categories: basically, Loose flowers

and Cut flowers. The total production analysis presented in this research is essentially the sum of cut flower and loose flower production. This study focuses on highlighting the market dynamics and growth of floriculture from a production-oriented perspective. For the third objective, the study primarily relied on secondary sources, including published research papers, articles, and other forms of grey literature. These sources were carefully interpreted to provide a summative and comparative assessment of floriculture, with an emphasis given to the financial aspects of major flowers. The analysis incorporated accounting indicators such as the Benefit–Cost Ratio (BCR), Rate of Interest (ROI), and Profitability. These indicators are instrumental in accentuating the financial viability of floriculture in the North Eastern Region (NER). Lastly, the analysis for this research was conducted in Microsoft Excel, accompanied by Python for the graphical representation of the data.

4.3. Economic indicators

This research focused on two major indicators for understanding the growth and market structure of the floriculture industry in Northeast India.

Compound Annual Growth Rate (CAGR)- this indicator intends to measure the average annual growth rate over a multi-year period. In this research, the given variables used for its evaluation are the area of production ('000 hectares) and the production of cut flowers and loose flowers ('000 MT).

$$\text{CAGR}\,(\%) = \left(\frac{X_{tn}}{X_{t0}}\right)^{\frac{1}{N}} - 1, \tag{1}$$

Here, the X_{t0} denotes the value of the variable recorded in the beginning year, and X_{tn} denotes the value of the variable in the final year. N represents the number of periods between the first year and the final year. CAGR is expressed as a percentage. CAGR was computed using the first and last available production figures in the period for each state (ignoring years of zero production).

The Herfindahl–Hirschman Index (HHI) is a standard economic measure of studying market structure, especially the market concentration, used to assess the degree of competition or dominance within a market. In this study, it is applied to evaluate each state's production structure by examining the balance between cut and loose flowers. HHI was calculated for each state-year based on the share of production (by weight) in two categories (loose flowers vs. cut flowers). The index ranges from 0 to 1, with values near 1 indicating strong specialisation in a single category, and values near 0 reflecting a more diversified output. An HHI around 0.5 suggests moderate concentration, where production is neither fully specialised nor evenly distributed. We define S_{loose} as the fraction of a state's production coming from loose flowers, and S_{cut} as the fraction from cut flowers (such that $S_{loose}+ S_{cut}=1$). The HHI is then calculated as:

$$HHI = s_{\text{loose}}^2 + s_{\text{cut}}^2 \tag{2}$$

4.4. Financial indicators

This research also delves into the financial dimensions of adopting floriculture as a full-scale enterprise, with the third objective focusing on the qualitative synthesis of the financial performance of popular floral plants in the North Eastern Region (NER). By integrating insights from secondary sources, it offers stakeholders a clear comparative understanding of the sector's potential to inform future policy decisions. Key financial indicators considered include the Benefit–Cost Ratio (BCR), which compares total benefits to total costs, the Rate of Interest (ROI), which measures the returns relative to investment cost, and lastly profitability (revenue), reflecting net financial gain after expenses.

5. Results and Discussions

Floriculture in Northeast India has traversed multiple stages of development over the years, reflecting both progress and persistent challenges. The growth trajectory of floral production in the region reveals considerable variability, marked by alternating phases of expansion and contraction. To capture this dynamic trend, the present study investigates the year-wise production growth patterns of the two principal categories of floral products, cut flowers and loose flowers, while also undertaking a financial assessment of major plants. By doing so, the research provides a detailed understanding of the floriculture production dynamics, its current market structure, and the cyclical upswing and downswing trends that define the floriculture sector in the region.

5.1. Growth trends of floriculture

Floriculture production in Northeast India is very much limited within the polyhouses and the nursery units (De & Singh, 2016). The maximum saplings that are grown within these units are imported on a larger scale from the main flower-producing states such as West Bengal and Karnataka (Anumala & Kumar, 2021). Thus, there is no proper stability observed in the production of the floral plants in this region. As per the published data by the Ministry of Agriculture and Indiastat, a spontaneous production throughout the years was hardly possible since there was an overdependence on imports. During the time period between 2011 and 2024, the magnitude of production differed across every state of the North Eastern Region (NER). Based on the data reports published by the Ministry of Agriculture and Indiastat it was observed that in Arunachal Pradesh, the active years of production of the cut flowers and the loose flowers were recorded between 2012 and 2018; in Manipur, the production had mostly taken place during 2014 to 2022; similarly, in Meghalaya, it was between 2014 and 2025; and in Tripura, in the recent years starting from 2023 to 2025. In contrast to these states, the production in Assam, Mizoram, Nagaland, and Sikkim has occurred at more regular intervals. However, while estimating the growth trend, it is not usually at par across all the states. As shown in Table 1, the compounded growth rates analysed using the secondary data showed their active years of production (cut flowers and loose flowers) throughout the North Eastern Region (NER).

Table 1: Compound Growth Rates in Northeast Region

States	Cut flower CAGR (%)	Loose Flower CAGR (%)	Active years of production officially recorded
Arunachal	-60.3%	0.4%	2012-2018
Assam	6.9%	9.7%	2013-2025
Manipur	42%	-35%	2014-2022
Meghalaya	-15.5%	0%	2014-2025

Mizoram	-8.0%	–69.23%	2012-2025
Nagaland	23	-92%	2012-2025
Sikkim	-20%	-4%	2012-2025
Tripura	0	0	2023-2025

Compound annual growth rates (CAGR) of loose flower vs. cut flower production (2011–12 to 2024–25) in each North-East Indian state. Positive values indicate expansion, negative values indicate contraction. Assam is the only state with strong growth in both categories, whereas most other states experienced declines, especially in loose flower output (Data source: Ministry of Agriculture & Farmers Welfare and Indiastat).

The growth rates shown in Table 1 clearly show that floriculture in this region is unevenly spread and is very unpredictable in terms of its demand and pricing. While states like Assam and Manipur show positive trends, most of the states in the North-Eastern part of India struggle with poor planning, weak market stability, and high dependence on inputs imported from international markets. During the time span of active production, the growth rate recorded did not follow a linear path of production. Some states were doing well in cut flower production, while others had shifted more towards loose flowers. Sikkim, for instance, is often recognised for its early push towards organic farming and for cultivating high-value flowers like orchids, anthuriums, and liliums (Sharma & Kumar, 2019). However, in practice, the growth of floriculture in the state has remained mostly stagnant as per the observed trend from the data retrieved from the Ministry of Agriculture and Indiastat. Between 2011–12 and 2024–25, cut flower production in Sikkim fell sharply from 1.65 thousand metric tonnes (MT) to just 0.09 thousand metric tonnes (MT). Loose flower production has stayed stable at around 16.5 thousand metric tonnes (MT) per year since 2013–14. This results in a negative compound annual growth rate (CAGR) of –20 percent for cut flowers and –4 percent for loose flowers. But this trend does not reflect a breakdown in the sector; it rather reflects the fact that the state reached its production peak at its early years of active production and could not grow beyond in the later years. Loose flower production, for instance, had already reached 28.3 thousand metric tonnes (MT) in 2012–13 and then declined.

Although the total land under floriculture in Sikkim has remained steady, from time to time, there has been a noticeable shift in focus. From 2013 onwards, the state began promoting marigolds and other traditional flowers for religious use and tourism. Sikkim had initially invested in institutions such as the National Research Centre for Orchids (NRCO) at Pakyong and the Cymbidium Development Centre at Rumtek (Das, 2020), with the hope of building a strong floriculture industry. The state was even declared an Agro Export Zone for floriculture under APEDA. However, the lack of strong cold chain systems, packaging infrastructure, strong climate variability, and export logistics meant that these early efforts did not grow into a large-scale commercial success (Sarmah, 2019). As a result, while Sikkim managed to maintain stable production levels in loose flowers, it may not have built on its early momentum in cut flower exports.

Among all the North Eastern states, Assam has resulted in consistent and balanced progress in floriculture. It recorded a CAGR of 9.7 percent in loose flowers and 6.9 percent in cut flowers. This success is a result of steady expansion in cultivated area, consistent yearly production, and a balanced output of both traditional loose flower cultivation (e.g., marigold, jasmine) and cut flower plantations (e.g., roses, gerbera) in Assam. Indeed, Assam's total flower production grew from virtually nil in 2011–12 to nearly 95 thousand metric tonnes by 2022–23, making it the driver of regional growth. Assam's performance points to a mature ecosystem for floriculture, possibly helped by stronger institutional support like the "Floriculture Mission" and better links to big markets in mainland India. The Assam Floriculture Mission, launched in January 2023, allocates roughly ₹150 crore to bring 1688 ha under commercial floriculture and provide benefits to 20,000 farmers. Moreover, in recent years, a few of the producing companies have provided support to the local farmers and nursery units, most popularly "Indramalati" located in Hajo, covering about 3000 bighas (roughly 400 ha) of marigold, tuberose, gladiolus, and gerbera plantations (Indramalati Agro Producer Company Limited, n.d.). The state also boasts rich natural endowments, with 191 orchid species and the foxtail orchid as its state flower, popularly known as "Kophu phul," highlighting its growing significance in Assamese culture. Moreover, under the "Floriculture Mission," the expansion of floriculture and production will also be recognised in the districts of "Jorhat, Morigaon, Tinsukia, Kamrup, Golaghat, Dima Hasao, Kokrajhar, Sonitpur, Sivasagar, Nalbari, Nagaon, Dibrugarh, Chirang, Karbi Anglong, and finally, Kamrup Metropolitan" as per the interview of the officials of the Directorate of Horticulture published in the news column of Business-Northeast (February 2, 2023). These growing establishments and institutional backdrop have created a relatively mature ecosystem, enabling Assam to sustain on both cut and loose flower segments while gradually reducing its dependence on imports.

Manipur presents a contrasting picture of the floriculture sector in Northeast India. By analyzing the data from the Ministry of Agriculture and Indiastat between 2014 and 2022, the state has witnessed an impressive 42 percent CAGR in cut flower production, primarily driven by its rich orchid biodiversity, home to nearly 300 species across 69 genera (Sahana, 2021). However, this growth was recorded only for a short-run period as production came to a halt after 2022–23, while the loose flower segment declined sharply, with a –35 percent CAGR. The industry's dependence on wild orchid extraction, rather than cultivated sources, made it particularly vulnerable to habitat loss, illegal trade, and inadequate infrastructural support. Despite commendable community-led conservation efforts identifying rare species beyond protected areas, the absence of robust policy backing, investment in nurseries, and cold chain logistics ultimately stalled progress (Sahana, 2021). In contrast to Assam, which appears to have followed a more structured and sustained approach.

Arunachal Pradesh, Meghalaya, and Mizoram show a more intricate pattern of development. Arunachal started strong, producing 17.94 thousand metric tonnes (MT) of cut flowers in 2011–12, but by 2017–18, the output had almost dropped to zero, leading to a –60.3 percent CAGR. Despite its immense floral wealth, an estimated 5000 flowering plants and about 600 orchid species are found in the Eastern Himalayas (Taro, 2021). Arunachal's floriculture has not taken off. A complex land-tenure system, poor market access, and a lack of local awareness hinder commercial cultivation. For instance, many remote communities rely on foraged orchids rather than organised nurseries, and the state's rugged terrain makes logistics difficult (Drema & Kessang, 2025). Experts recommend a cottage-industry model (Northeast Today et al., 2012) supported by research institutes and marketing cooperatives, but until these networks materialise, production remains minimal, explaining why Arunachal recorded a –60.3 percent CAGR for cut flowers and virtually no growth in loose flowers. Meghalaya has not yet capitalized on its full floriculture potential, as reflected in a negative Compound Annual Growth Rate (CAGR) of –15.5 percent in cut flower production. Additionally, the state does not have a significant area allocated to loose flower cultivation (De & Singh, 2016); its production is predominantly limited to cut flowers grown in private nursery units, resulting in virtually zero loose flower output. Recognizing this underperformance, the government launched Floriculture Mission 1.0 in March 2024, with a planned investment of ₹240 crore over three years (Nagaland Post, 2025). This mission focuses on high-value varieties such as Dendrobium, Cymbidium, Vanda, Phalaenopsis orchids, and Oriental Lilium, aiming to revive the sector through targeted interventions. Key components include subsidies of up to ₹7 lakh, development of storage and logistics hubs, and guaranteed buy-back mechanisms to ensure market linkages (Nagaland Post, 2025). However, since the floriculture industry in Meghalaya was largely limited to small-scale farmers before 2019, the benefits of

this policy initiative are not yet visible in the existing production data. The state's current negative growth rates thus reflect historical stagnation rather than the potential outcomes of this late but strategically timed intervention.

In comparison to other North-Eastern states, Tripura and Nagaland show two different scenarios. As per the secondary data provided by the Ministry of Agriculture and Farmers Welfare, Tripura entered the floriculture sector only in 2022–23 but has maintained a steady output of 4.06 thousand metric tonnes (MT) of loose flowers each year, grown on 0.81 thousand hectares. In 2025, Northeast Today reported that in Tripura's Champamura flower village, about 16 farmers grow marigolds on two hectares of land. With help, both money and technical guidance from the government's Mission for Integrated Development of Horticulture (MIDH), about 300 families are now earning from marigold farming on 20 hectares. So far, production has been steady. But it's still unclear if Tripura can grow other types of flowers or expand marigold farming enough to meet the bigger demand. The steady results in recent years show that the government's plan is working well and could help the flower business grow more in the future. While it is unpredictable to judge the long-term growth, the consistency in recent years hints at a well-thought-out policy approach that could scale up in the future. Nagaland, in contrast, saw the highest growth in cut flowers, going from 0.09 thousand metric tonnes (MT) to 33.81 thousand metric tonnes (MT), with a CAGR of 23 percent. But this came with a price: its loose flower production vanished completely, with a –92 percent CAGR. So, even though Nagaland grew fast in one area, it now depends heavily on orchids, which could be risky if that market fails or if problems hit that crop.

This heterogeneity throughout the North Eastern states of India confirms that floriculture development in the North Eastern Region (NER) is not uniform; only Assam (and to some degree Manipur and Nagaland in specific segments) showed robust growth in terms of the official records of the Ministry of Agriculture and Farmers Welfare, whereas most other states plateaued or declined. This finding underscores the necessity of state-specific analysis rather than treating the North Eastern Region (NER) as a monolith.

5.2. Floriculture production trend and market structure

A key aspect of the floriculture market structure is the composition of production, i.e., the balance between loose flowers and cut flowers. Loose flowers (typically sold by weight or volume for garlands, religious offerings, etc.) and cut flowers (sold as stems for bouquets, decorations) often have different market dynamics and value chains. An analysis of North Eastern production composition retrieved from the secondary sources reveals a notable structural transition from loose flower dominance in the early 2010s to a more cut flower-oriented profile in recent years. This structural shift from loose to cut has significant market implications. Loose flower cultivation in the Northeast (e.g., marigolds, chrysanthemums) is typically low-input and geared towards local markets (temples, festivals). Cut flower cultivation (roses, gerberas, orchids), on the other hand, often requires higher investment (greenhouses, irrigation) and targets higher-value urban markets or even exports. The fact that the Northeast aggregate output is now cut-flower heavy suggests a move up the value chain, albeit one driven mostly by Assam's expansion in cut flowers like gladiolus, gerbera, and tuberose for markets in Assam and neighbouring states. Nagaland's recent burst of cut flower production (mostly lilies and roses grown under protected conditions) further tilts the balance toward cut flowers region-wide. Figure 1 shows the Market concentration and diversification of floriculture at the individual state level based on the data published by the Ministry of Agriculture and Farmers Welfare and Indiastat.

Fig. 1: Herfindahl-Hirschman Index (HHI) Heatmap (Cut and Loose Flower Production Concentration).

The HHI heatmap illustrates the concentration dynamics of cut versus loose flower production across the North Eastern Region (NER) from 2011–12 to 2024–25. Green cells indicate high diversification (HHI = 0), yellow/orange represent moderate concentration (HHI = 0.5), and red shows high concentration (HHI = 1), often reflecting dominance of a single flower type.

5.2.1. Assam: balanced diversification and market leader

As per Figure 1, Assam has consistently demonstrated a moderately diversified structure, with loose flowers accounting for approximately 40 percent and cut flowers accounting for approximately 60 percent of total production. This structural balance is reflected in its HHI values, which remain in the narrow range of 0.51 to 0.54 throughout the 2011–2025 period, signalling neither extreme concentration nor fragmentation. The underlying production trend, shown in Figure 2, supports this view: both the area under floriculture and total flower production rose steadily from 2011–12 to 2022–23, before a minor decline in 2023–24, likely due to climatic anomalies or supply chain disturbances. Within this broader growth, cut flower production surged faster and consistently outpaced loose flower volumes, stabilizing above 55,000 metric tonnes (MT) since 2017–18, while loose flower production plateaued near 35,000 metric tonnes (MT).

This dynamic reflects Assam's dual-market base, with large-scale loose flower cultivation concentrated in lower Assam, and cut flower production notably gladiolus, tuberose, and gerbera dominant around Guwahati and other areas of Kamrup district. The structural duality has provided resilience and scalability, enabling Assam to contribute over 55 percent of the region's cut flower output and nearly 30 percent of loose flower production, thereby maintaining its leadership through both scale and diversification.

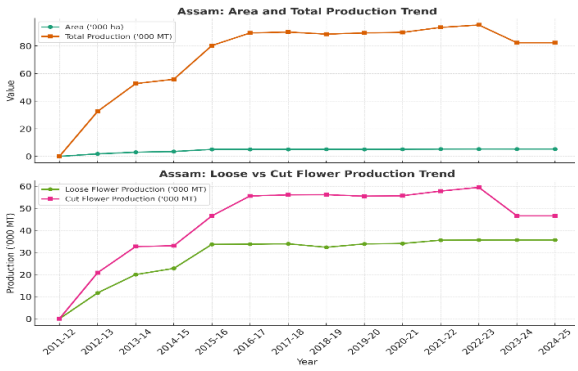

Fig. 2: Assam Production Trend.

5.2.2. Arunachal Pradesh: unstable and highly concentrated

As illustrated in Figure 1, Arunachal Pradesh exhibits a highly volatile and concentrated floriculture structure. In 2011–12, the state's production was entirely composed of cut flowers, pushing its HHI to 1.0, the highest level of concentration. A brief diversification occurred in 2013–14 with loose flowers entering the mix, temporarily reducing the HHI to 0.50, but production volume remained low. From 2015 onward, both the total area and output saw a sharp decline (Figure 3), with only negligible activity recorded thereafter. Cut flowers, primarily orchids and tropical spikes, remained dominant until production ceased altogether post 2018–19.

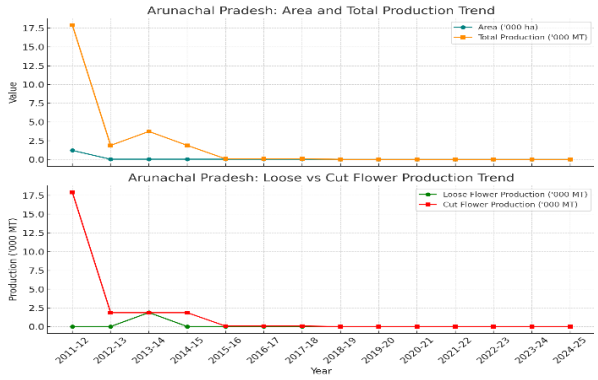

Fig. 3: Arunachal Pradesh Production Trend.

The lack of a resilient or diversified production base left the state vulnerable to decline. Even during the active years, floriculture in Arunachal was limited in scale, scope, and market linkages, and failed to transition beyond pilot-stage activity. The persistently high HHI values (ranging from 0.78 to 1.0) reflect structural dependence on a single crop category. Without sustained institutional support, supply chain infrastructure, or digital and marketing integration, Arunachal's floriculture ecosystem collapsed prematurely, unlike Assam's dual-base model, which thrived on both diversity and volume.

5.2.3. Manipur: erratic structural shifts

As depicted in Figure 1, Manipur presents a highly fluid and transitional floriculture profile, characterized by frequent shifts between loose and cut flower dominance. From 2013–15, production was exclusively loose flowers, reflected in an HHI of 1.0. The period from 2016–18 saw a structural pivot following the introduction of protected cultivation initiatives, which led to a significant rise in cut flower production, notably during 2017–18 when cut flowers captured over 80 percent market share, lowering HHI to 0.68–0.71. However, this trend reversed in 2018–19 when loose flower production rebounded (accounting for 63 percent share), pushing HHI further down to 0.54.

Yet, as shown in Figure 4, this diversification was short-lived. In subsequent years, cut flower production resurged while loose flower volumes declined drastically, resulting in rising concentration and HHI values climbing back up to 0.90–1.0 by 2021–22. The observed production fluctuations are often abrupt, suggesting that Manipur's floriculture expansion has been experimentally driven, shaped more by intermittent funding, pilot projects, and market speculation than by sustained policy or market-led structural transformation. The instability indicates the need for consistent infrastructure, training, and marketing channels to stabilize growth.

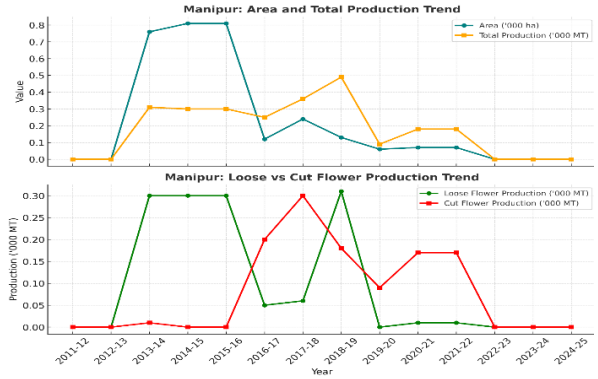

Fig. 4: Manipur Production Trend.

5.2.4. Mizoram: extreme reversal from loose to cut

Between 2012 and 2015, Mizoram's floriculture sector was overwhelmingly concentrated in loose flower production, particularly marigolds. This dominance is evident from both production volume and concentration levels. Loose flowers made up nearly 98–99 percent of total floriculture output, resulting in HHI values between 0.98 and 1.0 (see Figure 1). During this phase, the total production exceeded 180,000 metric tonnes (MT), and the area under cultivation remained stable, showcasing the state's short-lived but intensive investment in floriculture.

Post-2016, the sector witnessed a dramatic reversal. Loose flower production started to collapse, while cut flower production (primarily anthuriums and orchids) gradually took over. By 2018 onwards, cut flowers constituted 100 percent of output (HHI = 1.0), even though the total production declined sharply and cultivated area plateaued near zero. This strategic pivot to greenhouse-based, high-value cut flowers suggests an intentional reorientation toward niche market alignment, but it came at the cost of both output stability and product diversification.

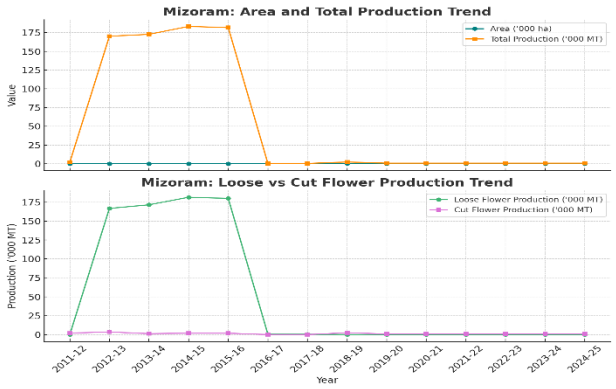

Fig. 5: Mizoram Production Trend.

5.2.5. Nagaland: from diversified to highly specialized

Nagaland's floriculture market has undergone one of the most striking structural transitions in the Northeast region. In the initial years, particularly 2015–16 and 2016–17, the state maintained a relatively balanced mix of loose and cut flowers (60:40), which is reflected in Figure 1 (HHI Heatmap) with values around 0.52–0.55, denoting moderate diversification. However, from 2018–19 onward, Nagaland aggressively transitioned toward cut flower dominance, with HHI peaking at 1.0, indicating a highly concentrated production structure. This shift was supported by greenhouse-based cultivation of lilies, gerberas, and carnations, pushing cut flower output from 8.79 thousand metric tonnes (MT) (2017–18) to 33.81 thousand metric tonnes (MT) (2023–24), a remarkable rise in scale.

The production trend, as visualized in the upper panel of Figure 6 (Area and Total Production Trend), also shows a massive expansion in area under floriculture from less than 0.05 thousand hectares pre-2019 to over 55 thousand hectares by 2024–25. While this expansion has led to a significant boost in total output from just 0.09 thousand metric tonnes (MT) in 2011–12 to 27.62 thousand metric tonnes (MT) in 2024–25, it comes with trade-offs. The complete erosion of loose flower cultivation suggests rising market vulnerability, as dependence on a single category exposes producers to price shocks, disease risks, and shifting demand patterns. While the production scale is impressive, the absence of diversification could hinder long-term sustainability.

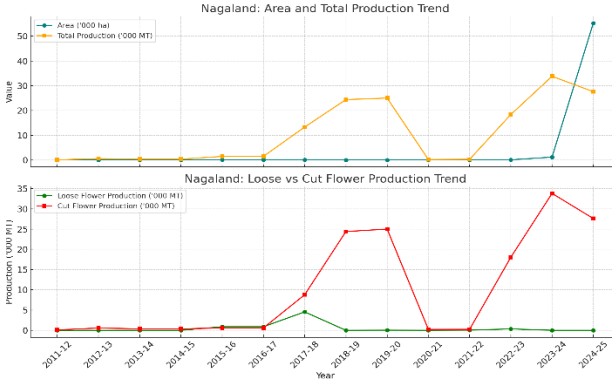

Fig. 6: Nagaland Production Trend.

5.2.6. Sikkim: stable loose flower production

Sikkim's floriculture landscape has shown remarkable consistency over the past decade, with an overwhelming emphasis on loose flower cultivation. As evident from the production data between 2015–16 and 2024–25, the state maintained a near-monoculture setup with annual loose flower production holding steady at 16.5 thousand metric tonnes (MT), while cut flower output stagnated at a mere 0.09 thousand metric tonnes (MT). This enduring structural bias is reflected in Figure 1 (HHI Heatmap), where Sikkim registers a consistently high Herfindahl-Hirschman Index (HHI) of 0.99, underscoring its status as one of the most concentrated production structures in the North-East region. The early spike in 2012–13, when loose flower output peaked at 28.3 thousand metric tonnes (MT), marks a brief deviation, but post-2015, the system settled into a stable pattern. This reflects a strategic alignment with organic, low-input cultivation, often linked to religious rituals, local festivals, and tourism.

The upper panel of Figure 7 (Area and Total Production Trend) highlights this plateau with the cultivated area fixed at 0.24 thousand hectares and total production stabilizing at 16.59 thousand metric tonnes (MT) annually after 2015. While this consistency minimizes

operational volatility and input risks, it comes with a significant opportunity cost, particularly in terms of innovation and market responsiveness. The absence of diversification into cut flower varieties, greenhouse ventures, or export-oriented floriculture suggests that Sikkim's model prioritizes cultural alignment and ecological balance over commercialization. However, in an era of rising floriculture trade and climate-resilient innovations, this lack of adaptive diversification could limit the state's future competitiveness and income scalability.

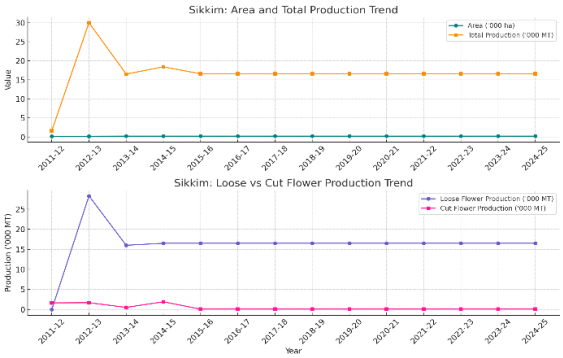

Fig. 7: Sikkim Production Trend.

5.2.7. Meghalaya: cut flower monoculture

Meghalaya's floriculture sector presents a textbook example of high-risk monoculture. As illustrated in Figure 1 (HHI Heatmap), the state consistently records an HHI of 1.0, indicating complete reliance on cut flower production across all years from 2011–12 to 2024–25. The lower panel of Figure 8 confirms this, with cut flower output dominating while loose flower production remains absent. Although early years (2013–2017) showed moderate success with outputs above 2.5 thousand metric tonnes (MT), post-2017 figures reveal a sharp and sustained decline, with production dipping to just 0.35–0.37 thousand metric tonnes (MT). This contraction coincides with market saturation, fluctuating demand, or possible policy gaps.

Despite a significant expansion in area from 0.01 thousand ha in 2018–19 to 12.47 thousand ha post-2019, as shown in the upper panel of Figure 8, total production has not proportionally increased, suggesting declining productivity and inefficiency. This stagnation underscores the fragility of a single-crop strategy in floriculture. With no diversification buffer such as loose flower cultivation, Meghalaya remains highly vulnerable to climatic risks, price volatility, and demand shocks. The data clearly highlights a need for restructuring towards a more balanced and resilient floriculture model in the state.

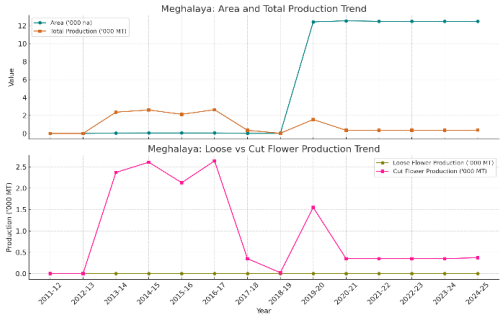

Fig. 8: Meghalaya Production Trend.

5.2.8. Tripura: late entrant and loose flower production

As seen in Figure 1 (HHI Heatmap), the state registers an HHI of 1.0 from 2022–23 onward, indicating complete dependence on loose flower production, a rare case of monoculture dominated by marigold and similar varieties. The lower panel of Figure 9 further validates this, where loose flower output appears suddenly in 2022–23 at 4.06 thousand metric tonnes (MT) and remains stagnant through 2024–25. Notably, cut flower production is absent, marking a deliberate strategic avoidance of high-investment crops.

Despite this focused growth, Tripura's production and area expansion story is quite limited in scale. As depicted in the upper panel of Figure 9, the area under cultivation reaches only 0.81 thousand hectares, with total production plateauing instantly, mirroring the absence of incremental productivity or crop diversification. This static pattern underscores potential risks, as heavy reliance on a single flower type could expose the sector to local demand saturation, pest outbreaks, or price crashes. While the late entry offers room for structured planning, the current monocultural approach lacks the resilience required for long-term market integration and national competitiveness.

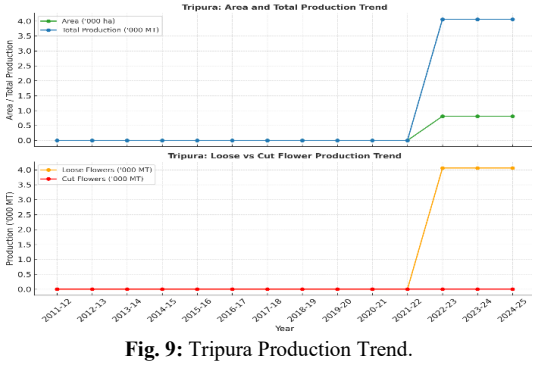

Fig. 9: Tripura Production Trend.

5.3. Financial viability of floriculture

A critical factor determining the uptake of floriculture in the Northeast is its financial viability for farmers and entrepreneurs. This section highlights the viability of major floriculture plants across the eight North Eastern states, drawing on secondary sources such as case studies, reports, research articles, and news articles. This section delves into by highlighting the key indicators such as the cost of cultivation, yield, and price realization, Benefit-Cost Ratio (BCR), net returns, and Rate of Interest (ROI) for major flower types grown in the region. This section focuses on five representative flowers that cover a spectrum of floriculture in the Northeast: marigold, rose, orchid, anthurium, and gerbera. These range from low-cost, quick-turnover crops (marigold) to high-investment, high-value ones (orchid, gerbera).

5.3.1. Marigold: economics and viability

Marigold (Tagetes spp.) is one of the most cultivated flowers in Northeast India, especially in Assam, Tripura, and parts of Manipur. It is a loose flower typically sold by weight or counted in garlands. Marigolds are popular because of their high demand during religious festivals, ease of cultivation, and relatively low input requirements. For small and marginal farmers, marigold often serves as an entry point into floriculture. Financial analyses consistently show marigolds to be a profitable crop under various conditions. According to the study conducted by Haque et al. (2013) on marigold cultivation in Bangladesh (comparable to eastern India's conditions), the BCR was 1.80 on a full-cost basis, meaning every ₹ 1 of cost yielded ₹ 1.80 in gross revenue. On a variable-cost basis (excluding fixed costs such as land rent), the BCR was even higher at 2.57. The per-hectare cost of cultivation was roughly Tk. 1.47 lakh, and the net return was Tk. 1.18 lakh. The net return from marigold was about 80–85 % higher than what farmers would earn from staple crops such as lentil or mustard on the same land (Haque et al., 2013). These figures illustrate why marigolds are attractive and they can nearly double a farmer's profit compared to many food crops, offering a quick cash flow within a single season. In Assam, similar profitability has been observed. Front Line Demonstrations (FLDs) conducted by Assam Agricultural University in farmers' fields have shown that the timing of marigold planting significantly affects returns. For example, Kachari and Mahanta (2020) reported that marigolds planted in March (for summer flowering) yielded a BCR of 4.85, whereas the traditional October planting (for winter flowering) gave a BCR of 3.0. The higher BCR in the March planting was due to off-season high prices in summer when flower supply is relatively low (Kachari & Mahanta, 2020). Marigolds' economics are consistent across the North Eastern states where the climate is suitable. Assam and Tripura enjoy nearly year-round growing conditions (except peak monsoon) and have local markets; hence, farmers see quick payback. According to Debnath (2023) field trials and demonstrations in the North Eastern Region (NER) have reinforced marigolds' viability. For instance, a Krishi Vigyan Kendra (KVK) in Tripura introduced improved practices for marigold (high-yield varieties like Pusa Narangi Gainda, timely nipping of buds, balanced fertilization). The results were a striking yield of about 1.8 million flowers per acre (4.4 million/ha), and net returns were ₹4.23 lakh/acre (₹1.04 million/ha). The cost of cultivation in this case was ₹1.17 lakh per acre, so the BCR came to 4.60:1, i.e., ₹4.6 back for every ₹1 spent (Debnath, 2023). Such promising results are possible since a marigold crop matures in 3 months, allowing multiple cycles or rotations with vegetables. The short turnaround and low risk (marigold is hardy) make its viability high. According to Singh et al. (2013). The main challenge is price volatility during peak festivals (Durga Puja, Diwali), prices soar, but on regular days, they can crash if supply gluts. Organizing farmers into cooperatives can help stabilize prices by timing plantings (as done in some KVK programs) (Singh et al., 2013). As observed through literature and varied other research articles, marigold cultivation in the North Eastern Region (NER) has a healthy financial profile with BCR typically falling in the range between 1.5 and 3.0 under normal conditions (and higher if offseason production is targeted).

5.3.2. Rose: economics and viability

Rose (Rosa spp.) cultivation in the North Eastern Region (NER) represents the mid-tier of floriculture, requiring more care and investment than marigolds, but still widely practiced by small and large farmers alike. Roses have a perennial crop cycle (bushes last several years) and are grown for cut flowers as well as potted/nursery plants. Two broad categories are seen in the North Eastern Region (NER): open-field roses, typically hardy local varieties (e.g., desi red roses) grown for garlands and offerings, and protected cultivation of hybrid roses (tea roses, floribundas) for high-quality cut flowers (Amita et al., 2021; Naveen et al., 2025). The open-field approach, common in Assam and Tripura, has relatively low cost but yields flowers of moderate quality and size. Even so, many North Eastern florists source their daily roses from local open-field producers for routine market demand. Tripura, for example, reports commercial open field rose cultivation in districts like Sepahijala and Gomati (North-Eastern Development Finance Corporation Ltd., 2025), supported by the State Horticulture Department (which provides subsidized inputs to flower growers).

In contrast, protected cultivation of roses under polyhouses has been introduced in parts of the North Eastern Region (NER) to produce long-stem, high-value blooms for the premium market (weddings, bouquets, etc.). This is still in nascent stages compared to India's main rose hubs (Bengaluru, Pune, etc.), but there are successful examples. As observed by the Sikkim government and private growers, polyhouse roses at mid-altitude regions. A detailed economic study by Ghimiray (2015) in Sikkim evaluated rose cultivation in a small greenhouse (approximately 1000 sq ft area) alongside other flowers. The findings indicated that on 93 m², about 13,800 rose stems were produced in a year (cuttings from a few hundred plants). With an average farmgate price of ₹5 per stem, the gross revenue was ₹69,000/year for that area. The cost of cultivation (including prorated greenhouse structure cost, planting materials, manure, labor, etc.) came to ₹39,229 for 1000 sq ft. This yields a net profit of ₹29,770 per 1000 sq ft and a BCR of 1.75. In other words, the rose enterprise returned ₹1.75 for every ₹1 spent, with an ROI of around 75 percent. While this is a healthy profit, it is notably lower than Marigold's returns, reflecting the higher input costs and somewhat limited yield of roses. Scaling those figures, the study implied 1.49 million stems per hectare could be produced under intensive management, costing about ₹42 lakh/ha and yielding perhaps ₹32 lakh/ha net. Such a scale would likely be achieved only by organized growers or cooperatives, given the capital involved (Ghimiray, 2015).

Different farm sizes also affect profitability. The smaller farmers likely optimized family labor and local marketing, reducing costs, hence a better return per rupee. This suggests that smallholders in the North Eastern Region (NER) can profitably grow roses, especially if they leverage family labor and direct sales (e.g., selling garlands or bouquets themselves). Meghalaya and Manipur mention small women-led groups cultivating local roses and selling value-added garlands in town markets, obtaining good margins. Meanwhile, larger commercial rose ventures in the North Eastern Region (NER) are few; one reason is competition from roses shipped in from mainland India. Assam's florists often import premium roses from Pune or Bengaluru for big events, due to consistency in quality and colour variety (Deb & Dutta, 2025). Nonetheless, Nagaland and Sikkim have shown interest in high-quality rose production (Deccan Chronicle, 2014). The Nagaland horticulture department identified rose (especially Dutch varieties) as a focus crop given local demand and the state's mild climate; some districts like Kohima and Dimapur are experimenting with English Roses and hybrid teas in controlled environments. In Sikkim's case,

rose cultivation in open conditions (for domestic use) has a BCR around 1.75 as noted, but in peak flowering season, the profit margin can increase if tourism-driven demand spikes (Sikkim markets often sell roses to visiting tourists and hotels at premium rates).

5.3.3. Gerbera: economics and viability

Plantations such as gerbera and roses are representative cut flowers commonly cultivated under protected conditions (greenhouses or polyhouses) to ensure high-quality blooms. These are capital-intensive crops, requiring substantial investment in polyhouse structures, high-yielding planting material, fertigation systems, and skilled labor.

In the context of Northeast India, the humid subtropical climate presents challenges for rose cultivation, particularly due to high disease pressure. However, with appropriate protected cultivation practices and careful selection of suitable varieties, profitable production is possible. Gerbera jamesonii, a daisy-like flower, thrives especially well in controlled environments and has emerged as a popular commercial flower across several Indian states.

A study conducted by Tiwari et al. (2020) in Madhya Pradesh analyzed the economics of cut flower production (rose and gerbera) under polyhouse conditions, offering insights that can be extrapolated to potential ventures in Northeast India. The study examined costs and returns for an average polyhouse size of 1,200 m² (0.12 ha), with the following key findings:

- Total Cost: Approximately ₹9.09 lakh for gerbera and ₹8.82 lakh for rose per 0.12 ha annually. These costs accounted for greenhouse construction (amortized), planting material, inputs, and labor.
- Annual Production: Gerbera plantations yielded about 409,288 flowers per year from the sample polyhouses.
- Break-Even Analysis: Production levels were significantly higher than the break-even requirement, 108 percent above for gerbera and 76 percent above for rose, indicating strong economic viability.
- Net Profit: ₹5.30 lakh/year for gerbera and ₹3.45 lakh/year for rose (per 0.12 ha).
- Benefit–Cost Ratio (BCR): 1.85 for gerbera and 1.61 for rose, reflecting the relatively higher profitability of gerbera compared to rose in this context.

Overall, the findings demonstrate that protected cultivation of gerbera is more economically rewarding than rose, although both crops can be profitable under polyhouse systems in suitable agro-climatic zones, including the Northeast.

5.3.4. Anthurium: economics and viability

Anthurium (Anthurium andraeanum), an exotic tropical flower, has become a flagship floriculture crop for Mizoram and parts of Nagaland. Anthuriums are typically grown under 60-80 percent shade (shade-net houses) (Lalbiakthangi, 2020), requiring high initial investment for infrastructure and quality planting material (often imported hybrids). They have a long productive life (5-8 years of flowering) and produce unique, long-lasting blooms that are in demand in florist markets. Financial viability of anthurium in North-East India is closely tied to institutional support (Lalbiakthangi, 2020). According to Thanga and Rohmingliani (2015), the commercial cultivation of anthurium in Mizoram took off under government schemes where the state played the role of main facilitator. The Technology Mission provided subsidies for greenhouses, planting material, and training. As a result, Mizoram accounted for around 44 percent of India's anthurium production by 2012-13, indicating a major cluster had developed. The marketing was organized through grower cooperatives (e.g., the Zo Anthurium Growers Society), which helped farmers sell their flowers collectively and access distant markets (Thanga & Rohmingliani, 2015).

From a financial standpoint, anthurium cultivation can be profitable but has thin margins if done without support. The high initial costs pose the biggest challenge. Thanga & Rohmingliani (2015) note that "requirements of high initial investment for equipment, planting materials, etc posed a serious threat to sustainability in the long run". This suggests that without subsidies, the viability might be marginal because paying back the capital cost can be difficult if yields or prices fluctuate. However, with subsidies covering say 50-75 percent of capital cost, the situation improves dramatically.

Empirical data on anthurium farm economics in Mizoram (from local department reports) indicate that a unit with 1000 plants (which might occupy 500 sq.m) can yield around 60-80 flowers per plant per year under good management (this number builds up over time, as young plants yield less). That could translate to 60,000–80,000 flowers annually. If each flower is sold at an average of ₹5 (wholesale, considering some are smaller or lower grade), gross income is ₹3–4 lakh. Input costs (fertilizer, labor, etc.) are relatively low, perhaps ₹1 lakh/year. The main cost to recover is the greenhouse and planting stock investment, which could be on the order of ₹4–5 lakh for 1000 plants, including structure and plants. If that investment is largely grant-funded, the grower mainly covers recurring costs and thus can net ₹2–3 lakh (i.e., BCR well above 2) (Thanga & Rohmingliani, 2015). If the grower had taken a loan for it, the net might go into servicing that loan for several years, making it less attractive in the absence of support.

5.3.5. Orchids: economics and viability

Orchids are among the most valuable floricultural crops worldwide, and in the North Eastern Region (NER) of India, they hold unparalleled ecological, cultural, and economic significance. States like Sikkim, Arunachal Pradesh, and Manipur are natural habitats of diverse orchid species, including Cymbidium, Dendrobium, Vanda, and Phalaenopsis. These species thrive under specific agroclimatic conditions and have been increasingly commercialized through scientific interventions and government support. Cultivation generally requires shade-net houses or polyhouses, along with meticulous husbandry, since orchids take 2–3 years to achieve commercial flowering. However, once established, they provide a continuous supply of blooms for several years, thereby ensuring medium- to long-term profitability (Lepcha, 2020).

Financial analyses from the Eastern Himalayas affirm that orchid farming is not only viable but also highly profitable. Lepcha (2020) reported that small-scale orchid farms in hilly areas, with sizes ranging from 500 to 1000 sq. ft., recorded an Internal Rate of Return (IRR) of 25.38 percent, Benefit–Cost Ratio (BCR) of 1.76, and Net Present Value (NPV) of ₹98,000. The average annual net income from a 1000 sq. ft. orchid unit was about ₹1.98 lakh, with a payback period of 3–5 years, substantially outperforming traditional horticultural crops. Similarly, reports from Sikkim and Arunachal Pradesh show that well-managed cymbidium orchid projects achieve BCRs between 1.5 and 1.8 and IRRs of 20–30 percent, which align with Lepcha's findings (De et al., 2020).

The Northeast is home to more than 800 species of orchids across 151 genera, making it one of the richest reservoirs of orchid biodiversity in Asia (De et al., 2020). Arunachal Pradesh alone hosts over 622 species, followed by Sikkim (543 species) and Meghalaya (389 species) (De et al., 2020). Many of these are endemic or threatened, such as Paphiopedilum fairrieanum and Vanda coerulea, necessitating conservation alongside commercialization. The broader floriculture market underscores the strategic importance of orchids. Globally, orchids represent nearly 10 percent of the cut flower trade, with species like Dendrobium and Phalaenopsis dominating exports from Thailand, Taiwan, and the Netherlands. India, however, continues to import a large share of cut orchids, highlighting the untapped potential of the

Northeast's orchid industry to reduce import dependence and capture export markets (Kamboj, 2018). Thus, orchids in Northeast India represent both a biodiversity treasure and a promising avenue for sustainable livelihoods. By combining conservation measures with structured commercialization, supported by government incentives, technology integration, and global market linkages, the region has the potential to emerge as a hub of orchid-based floriculture in South Asia.

The findings of these five major flowers reveal wide variation in their investment requirements, production cycles, and economic returns within Northeast India's floriculture sector. Marigold offers the most accessible entry point, with low establishment costs, a short growing period, and high benefit–cost ratios, especially when marketed during off-season peaks, making it well-suited for small and marginal farmers seeking quick cash flow. Roses provide moderate but steady profits and require more care and capital; however, their margins are tempered by disease pressure and competition from premium roses imported from other regions of India. Gerbera, cultivated under polyhouse conditions, generates the highest absolute net returns per hectare and a strong BCR, but demands substantial upfront investment and skilled management. At the high-value end, anthurium and orchids command premium prices and have long productive lives, yet their financial viability depends heavily on subsidies or capital to offset high initial costs and, for orchids, the extended time to reach full commercial flowering. These patterns highlight the need for policies and financing mechanisms that recognize the differing risk profiles, capital intensities, and market opportunities of each flower type across Northeast India.

5.4. Challenges underlying the floriculture sector of Northeast India

Despite the positive trajectory in several states, the North Eastern floriculture sector faces significant challenges that need to be addressed to ensure sustainable growth:

- Logistics and Market Access: Perhaps the most cited challenge, as pointed out by Chittibomma et al. (2023), is the inadequate transportation and market linkage infrastructure. Flowers are perishable and require fast transit. In Northeast India, roads in hilly areas are often poor, distances to big markets are long, and cold-chain facilities are scarce. For example, a farmer in Arunachal Pradesh might grow wonderful marigolds, but getting them to the nearest wholesale market (which could be in Assam or West Bengal) may involve an overnight journey on rough roads, during which a significant portion of blooms can wilt. Limited cold storage and refrigerated vans mean flowers cannot be stored to smooth out supply gluts or transported long distances in fresh condition. The PIB press release on Mizoram's export noted that APEDA had to facilitate air transport for the anthuriums to reach Singapore via Kolkata. This kind of support is exceptional and not available for everyday sales (Press Information Bureau, 2025). Most local growers rely on vans and trains at best. The ongoing improvement in connectivity (new highways, rail lines, even air cargo out of Guwahati) will gradually alleviate this, but at present it remains a bottleneck.
- Input Supply and Extension Services: A recurring problem is the lack of quality planting material and technical knowledge. Floriculture often requires specific varieties (for example, long-stem roses, disease-free chrysanthemum cuttings, high-yield marigold varieties). Unlike traditional crops, seeds or cuttings for flowers might not be readily available in local agri shops. Farmers need greenhouses or shade nets to raise saplings, which many do not have. In the North Eastern Region (NER), the agricultural extension network (state horticulture departments, Krishi Vigyan Kendras, etc.) has been trying to introduce new flower varieties, but resource constraints limit their reach. If a farmer plants suboptimal varieties or does not have knowledge of proper crop management (fertilizer, pruning, pest control for flowers), yields and quality suffer. Weak extension support could be one reason some states haven't progressed fast. Farmers stick to low-yield local flower types or use methods that don't maximize output.
- Financial and Economic Viability: Floriculture can require higher initial investment than many field crops. Greenhouses, planting material, irrigation systems, and even packaging for flowers all need capital. Access to credit is a challenge that small farmers in the Northeast often find it difficult to get bank loans for non-traditional farming, like floriculture. There is also an income gestation issue: many flower crops (like orchids or even rose plantations) may take a couple of years to yield full output. Farmers need to sustain themselves until then. If floriculture is seen as risky, credit institutions might be reluctant. Kalita (2019) observed that the lack of finance and insurance makes farmers risk-averse in expanding floriculture. The government has tried schemes like subsidizing polyhouses under MIDH, or providing some grant for planting material, but the scale seems limited.
- Market Structure and Middlemen: The absence of organized markets in the Northeast means farmers often sell through middlemen who collect flowers and take them to Assam or outside. These middlemen might provide convenience, but often at the cost of low farmgate prices (since they take a margin). Kalita's (2019) study noted exploitation by middlemen as a key issue. Without transparent pricing or farmer cooperatives, growers might not get remunerative returns, which in turn demotivates them from investing more in floriculture the following year.
- Socio-cultural Factors: Floriculture in the Northeast also intersects with cultural norms. In some North Eastern Region (NER) states, communities have not traditionally grown flowers as a cash crop. Convincing them to switch from, say, subsistence rice or jhum cultivation to a delicate commercial crop needs extension effort and proof of profitability. Younger, educated entrepreneurs are more likely to take up floriculture as a business (as evidenced by many floriculture startups in Manipur/Arunachal reported in the media), but they need an ecosystem to succeed. Land tenure can be a problem too in tribal areas, land might be community-owned, making individual long-term investment in floriculture difficult (because one needs secure land rights to invest in a polyhouse). This was pointed out as a "lack of uniform land tenure system" affecting floriculture in a study.
- Sustainability and Climate Concerns: While not immediately evident in this research, climate change looms as a concern. Higher temperatures or unseasonal rains can shift flowering seasons and pest incidence. Ensuring that floriculture development is climate-resilient (through, for example, selecting hardy varieties or implementing protected cultivation) is critical. Also, environmental impact needs monitoring; for instance, floriculture can involve high use of fertilizers and pesticides for perfect blooms, which, if unchecked, could harm the Northeast's fragile ecosystems. An emphasis on organic floriculture (as Sikkim might pursue) could be a niche but requires more effort for pest control.

5.5. Future implications

Despite the challenges, the Northeast's floriculture sector stands at an optimistic inflection point. The growth in multiple states suggests a momentum that policy can further catalyse. Here are some opportunities and implications drawn from the analysis:

- Specialization and Branding: Each North Eastern state has unique climatic niches and could specialize in different flowers, reducing direct competition and creating a diverse regional supply. Assam has strength in year-round marigold and tube rose production (used heavily in ceremonies) and can further develop loose flower supply chains. Sikkim and Arunachal have cool climates suited for high-end orchids and bulbs (gladiolus, lilies), which can target not just Indian metros but export markets in neighbouring countries. Tripura

and Manipur could focus on greenhouse cut flowers like gerbera, roses, and carnations for the Eastern India market, taking advantage of improved connectivity to Kolkata. If such specializations are developed, the North East Region (NER) can become a "bouquet" of complementary products rather than redundant producers of the same flowers. This ties to an opportunity to brand North Eastern flowers, for example, "Sikkim Orchid", "Mizoram Anthurium" or "Meghalaya Floral Greens", tapping into the exotic appeal of the region. With appropriate geographical indication (GI) tags or collective branding, these could fetch premium prices.

- Market Linkages and Export Potential: The recent example of Mizoram's anthurium export shows that if quality standards are met and logistics arranged, the Northeast can directly access international markets (especially Southeast Asia, which is geographically closer). North Eastern Region's (NER) proximity to Southeast Asian countries could be turned from a geographic challenge (distance from the Indian heartland) into an advantage (gateway to ASEAN) (Asian Development Bank, 2022). For instance, Thailand, a floriculture hub, imports certain flowers; the North Eastern Region (NER) could potentially supply niche products to Southeast Asia or China's south-west. The central government's Act East Policy and improved border trade infrastructure (like the India-Myanmar border trade post at Moreh, Manipur) (Das & Bordoloi, 2015) can facilitate this. APEDA's involvement in the Mizoram case is a blueprint for having such institutional support for other states (like organizing buyer-seller meets, inviting international florists to Northeast flower shows, etc.), which can open new channels. Export-oriented growth would also encourage adherence to quality norms, benefiting the industry's professionalism.
- Digital Marketplaces and Supply Chain Digitization: Digital platforms are revolutionizing the floriculture supply chain by connecting growers directly with buyers, reducing reliance on intermediaries, and improving price realization for farmers. E-commerce and digital supply chain (Singh et al., 2025) solutions enable real-time inventory management, transparent transactions, and access to broader markets, including exports. For Northeast India, fostering digital marketplaces can help overcome geographic isolation, reduce information asymmetry, and facilitate integration with national and international buyers.
- Infrastructure Investments: The study's findings could justify targeted infrastructure investments. Tripura's floriculture can grow by establishing a floriculture auction centre or hub in Tripura that could help stabilize prices and encourage more production (like how a flower auction in Jaipur boosted marigold trade in Rajasthan). Likewise, states with high volatility might need more pack houses and cold storage at cluster levels to buffer oversupply and reduce wastage. The government could consider a scheme under HMNEH specifically dedicated to floriculture infrastructure (for instance, subsidizing refrigerated transport on certain routes on specific days to move flowers to major markets). Additionally, fostering digital marketplaces where Northeast flower growers can connect with wholesale buyers in real time might reduce the information asymmetry and reliance on middlemen.
- ESG (Environmental, Social, and Governance) Considerations: ESG frameworks are becoming central to the global floriculture industry, influencing investment, market access, and consumer preferences. Integrating ESG principles means adopting sustainable production methods, ensuring fair labour practices, and maintaining transparent governance structures (Li et al., 2021). For Northeast India, ESG adoption can enhance the sector's reputation, attract responsible investment, and open premium markets that demand traceability and ethical sourcing. Digital transformation is shown to significantly improve ESG performance by enabling better environmental monitoring, social impact tracking, and governance transparency. Institutional support and policy incentives for ESG compliance, such as certification schemes, carbon tracking, and circular economy initiatives, can further professionalize the sector and align it with global sustainability standards.
- Skill Development and Extension: Given the observed disparities, a knowledge mission could be launched. The Indian Council of Agricultural Research (ICAR) can strengthen its outreach via the Krishi Vigyan Kendras (KVKs) in each North Eastern state to train farmers in floriculture best practices. Exposure visits for Northeast farmers to floriculture centres in Bangalore or Pune could be organized to learn successful models. More locally, farmers within the Northeast could be networked – e.g., Assam's experienced farmers could mentor those in Arunachal or Nagaland. The success stories need to be propagated: if one village in Tripura prospered through floriculture, others should know. Governments and NGOs can act as facilitators in this knowledge exchange. Encouraging the formation of cooperatives or FPOs (Farmer-Producer Organizations) in floriculture will help overcome scale issues in input purchase and output marketing.
- Financial Incentives and Insurance: To mitigate the high risk, insurance products for floriculture should be introduced. Crop insurance coverage in floriculture is currently minimal. Innovative products, possibly with government premium support, could encourage farmers not to abandon the crop after one bad year. On credit, banks could be incentivized to lend for floriculture by including it under the priority sector with some interest subvention, at least in the initial years. Microfinance and self-help groups could also be involved in supporting women floriculturists, as floriculture is often very suitable for women entrepreneurs (for instance, in Mizoram, a lot of anthurium growers are women, which has been a boon for their empowerment).
- Integration with Tourism and Allied Sectors: Northeast India's tourism is on the rise, and floriculture can tie into that. Flower festivals (like the Anthurium Festival in Mizoram or the Cherry Blossom Festival in Meghalaya) not only celebrate local blooms but also draw tourists and create local market spikes. These should be further promoted, and perhaps every state can develop a signature flower festival. Agro-tourism involving flower farms (similar to how travellers visit tulip gardens in Kashmir or orchidariums in Sikkim) could provide additional income to growers and raise the profile of Northeast floriculture. Moreover, linking floriculture with the floristry industry (bouquet makers, event decorators) in the region can create local value chains so that a greater portion of the final consumer price stays in the region. Currently, a lot of high-end flower arrangements in North Eastern's urban markets use flowers shipped from elsewhere; with local production up, local florists should be encouraged to source North Eastern-grown flowers, which requires ensuring consistency and quality.
- Climate-Resilient Practices: The floriculture sector is highly vulnerable to climate change, with shifting weather patterns affecting flowering cycles, productivity, and quality. Climate-resilient practices such as breeding stress-tolerant varieties, adopting controlled environment agriculture (e.g., greenhouses, hydroponics), and implementing precision irrigation are critical for sustaining production in the face of these challenges. Integrating climate-smart agriculture and digital monitoring systems can help farmers adapt to environmental stressors, reduce resource use, and maintain consistent quality, which is vital for both domestic and export markets.

6. Conclusion

In conclusion, the floriculture sector in Northeast India presents a complex yet compelling narrative of uneven growth, structural transition, and financial opportunity. Assam has emerged as a regional frontrunner, demonstrating sustained expansion in both loose and cut flower production, underpinned by dedicated policy initiatives, institutional engagement, and improved market access. In contrast, other states such as Arunachal Pradesh, Mizoram, and Sikkim, despite possessing favourable agro-climatic conditions and biodiversity, have

experienced stagnation or contraction, often due to logistical constraints, limited infrastructure, and inconsistent policy support. The shift from loose to cut flower cultivation across the region signals an attempt to align with higher-value markets; however, this transition remains fragmented and largely dependent on individual state-level capacities. Economic assessments indicate that floriculture can be a financially viable enterprise, particularly for plant crops such as marigolds and gerberas, which require lower investment and offer quicker returns. High-value crops like orchids and anthuriums also show promise, provided there is adequate technical support and infrastructural investment. A key limitation of this study is that the analysis is confined to officially recorded production data sourced from the Ministry of Agriculture and Farmers Welfare and Indiastat. Consequently, the findings do not capture unregistered, informal, or subsistence-level cultivation, which may be significant in certain districts and communities. While the results provide a robust overview of the formal floriculture landscape, further micro-level field studies are necessary to capture the full breadth of activity in the region. The future research direction should include assessing economic profitability and employment generation in floriculture. Ultimately, the success of floriculture for the region will be measured by farmer incomes and jobs created (especially for women and youth). Studies on cost-benefit analyses in each state for different flower crops would be valuable for guiding farmers on what to grow. Another direction is exploring floriculture's ancillary industries like essential oil extraction from flowers (e.g., citronella, lemongrass, which some North Eastern states already grow, and aromatic flower oils), dried flower crafts, and nursery trade (selling saplings of ornamental plants). These can diversify income for floriculture farmers and protect them against fresh flower market risks.

Authors' Contributions

Alorika Deb conceptualised the study, conducted the data analysis, and prepared the initial manuscript draft. Dr. Durba Dutta provided supervision, methodological guidance, and critical revisions to the manuscript. Dr. Rabinjyoti Khataniar contributed to the interpretation of results, refinement of the analytical framework, and final approval of the version to be submitted.
All authors have read and approved the final manuscript.

Conflict of Interest

The authors declare that there is no conflict of interest related to the content, authorship, or publication of this research.

Data Availability Statement

The data used for this study were obtained from publicly accessible secondary sources. The primary datasets were sourced from the Ministry of Agriculture and Farmers Welfare, Government of India and Indiastat. These sources contain officially recorded data on area and production of floricultural crops, including cut and loose flowers, for the period 2011–12 to 2024–25. The authors confirm that no proprietary or confidential data were used in the analysis.

Funding

The authors declare that no funding was received from any public, private, or non-profit organisation for the conduct of this research.

References

[1] Amita, V., Bahadur, V., Fatmi, U., & Singh, D. (2021). Varietal evaluation of different floribunda rose (Hybrid teas × Polyanthas) under Prayagraj agro-climatic condition. International Journal of Current Microbiology and Applied Sciences, 10(1), 3028–3035. https://doi.org/10.20546/ijcmas.2021.1001.352
[2] Anumala, N. V., & Kumar, R. (2021). Floriculture sector in India: Current status and export potential. The Journal of Horticultural Science and Biotechnology, 96(5), 673–680. https://doi.org/10.1080/14620316.2021.1902863
[3] Asian Development Bank. (2022). *Assam: India's gateway to ASEAN*. Manila: ADB. https://www.adb.org/publications/assam-india-gateway-asean
[4] APEDA (Agricultural and Processed Food Products Export Development Authority). (n.d.). Floriculture & seeds. https://apeda.gov.in/Floriculture-AndSeeds#:~:text=As%20per%20National%20Horticulture%20database,24
[5] BDO. (2025, June). Dutch Floriculture & Horticulture Market Research – Market Analysis Report. BDO Netherlands. https://www.bdo.nl/getmedia/e2555664-14d3-422a-a580-283ce9517ef8/BDO-Floriculture-Horticulture-Market-Research-June-2025.pdf
[6] Business Northeast. (2023, February 1). Assam cabinet approves floriculture mission. https://www.business-northeast.com/assam-cabinet-approves-floriculture-mission#:~:text=Within%20three%20years%2C%20it%20will,2%2C200%20hectares%20to%203%2C288%20hectares
[7] Business-Northeast. (2023, February 2). 15 districts selected for Assam Floriculture Mission. https://www.business-northeast.com/15-districts-selected-for-assam-floriculture-mission
[8] Chatterjee, R. (2025, March 7). How Kenya is fuelling global romance with fresh flower exports. Logistics Update Africa. https://www.logupdateafrica.com/trade/how-kenya-is-fuelling-global-romance-with-fresh-flower-exports-1354684
[9] Chittibomma, K., Naorem, C., Singh, H. B., et al. (2023). Opportunities and challenges in the floriculture industry for entrepreneurship development in the North East Region of India. International Journal of Statistics and Applied Mathematics, 8(6), 1340–1346. https://doi.org/10.22271/maths.2023.v8.i6Sr.1568
[10] Das, R. B., & Bordoloi, A. K. (2015). Opportunities of border trade in North East India: With special reference to Indo-Myanmar border trade. World Journal of Research and Review (WJRR), 1(1), 4–11. https://www.researchgate.net/publication/386274923_Opportunities_of_Border_Trade_in_North_East_India-_With_Special_Reference_to_Indo-Myanmar_Border_Trade
[11] Das, C. (2020, August). Know all about the land of orchids – Sikkim. Krishi Jagran. https://krishijagran.com/agripedia/know-all-about-the-land-of-orchids-sikkim/#:~:text=National%20Research%20Centre%20for%20Orchids
[12] Data.gov.in. (2023). State/UTs-wise details of the financial assistance provided for cultivation of flowers under MIDH Scheme (2014–15 to 2021–22). Government of India – Open Government Data Platform. https://www.data.gov.in/resource/stateuts-wise-details-financial-assistance-provided-cultivation-flowers-open-conditions
[13] Deb, A., & Dutta, D. (2025). Socio-economic dynamics and profitability of floriculture: A study of Kamrup Metro, Assam. The Review of Contemporary Scientific and Academic Studies, 5(1), 1–13. https://www.researchgate.net/publication/388406590_The_Review_of_Contemporary_Scientific_and_Academic_Studies_1_Socio-Economic_Dynamics_and_Profitability_of_Floriculture_A_Study_of_Kamrup_Metro_Assam

[14] Debnath, A. (2023). Adopting commercial floriculture as an alternative source of livelihood in North Tripura District, Tripura. Ecofarming e-Magazine, 3(3), 1–4. https://ecofarming.rdagriculture.in/wp-content/uploads/2023/06/1-Adopting-commercial-floriculture-as-an-alternative-source-of-livelihood-in-North-Tripura-District-Tripura-.pdf

[15] De, L. C., & Singh, D. R. (2016). Floriculture industries, opportunities and challenges in Indian hills. International Journal of Horticulture, 6(13), 1–9. https://www.researchgate.net/publication/335422505_Floriculture_Industries_Opportunities_and_Challenges_in_Indian_Hills

[16] De, L. C., Rao, A. N., & Singh, D. R. (2020). Endangered orchids and their conservation in North East India. ICAR–National Research Centre for Orchids. https://www.researchgate.net/publication/306232070_Endangered_Orchids_and_Their_Conservation_in_North_East_India

[17] Deccan Chronicle. (2014, February 14). North-East demands 2 lakh red roses for Valentine's Day. https://www.deccanchronicle.com/140213/lifestyle-relationship/article/north-east-demands-2-lakh-red-roses-valentines-day

[18] Drema, L., & Kessang, D. (2025). Orchids of Arunachal Pradesh: Diversity, economic potential, and medicinal benefits. Indian Farmer, 12(1), 12–16. https://indianfarmer.net/uploads/ORCHID.pdf

[19] Ghimiray, S. (2015). Economics of floriculture in Sikkim (Master's thesis, Sikkim University). Sikkim University Digital Repository. https://dspace.cus.ac.in/jspui/bitstream/1/3147/1/Suman%20Ghimiray.pdf

[20] Halder, B., & Yaseen, Z. M. (2024). Long-term climate change analysis in northeast and eastern India. Geomatics, Natural Hazards and Risk, 15(1). https://doi.org/10.1080/19475705.2024.2409206

[21] Haque, M., Miah, M. M., Hossain, S., & Alam, M. (2013). Economics of marigold cultivation in some selected areas of Bangladesh. Bangladesh Journal of Agricultural Research, 37(4), 711–720. https://doi.org/10.3329/bjar.v37i4.14395

[22] Indiastat. (n.d.). Indiastat – socio-economic statistical database. Datanet India. Retrieved from https://www.indiastat.com/

[23] Indramalati Agro Producer Company Limited. (n.d.). [Company profile page]. https://atmsagro.org/PromotedFPCs/indramalati/#:~:text=The%20average%20land%20holding%20per,3000%20bighas%20of%20cultivable%20land.

[24] Kachari, M., & Mahanta, S. (2020). Popularization of marigold cv. Seracole for income generation through front line demonstration in Assam. International Journal of Chemical Studies, 8(5M), 894–896. https://doi.org/10.22271/chemi.2020.v8.i5m.10409

[25] Kalita, A. (2019). Problems of growth of floriculture business: A study from Assam. Open Access Journals. https://www.rroij.com/open-access/problems-of-growth-of-floriculture-business-a-study-from-assam.php?aid=87475

[26] Kalmegh, R., & Singh, P. (2016). Challenges and Obstacles in Indian Floriculture Industry (Conference paper). https://www.researchgate.net/publication/385003908_Challenges_and_Obstacles_in_Indian_Floriculture_Industry

[27] Kamboj, D. (2018). Dendrobium and Vanda orchids as potential cut flowers in the North Indian market (Master's thesis, MHU, Karnal). https://www.researchgate.net/publication/340315656_Dendrobium_and_Venda_Orchids_as_potential_cut_flower_in_North_Indian_Market

[28] Lalbiakthangi, M. (2020). Institutional arrangement and support for production of Anthurium in Mizoram. International Journal of Applied Research, 6(1), 161–169. https://www.allresearchjournal.com/archives/2020/vol6issue1/PartC/6-1-43-641.pdf

[29] Lepcha, A. (2020). Economics of flower cultivation with special reference to orchid in hilly areas of West Bengal. Economic Affairs. https://doi.org/10.46852/0424-2513.3.2020.11

[30] Li, T.-T., Wang, K., Sueyoshi, T., & Wang, D. D. (2021). ESG: Research progress and future prospects. *Sustainability, 13*(21), 11663. https://doi.org/10.3390/su132111663

[31] Ministry of Agriculture & Farmers Welfare, Government of India. (n.d.). Area and production of horticulture crops. https://agriwelfare.gov.in/en/StatHortEst

[32] Misra, D., & Ghosh, S. (2016). Growth and export status of Indian floriculture: A review. Agricultural Reviews, 37(1), 77–80. https://www.researchgate.net/publication/296626671_Growth_and_export_status_of_Indian_floriculture_A_review. https://doi.org/10.18805/ar.v37i1.9269

[33] Nagaland Post. (2025, August 6). Meghalaya CM announces Rs. 240 crore for Floriculture Mission 1.0. https://nagalandpost.com/meghalaya-cm-announces-rs-240-crore-for-floriculture-mission-1-0/

[34] Nath, M. K., & Datta, H. S. (2022). Advances in Indian floriculture with focus on the North-East region. Research Biotica, 4(3), 108–112. https://www.researchgate.net/publication/364071036_Advances_in_Indian_Floriculture_with_Focus_on_the_North-East_Region. https://doi.org/10.54083/ResBio/4.3.2022/108-112

[35] Naveen, M. P., Patil, S. R., Patil, B. C., Balaji, S. K., Meti, S., Mahesh, Y. S., & Babu, A. G. (2025). Performance of different floribunda rose varieties for growth parameters, pest and diseases under northern transitional zone of Karnataka. International Journal of Advanced Biochemistry Research, 9(2), 155–157. https://doi.org/10.33545/26174693.2025.v9.i2c.3749

[36] North-Eastern Development Finance Corporation Ltd. (NEDFi). (2025, June). Preparation of project profiles for floriculture industries in the North-Eastern Region: Executive summary [PDF]. https://www.nedfi.com/wp-content/uploads/2025/06/Cover-ES.pdf

[37] Northeast Today. (2025, March 21). Tripura's Champamura blossoms into a flourishing flower village at Bishalgarh. https://northeasttoday.in/north-east/tripuras-champamura-blossoms-into-a-flourishing-flower-village-at-bishalgarh/

[38] Oyi, D., Gibji, N., Sunya, B., & Karma, C. (2012). Floriculture prospects in Arunachal Pradesh with special reference to orchids. Journal of Biodiversity and Environmental Sciences, 2(3), 18–32. https://www.innspub.net/wp-content/uploads/2022/02/JBES-V2-No3-p18-32.pdf

[39] Paiva, P. (2023). Climate change as a challenge for floriculture [Editorial]. Ornamental Horticulture, 29(1), e202329010. https://doi.org/10.1590/2447-536x.v.29i1.2590

[40] Press Information Bureau. (2025, March 22). First-ever export of Anthurium flowers from Mizoram to Singapore, a fillip to India's floriculture potential. Ministry of Commerce & Industry. https://www.pib.gov.in/PressReleasePage.aspx?PRID=2113965

[41] Priyadarshini, S. (n.d.). Risks mount as climate change hits the high Himalaya. Nature. https://www.nature.com/immersive/d44151-024-00033-7/index.html (accessed 19 September 2025)

[42] Rampal, A., & Prasad, K. V. (2024). Harnessing floriculture potential of Northeastern India. Indian Horticulture, 68(6), 76–83. https://epubs.icar.org.in/index.php/IndHort/article/view/148523

[43] Sahana. (2021, February 18). Conserving rare orchids through community participation in Manipur. Mongabay-India. https://india.mongabay.com/2021/02/commentary-conserving-orchids-through-community-participation-in-a-manipur-village/#:~:text=India%20www,data%20that%20they%20are%20distributed

[44] Sarmah, D. (2019). Status of floriculture in Sikkim. International Journal of Applied Research, 5(10), 249–252. https://www.allresearchjournal.com/archives/2019/vol5issue10/PartD/5-10-9-367.pdf

[45] Sharma, M., & Kumar, S. (2019). Floriculture as a profession: Demographic factors affecting floriculture business in Sikkim. Asian Journal of Managerial Science, 8(2), 74–78. https://doi.org/10.51983/ajms-2019.8.2.1548

[46] Singh, A. K., Singh, M. K., & Singh, R. R. (2013). The economics of marigold flowers in Eastern Uttar Pradesh. The Journal of Rural and Agricultural Research, 13(2), 75–78. https://jraragra.in/Journals/journal%2075.pdf

[47] Singh, H., Singh, T., & Sood, Y. (2025). Smart floriculture: Emerging technologies and future prospects. Journal of Experimental Agriculture International. https://doi.org/10.9734/jeai/2025/v47i23278

[48] Smiley, S. (2019, February 14). When a Rose Isn't Just a Rose: How Trade Policy was Used to Fight Drugs from Colombia. TradeVistas (CSIS). https://tradevistas.org/rose-how-trade-policy-was-used-to-fight-drugs-from-colombia/

[49] Snehlata, & Ahlawat, V. (2025). Trend of growth and instability in area and production of flower crops in Haryana. International Journal of Agriculture and Nutrition, 7(4), 31–40. https://www.agriculturejournal.net/archives/2025.v7.i4.A.217/trend-of-growth-and-instability-analysis-of-area-and-production-of-flowers-crop-in-open-field-in-haryana. https://doi.org/10.33545/26646064.2025.v7.i4a.217

[50] Taro, K. (2021). Biodiversity of Arunachal Pradesh and its conservation. *Dera Natung Government College Research Journal, 6,* 79–85. https://doi.org/10.56405/dngcrj.2021.06.01.08

[51] Thanga, J. L. T., & Rohmingliani. (2015). Economics of anthurium flower cultivation in North Eastern India. International Journal of Management and Social Science Research Review, 1(11), 77–81. https://www.researchgate.net/publication/351970522_ECONOMICS_OF_ANTHURIUM_FLOWER_CULTIVATION_IN_NORTH_EASTERN_INDIA

[52] Times of India. (2024, April 29). Mizoram exports 1st consignment of anthurium. https://timesofindia.indiatimes.com/city/guwahati/mizoram-exports-1st-consignment-of-anthuriam/articleshow/118610493.cms

[53] Tiwari, Y., Awasthi, P. K., & Pandey, P. R. (2020). Economic analysis of cut flower (rose and gerbera) production under polyhouse in Jabalpur district of Madhya Pradesh, India. Asian Journal of Agricultural Extension, Economics & Sociology, 37(4), 1–5. https://doi.org/10.9734/ajaees/2019/v37i430284

[54] Tripura Info. (2025, March 21). Champaramura blossoms as Tripura's new flower village: Farmers find new livelihood in marigold cultivation. https://northeasttoday.in/northeast/tripuras-champamura-blossoms-into-a-flourishing-flower-village-at-bishalgarh/

[55] Weiden, D. van der (David). (2012, December 3). Business Cycles within the Dutch Floriculture Industry. Business Economics. Retrieved from http://hdl.handle.net/2105/18588

[56] Yeptho, K. H., Keditsu, R., A. R. M., & Hemanta, L. (2025). Supply chain of cut flowers with special reference to North-Eastern Region (NER): A case study. International Journal of Advanced Biochemistry Research, 9(2), 269–282. https://doi.org/10.33545/26174693.2025.v9.i2d.3771