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Supply chain of cut flowers with special reference to north-eastern region (NER): A case study

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Abstract
The Northeastern region of India, with its unique biodiversity and congenial climatic conditions, holds immense potential for floriculture development. The floriculture sector has been blossoming in the area, significantly contributing to the regional GDP through promising employment, income opportunities, and sustainable livelihood. Among the flower crops, high value and low volume crops are promising in the North-Eastern region some of which include orchids, roses, lilies, bulbous ornamentals, anthurium, gerbera, baby's breath etc., and can be viewed as a prospective commercial hub. However, floriculture is at a nascent stage in the north-eastern states of India. To realise its potential, a well thought out strategy involving all stakeholders and government support is required. The current supply chain of floriculture crops in the NER is very complex involving many stakeholders between farmers and consumers causing price rise and value degradation. Poor road conditions, non-availability of vehicles, lack of cool chain facilities and high air logistic costs are also major hurdles in promoting floriculture crops in the region. Thus, the current study reveals the status of lucrative enterprises in the area, identifying and highlighting the problems and challenges faced by the floriculture sector in the NER.

Keywords: Cut flowers, floriculture, north-eastern region, supply chain

Introduction

Floriculture has blossomed into commercial activity with a considerable growth and a useful crop diversification option and is being viewed as a high-growth industry both for the domestic as well as export markets. In the past, floriculture was always considered an object of joy and beauty, always firing up human emotions and imagination. The demand for flowers has gone up with liberalization, due to changes in lifestyle, increases in income level, corporate culture, increase in the standard of living, increase in purchasing of individuals, increase in educational status, etc. Floriculture has proved to be a prosperous occupation in different regions of India where it has been pursued professionally. The sector also promises sustainable livelihood. It not only ensures present occupation and earnings but also makes way for scope of employment and income opportunities in the future by utilizing local strength and resources. Mudde (2007) [26] remarked floriculture has prospects in income, employment generation and production. The government of India has initiated the Council of Scientific & Industrial Research (CSIR) floriculture mission in 21 states and union territories wherein agro-technologies, new floral varieties and value addition technologies are being made available to farmers and entrepreneurs, and help them multiply their income (Editorial, Invest India Outlook, 2022) [10]. On the count of value addition, Mohapatra (2022) [25] also stated that floriculture should go hand in hand with bee-keeping and indigenous processing and value-addition technologies and the production of high-value compounds with nutraceutical or pharmaceutical properties needs to be developed in collaboration with the CSIR labs. Sudhagar (2013) [48] reported on the vast opportunity of the floriculture business in India where the demand exceeds supply. Therefore, the government has in recent years recognized floriculture as an extreme focus segment for development initiatives and declared it as a sunrise sector, with a 100% export-oriented status.

The hill regions include Himachal Pradesh, Jammu & Kashmir, Uttarakhand and the North-Eastern Region (NER) comprising states of Arunachal Pradesh, Assam, Manipur, Meghalaya, Mizoram, Nagaland, Tripura and Sikkim. Agro climatology of the North-East is much more suitable for commercial floriculture and ornamental horticulture. The region has great potential to become one such hub of commercial floriculture that can be comparable to Holland and the Netherlands due to its similarity in climatic conditions. The need for providing artificial cooling can be done away with due to its mild climate around the year (Sarmah, 2019) [44]. Almost all the hilly states of the region have favourable climatic conditions for the commercialization of flower cultivation (Mishra and Misra, 2008) [23]. North-east regions are endowed with rich natural resources, congenial climate, sufficient land, cheap labour and other inherent strengths that make these areas extremely conducive to floriculture. Despite the wealth of natural resources and climatic diversity, economic development in the region is the poorest of the rest of the country. Climate change, declining crop yields, poverty and unemployment are putting pressure on natural resources. As a result, natural resources in the region are under threat. To achieve the vision and goals of the blooming floriculture sector in the hills of the north-eastern region, strategies like the development of improved cultivars and the generation of quality planting materials can be implemented. The development of farmer's friendly production technologies can also aid in the progress of the sector (Ram and Aier, 2017) [38].

The globalisation of the Indian economy has opened up new markets and improved access to agricultural machinery and inputs, especially seeds and planting materials from all parts of the world. The demand for floriculture products has increased manifold in national and international markets. Sporadic but impressive attempts to develop floriculture have begun in several states in the region. (Sharma, 2020) [45] stated that there is a need to make quality planting materials available to farmers at affordable prices. (Nath and Datta, 2022) [29] observed that support to individual growers, grower's associations or co-operatives and marketing federations in the form of transport subsidy, packaging units, technology and promotional activities is critical for the development of sustainable floriculture marketing system in north-eastern region of India. However, to realise the potential of floriculture in North-east India, a well thought out strategy involving all stakeholders and government support is required (Prasad and Rampal, 2023) [37].

Among the flower crops, high value and low volume crops are promising in the North-Eastern region and can be viewed as a prospective commercial hub. Large variety of flowers can be grown round the year at open and protected environments at low cost leading to increased availability of varieties of good quality flowers to consumers at affordable prices. Prajapat (2012) [35] reported that process like flower cultivation, storage, processing, product development and marketing should have clear chain. As flowers are being highly perishable open cultivation must be directly attached to the storage and processing unit. Patwardhan (2012) [34] observed cut flowers have market potential. The export of cut flowers can give good foreign exchange reserve. Misra and Ghosh (2016) [22] observed that the production and business of floricultural products have been increasing consistently. They opined that to make it sustainable business, new strategies must be followed which can give good results in long run. The region has the potential to grow almost all types of flowers, some of which include orchids, roses, lilies, bulbous ornamentals, anthurium, gerbera, marigold etc. Mizoram and Meghalaya have already started commercial cultivation and export of anthurium, and lilium in Nagaland, and cymbidium orchids in Sikkim. Shirui lily (*Lilium mackliniae*), a rare and endangered species endemic to Manipur only, is found in their natural habitat. Marigold and tuberose are the thrust flowers in the state of Tripura.

Cut flowers industry is dynamic, fast-developing, and global which contains the major flower supply chain of growers, wholesalers and retailers. Rao (2012) [39] in his study remarked floriculture business has a high scope as there is internal consumption and export potential which can help develop the farming community. Harisha (2017) [14] also observed various factors restricting the growth of floriculture. Despite a strong productive base, the low performance is the result of the non-availability of proper space and the shortage of airlines. Fresh cut flowers are extremely perishable because they preserve mere limited life-supporting processes by taking water up through their stems (Sirisaranlak, 2017) [46]. The importance of quality at the point of sale will determine the price of cut flower not when it is harvested to decrease the risk of flowers losing their value, the temperature issue necessity to be sensibly considered (Hulst, 2004) [17]. SADC (2004) [43] states that cut flowers are extremely perishable produce and can solitary preserve exact limited life-supporting practices, therefore significantly relying on effective and rapid distribution channels, and outstanding cold chain management systems. During the transportation of cut flowers from the grower to the end customers from around the world, cool supply chain management is essential for preserving the cut flower quality (Musoke, 2010) [28]. The supply chain management for temperature sensitive products requires fast decisions making; products are transported within hours. Consequently, the flower market is a critical challenge for the supply chain to manage temperature control and time constraints for cut flowers as highly perishable goods.

However, floriculture as a profession is at a nascent stage in the North-eastern states of India. Economic upliftment of a community with the help of the existing inputs has proved to be inadequate in these areas. New avenues like floriculture can offer an added impetus in this regard which is being held back by certain factors that need to be addressed to ensure economic welfare. The National Horticulture Board (NHB), APEDA, NABARD, and nationalized banks are the key financial resources for establishing the floriculture business in India. APEDA facilitates the marketing exports and the development of the floriculture industry by providing quality certification, market intelligence and logistical support.

Scenario of Floriculture Sector in the North-Eastern Region (NER)

According to the gross value of output (GVO) of Agriculture and Allied Sectors report, the value of floriculture in the country has increased by 55% from ₹ 17,365.38 to ₹ 26,987.41 crore in 2019-20. Though exports have increased by a similar proportion in the last nine years, its share in value remained around 2%. India's floriculture exports increased by 48% to ₹ 541.61 crore in 2019-20 from ₹ 365.32 crore in 2011-12. The gross value of output (GVO) of floriculture in the Northeastern states, except Assam, has declined by 5-10% between 2011-12 and 2019-20. Assam is the only state that recorded a growth of 251%. The total value of floriculture in Arunachal Pradesh, Mizoram, Sikkim, Nagaland and Manipur has declined by 31% and Sikkim saw a decline of 34%. (National Statistical Office Data, 2022) [31].

The status of floriculture in North-Eastern Region is described below:

Arunachal Pradesh

Arunachal Pradesh has been termed as the *'Orchid Paradise of India'*. Around 622 species of orchids have been reported from the state. The climatic conditions of Hapoli (Ziro) are suitable for growing cymbidium orchids. Renades "Arunodaya," Arachnocentron "Tipi Jubilee Star," Esmeranda "Millennium Dawn," Cymbidium Sessa "Green Beauty," and Ascocenda "Tipi Blue Boy" are among the five-hybrid genus that have been registered with the Royal Horticulture Society (RHS) in London produced from Orchid Research Centre, Tipi (Oyi *et al.*, 2012) [33]. A centre for the conservation and propagation of wild orchids of Arunachal Pradesh was inaugurated by Agriculture and Horticulture Minister Tage Taki on September 2021. The state government is focusing on the cultivation of cut flowers such as orchids, gerberas, anthuriums, and carnations, among. On an institutional basis, significant research works are conducted by the College of Horticulture and Forestry, CAU contributing to the development of floriculture in the state.

Assam

Floriculture is a sunrise area in Assam. Flower growing is a tradition in Assam's Hajo (flower capital), located in Kamrup district. Earlier people from Hajo used to supply their floriculture produce to the Kamakhya temple. Presently, the region has emerged as the most important flower-growing region on a commercial scale, feeding 30% of Guwahati's floral market. Cultivators of Kamrup district are entering into commercial floriculture followed by Jorhat, Tinsukia, Morigaon, Nagaon and Cachar (Talukdar, 2017) [50]. Daffodil Nursery established in the year 1985 has emerged as the prominent and biggest nursery in the state catering to the demands of quality planting materials. Assam Agricultural University (AAU) has immense contributions to the development of the floriculture sector in the state. The state government launch Floriculture Mission in the year 2023 to increase the area under flower cultivation and improve infrastructure for flower growers in the state.

Nagaland

Early on, floriculture in Nagaland was just considered as a housewife's activity in the confines of their home. But the sector in the state received attention and made tremendous strides when the Department of Horticulture through the support of the Ministry of Agriculture & Farmers Welfare, Govt. of India introduced commercial floriculture through the Mission for the Integrated Development of Horticulture Scheme in the year 2014. Consequently, there are over 1000 officially registered flower growers in the state who have conglomerated under the aegis of Flower Growers Societies in different districts and have strived forward to blossom into successful entrepreneurs (Dept. of Horticulture, GoN, 2018). Flower shows are held by the Department of Horticulture every year to promote commercial flower, foliage, and decorative plant production (De and Singh, 2019) [7].

Mrs. Akruzo Putsure founded a society named the Blossoms Florist Society after touring Holland's auction and breeding facilities. Society has presently developed a high-tech playhouse to grow flowers like roses, liliums, *etc.* for the export market. Carnations, heliconias, alstroemerias, orchids, baby's breath and other exotic flowers also have potential as there is a huge demand in the market both within and outside the state, as is evident by the mushrooming of florist shops in almost every nook and corner of the state. Bloom Bazaar, an initiative of the Investment & Development Authority of Nagaland (IDAN) started in the year 2023 is specifically designed to boost the floriculture market and foster entrepreneurship. Also, research works are done by the Central Institute of Horticulture and School of Agricultural Sciences (SAS) to promote the development of floriculture in the state.

Manipur

The state has the advantage of being India's 'Gateway to the East' through the city of Moreh, as this is the only viable land route for trade between India and Myanmar and other Southeast Asian countries. Shirui lily, a rare and endangered species of lily was registered for GI in 2017. Dendrobium species have shown promise in the state when it comes to orchids. Orchid species are being preserved at Orchid Preservation Centre, Khonghampat. Dendrobium, carnations, anthuriums, gerberas, leather leaf ferns, and alstroemerias are supplied by the Flower Growers Association of Manipur through the Bangalore-based Florence Flora under buy-back arrangements to several metropolitan cities such as Delhi, Kolkata, Bangalore, and others (De and Singh, 2019) [7].

Meghalaya

Flower cultivation in the state started only with the launch of the Horticulture Mission in the year 2001. It has established Horti Hubs & Farms under the district Horticulture office, which serves as model farms and learning centres for farmers. A total of 13 Horti-hubs have been established in the state (Syiem and Marak, 2016) [49]. The climatic conditions in the state favours the growth of various cut flowers crops like anthuriums, roses, orchids, carnations, and liliums (De and Singh, 2019) [7]. Model Pilot Projects boosted the production of roses and anthuriums in the state.

Model Pilot Project on rose: It is located at the Dewlieh Horticulture farm, in Umsning, Ri Bhoi district, 30 km away from Shillong, set up in 2004, to demonstrate the viability of commercial cultivation of roses as well as a step destination for training and collection centre for existing and potential growers. An average of 2000 roses per day are distributed for farms serving as viable revenue generators too (Kumar and De, 2006) [19].

Model Pilot Project on anthurium: It is located at Samgong Horticulture Farm, on the outskirts of WilIiamnagar, East Garo Hills. This is an attraction for local farmers as well as for visitors with 3 shade net houses covering a total area of 4000m^2 and 40,000 plants, the project is growing 8 varieties of Anthurium from Anthura, Holland. It acts as a demonstration and training centre for farmers of this exotic flower (Kumar and De, 2006) [19].

Mizoram

The climatic conditions of Mizoram are suitable for growing almost all types of flowers like anthuriums, roses, bird of paradise, orchids etc., round the year. At present, more than 400 farmers are growing anthurium within the state. Anthurium and rose cultivation have become popular among the farmers of the state. The climatic conditions of the state are suitable for the growth of various types of orchids. Further, the state can focus on Cymbidiums at higher hills and Dendrobium and Phalaenopsis at lower state hills (Prasad and Rampal, 2023) [37]. Annual Anthurium festival is held to promote flower cultivation in the state. Anthurium growers have formed a society named 'Zo Anthurium growers Society' (ZAGS) for smooth marketing of the cut flowers (Nath and Datta, 2022) [29].

Sikkim

Sikkim has been declared as an Agro-Export zone with a focus on floriculture (Lama, 2004) [20] and (Misra, 2013) [24] stated that it is worth noticing the efforts which have been led by government to make floriculture blossom in Sikkim, which not only enhances the beauty of state but also is helping farmers to make alternative livelihood. Cultivation of orchids and anthuriums has long been popular in Sikkim. Government has established Cymbidium development and model floriculture centres in the state for promotion and coordination of critical activities like varietal screening, technology upgradation training, skill development and dissemination of knowledge to the farmers (Choubey and Ghimire, 2017) [4]. In Rangpo, East Sikkim, an Integrated Pack House has been established to ensure minimal post-harvest losses and quality flower production. Moreover, rose villages have been developed to encourage farmers to adopt scientific based rose cultivation on commercial basis under the supervision of the State Department of Horticulture (Sarmah, 2019) [44]. The National Research Centre for Orchids (NRCO) has developed protocols for the cultivation and preservation of 500 plus species of orchids in the state which also include the famous *Dendrobium nobile* (consider as state flower). It has 35 poly houses which keeps more than 800 varieties of orchids found all over the world. The orchids here are provided by the government solely for research purposes and not for commercial use. These are later returned to the government or given away to local farmers. It has developed more than 11 distinct hybrids of orchids over the years.

Tripura

Commercial production of flowers such as marigold, tuberose and gladiolus, has received much interest in open fields. Flower exhibitions are held annually to revitalize floriculture. Nath Para, a village in the Laxmibil area of the Sepahijala district has turned out into a model floriculture village with the villagers earning around Rs. 20,000-30,000 per month by exporting their products. This is the only village in the state where the farmers only cultivate flowers (Nath and Datta, 2022) [29].

Table 1: Area and production of flowers in the North-East region.

State	Area ('000 ha)	Production ('000 MT)	
		Loose flowers	Cut flowers
Arunachal Pradesh	0.00	0.00	0.00
Assam	5.32	35.70	46.58
Manipur	0.07	0.01	0.17
Meghalaya	0.07	0.00	0.26
Mizoram	0.08	0.00	0.80
Nagaland	0.04	0.00	0.24
Sikkim	0.24	0.09	16.50
Tripura	0.56	2.75	0.00

***Source*:** DAC & FW, Ministry of Agriculture Cooperation and Farmers welfare, Govt. of India, (2nd Advance Estimate, 2023-24).

Supply Chain (SC)

Large contingents of management experts have expressed their understanding of supply chain and supply chain management. Christoper and Martin (1993) [5] stated that the supply chain represented an intricate network of suppliers, distributors and customers who shared carefully managed information about demand, decisions and performance, and who recognized that success for one part of the supply chain meant success for all. Beamon (1999) [2] defined the supply chain as an integrated process where raw materials are transformed into final products and delivered to customers. A supply chain typically consists of inbound distribution or logistics, firm operations, outbound distribution or logistics, marketing and channel value chain. These activities are supported by purchasing, research and development, human resource management and infrastructure. On comparing the views of the experts, it could be summarized that the supply chain represents a sequence of operations from production to processes along the chain, under the delivery of the final product to the consumer. It includes input suppliers, producers, processors, packers and movers, wholesalers, traders, retailers, and export/import distributors.

Supply Chain Management (SCM): According to Chase *et al.* (2005) [3] supply chain management is a total system approach to manage the entire flow of information, materials, and services from raw-material suppliers through factories and warehouses to the end customer. Fantazy *et al.* (2010) [12] defined supply chain management (SCM) as an integrated approach beginning with planning and control of materials, logistics, services, and information stream from suppliers to manufacturers or service providers to the end client and it also represents a most important change in business management practices. An efficient supply chain management system provides an incentive to farmers to produce more and convey changing needs of the consumers to enable farmers to take up production planning based on market forces. Flower supply chain contains the various elements to transport from farm to the consumer such as grower, freight forwarder, airline, flower auction, wholesaler, and retailer to consumer.

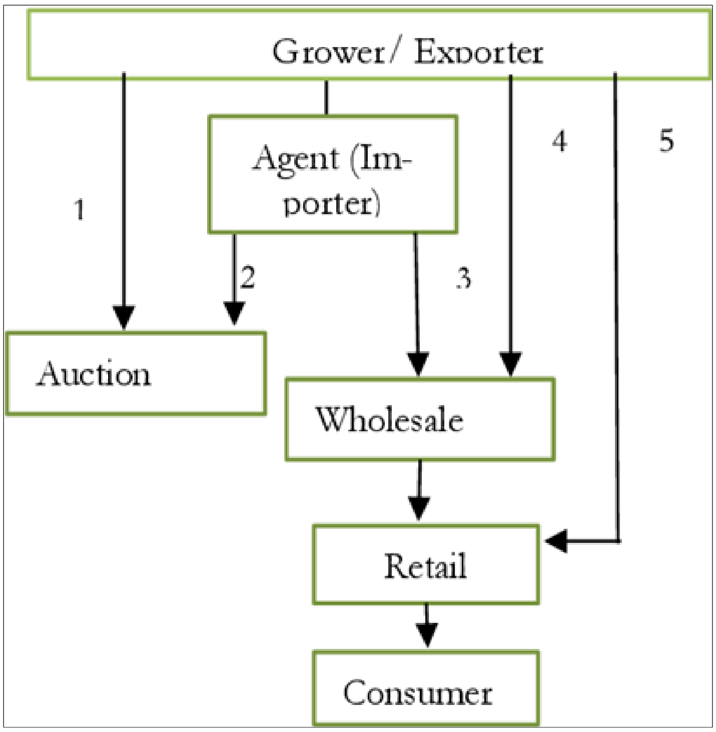

Fig 1: Supply chain for flowers (Source: Rikken, 2010) [41]

Cool Chain Management

Cold Chain Management (CCM) could be defined as the distribution options and network of facilities that executes the typical functions of a regular supply chain cycle however it concerns with temperature and humidity control through the supply chain stages and persons (Tamimi *et al.*, 2010) [51]. Kazmi and Naaranoja (2014) [18] argue that cool chain management system is defined as a logistic solution generally for perishable products and goods, in which temperature sensitive cargo or shipment is supposed to maintain the integrity and credibility throughout multistage movement and the goods are kept in enclose facilities to certify the originality, product's 100% quality, freshness, and the accomplishment of maximum customer satisfaction. Heap (2006) [15] claim that the cold chain is normally considered as the storage and transport chain among the primary production and the final consumer of temperature-controlled perishable goods.

Cool Chain Management of Cut Flowers

In order to preserve the quality of cut flowers, cool chain management is significant though the processes. (Nordas *et al.*, 2006) [32] State that global trade for cut flowers needs a cold storage, cold transportation facilities, and well-organized in land and air-freight distribution system for remaining the flowers freshness. Gebreeyesus and Sonobe (2011) [13] argue that cool chain management play significant role for preserving the quality of cut-flower exports besides; it involves a farm level pack-house, cold transportation, and airport cool storage.

Musoke (2010) [28] claim that after harvest, cut flowers needed effective cool chain management begins and keeping the product at the greatest possible temperature during the processing, packing, store, and transport to the end retail market. There are usually many breaks in the chain though the processes which have addition impact on dropping the possible quality and shelf life of the flowers. Growers are the first priority to reduce these breaks in the cool chain so as to have the maximum quality and shelf life of cut flowers and foliage.

Lead Time Reduction

Cut flower business is concerned about freshness and time because flowers have short product-life cycle. It is not only the cool chain management but lead time reduction is also the critical issue that needs to be considered. Munster and Vestin (2012) [27] state that lead time definition is "that period of time (minutes, hours etc.) required by any process to transform the inputs (materials, customers, money, information) into outputs (goods, services)". Lenderink (2014) [21] discussed the category of lead time that includes order handling lead time, delivery lead time, supplier lead time, and manufacturing lead time while Antonin (2014) [1] conclude that there are two kinds of lead times in supply chain management: manufacturing lead time and information lead time.

Supply Chain in North-Eastern Region

Current supply chain of all horticulture crops in NER is very complex. There is involvement of many stakeholders between farmers and consumers. This is the main concern which causes the price rise and value degradation. Poor road conditions, non-availability of vehicles and high logistic cost are also major hurdles in promotion of horticulture from the region. Major existing market channels through which the trade is occurring are: Consolidators, aggregators and commission agents play major role at the production end in aggregating the product and making it available in the market (Srivastava and Sihag, 2012) [47]

In case of flower, trade from NER to metros is as below:

1. Growers -> Consolidators -> Traders in Sourcing State -> Traders in Metros -> Retailers -> Consumers
2. Growers -> Traders in sourcing state -> Traders in Metros -> Retailers -> Consumers
3. Growers ->Traders in Metros -> Retailers -> Consumers

Growers

Production occurs in greenhouses or open field conditions where flowers are planted, tended and harvested. The cool chain is needed when the flowers have been harvested until they reach the final destination. Preferably, temperatures in the series of 10-14^{0}C must be maintained during processing, storage and transport. Flowers are cut and conveyed to packing houses for processing, bundling into bunches and then packing into the box ready for storage and transportation in refrigerated trucks to the airport (Evers *et al.*, 2014) [11].

Post-harvest management helps to maintain product quality by minimising losses caused by physical, biological and environmental factors. Post-harvest losses occur in the value chain at the farm, wholesaler and retailer levels. The lack of post-harvest infrastructure deteriorates the quality of perishable commodities. The unit operations involved in the post-harvest handling of flowers include harvesting, conditioning, pre-cooling, pulsing, bunching, tubing, sleeving or pre-packaging, packaging, storage and transport.

- Harvesting should be done early morning or late evening when the temperatures are mild to avoid faster respiration rate to excessive water loss.
- Pre-cooling refers to subjecting flowers to cold storage conditions (2-4^{0}C) immediately after harvest to bring down the respiration rate and field heat.
- Conditioning is done by placing the flower stem ends immersed in warm water at room temperature for a short duration and overnight in a cold room.
- Pulsing refers to keeping flowers in a high concentration of sucrose (4%) and germicide for 10-24 hours to rehydrate flowers.
- Grading refers to the categorization of flowers and is done on the basis of appearance, harvesting maturity, blemishes due to disease, attack of pests, colour and bud size, straightness, strength and stem length.
- Flowers immediately after harvest, are made into bunches of 5, 10 or 12 stems and loosely tied with a rubber band at the base and close to the bunch head. Bunching helps for easy packing and handling.
- Primary packaging directly holds the product. Secondary packaging helps to store, transport, inform, display and protect the product. Tertiary packaging helps in the grouping of products for storage and transportation.
- In wet storage, flowers are stored with their bases dipped in water or a preservative solution. In dry storage, flowers are sealed in plastic bags are stored to prevent loss of moisture.

Transportation

The packed flowers need refrigerated trucks to transport them to the airport cold storage where they stopover until re-loaded onto the plane (Gebreeyesus and Sonobe, 2011) [13]. Hortiwise (2012) [16] states that local traders transport the flowers to the freight forwarders at the airport, some bring their trucks, and some forwarders offer trucks to collect the flowers. Poor roads in farm areas cause the delay in distribution and deterioration of quality due to insufficient allocation of funds for road maintenance and development in production zones.

Road Transportation

The road transportation system from the sourcing point to the destination markets is poor. Because of poor connectivity from the farm gate to the main road, farmers have to carry their produce from the farm by head-load, cart-load or small vehicles arranged by them. Availability of vehicles at the time of harvest is also a challenge and due to this, vehicle owners charge exorbitantly from producers and traders for transportation. The products are transported from production belts to markets through passenger vehicles, pick-up vans and mini trucks. Transportation through passenger buses by keeping the produce on footway inside the bus is also practised widely. Poor road conditions, bundh (strikes), insurgency, weather conditions, higher rate of vehicle break-down etc. lead to longer transportation time and cause physical damage to products, which do not remain marketable. This is happening to keep road logistic costs as low as possible by allowing produce to share the space in the vehicle, which is not suitable for transportation of floricultural produce.

Air Transportation

Air transportation of horticulture produce from NER is limited to flowers only. Very high air logistic costs and unavailability of infrastructure to handle perishable cargo are the major concerns in promoting air transportation of horticulture produce to metros like Delhi, Mumbai, Kolkata, Bangalore etc. At present, only Guwahati airport has the facility to handle perishable cargo. Many airports in NER are not directly connected to Delhi, Mumbai and Bangalore. They are connected via Guwahati or Kolkata.

Table 2: State wise proposed evacuation points and destination airports.

State	Nearest Evacuation points	Destination Airports
Arunachal Pradesh	Guwahati	Delhi, Mumbai, Kolkata, Bangalore, Hyderabad
Assam	Guwahati	Delhi, Mumbai, Kolkata, Bangalore, Hyderabad
Manipur	Imphal	Kolkata
Meghalaya	Guwahati	Delhi, Mumbai, Kolkata, Bangalore, Hyderabad
Mizoram	Aizawl	Kolkata
Nagaland	Dimapur	Delhi, Kolkata
Sikkim	Bagdogra	Delhi, Kolkata
Tripura	Agartala	Mumbai, Delhi, Kolkata, Bangalore, Hyderabad

***Source*:** (Srivastava and Sihag, 2012) [47]

Table 3: Total cargo space available in flights originating from North-Eastern Regions.

Cargo Capacity from various originating destination in North Eastern Region		
Originating Airport	Destination	Cargo Capacity (MT)
Agartala	Delhi	24
	Kolkata	92.4
Bagdogra	Delhi	67.2
	Kolkata	43.4
Dimapur	Delhi	20
	Kolkata	11.2
Guwahati	Delhi	128.8
	Kolkata	147
Imphal	Delhi	25.2
	Kolkata	40.6
Aizawl	Delhi	20
	Kolkata	5.6
Silchar	Delhi	40
	Kolkata	15.4

Source: Srivastava and Sihag, 2012 [47]

Table 4: Approximate Cargo charges from North-Eastern Region to Kolkata and Delhi.

Originating airport	Destination airport	Air transport (Rs per Kg)
Guwahati	Kolkata	30
Imphal	Kolkata	30
Dimapur	Kolkata	30
Aizawl	Kolkata	25
Bagdogra	Delhi	10
Guwahati	Delhi	50
Imphal	Delhi	60
Dimapur	Delhi	60
Bagdogra	Delhi	20

Source: Srivastava and Sihag (2012) [47].

Wholesaler

Wholesalers are the critical links in the supply chain that connect growers to retail and the end customers by auctioning the flowers for trading with retailers. Cool chain management in wholesalers still has some issues to detect. These include cooling before departure is not a mutual practice, product qualifications are not planned for the specific needs of the wholesaler but for common auction purposes, cold stores are used for the distribution process, but are not real storage facilities, optimum storage temperatures are not attained, and short notice ordering makes fluctuations in demand. An increase in commitment (fixed quantities for fixed terms) will stabilize the supply in the chain and will encourage an improved cold chain.

Retailers

The end retailers in the flower supply chain include flower shops and supermarkets. It has been shown that flower retailers still follow by the traditional flower chain which trades flowers through wholesalers, and suppliers.

Impacts of ineffective cool chain management

The problems include lack of cool chain facilities, insufficient packing knowledge, ineffective or pre-cooling, lack of refrigerated trucks, poor road pavement, Ineffective and costly re-cooling service at airport, and incorrect temperature setting in aircraft compartment. The obvious of this practice will result in warm, bruised flowers, with a reduced potential vase life of flowers (Reid, 2009) [40].

Implementing cool chain management for cut flower, the knowledge and awareness of temperature requirement are the main idea for keeping the flower freshness. According to Reid (2009) [40] that possibly the frailest link in the flower cool chain is at the airport that freight forwarders might be handled roughly with late arrivals flower before aircraft departure for instance no time to pre-cool the warm flowers, pallets are gathered hurriedly, and boxes are managed casually. In additional, issues of flight delays, quality effect of transit flights routes and temperature settings in the compartment of airplanes. At the wholesalers sector, cooling before departure is not a mutual practice (Hortiwise, 2012) [16]. At retail section, most of the flower retailers still lack of knowledge in specific nomenclature of cool chain management but they keep working by the routine of normal working practice to keep the flower fresh such as keeping the flowers in cool storage and changing the water regularly. Hence, all sectors in supply chain have the responsibility to operate the best practices for cool chain in order to serve the longer product vase life, quality, and price for the end customers.

Case studies of supply chain analysis in cut flowers: Gerbera

An investigation was carried out to study the profitability of gerbera farmers and the involvement of different stakeholders in supply chain of gerbera in East Khasi Hills district of Meghalaya. Total number of 30 gerbera producers from Mawphlang block and Ylliem block and 18 market intermediaries from Bara bazar and Laitmukhrah market were selected randomly. Three marketing channels were identified in marketing of gerbera cut flowers with involvement of wholesalers, retailers and local traders. Marketing efficiency was found to be highest in channel-III (8.52) followed by channel-II (2.67) and channel-I (2.14). The maximum quantity of the produce was disposed of through channel-I (68.53%)

Channel-I: Producer ---- Wholesaler---- Retailer---- Consumer (68.53%)
Channel-II: Producer ----Local Trader----Retailer---- Consumer (23.24%)
Channel-III: Producer ----Consumer (8.24%)

Table 5: Marketable & marketed surplus of gerbera stem (stem/annum) Note: Figures in parentheses indicate percentages to total.

Particulars	Production
Total production	1865 (100.00)
Total consumption (a+b)	110 (5.90)
Personal consumption	80 (4.29)
Sending to relatives	30(1.61)
Marketable surplus	1755 (94.10)
Handling loss	55 (2.95)
Marketed surplus	1700 (91.15)

Source: Prakash *et al*., 2023 [36]

Table 6: Disposal pattern of gerbera flower through different marketing channels.

Marketing channel	Quantity (no. of stem)	Quantity (%)
Channel-I	1165	68.53
Channel-II	395	23.24
Channel-III	140	8.24
Total	1700	100

Source: Prakash *et al*., 2023 [36]

Table 7: Marketing cost & margin of gerbera flower through different marketing channel. (₹/stem.) Note: Figures in parentheses are percentages to consumer's rupee.

Particulars	Channel-I	Channel-II	Channel-III
Price received by producer	15.00 (68.18)	16.00 (72.73)	16.11 (89.50)
Cost incurred by producer			
a. Packaging	-	-	0.85 (4.72)
b. Loading & unloading	-	-	0.35 (1.94)
c. Transportation	-	-	0.69 (3.83)
d. Market fee	-	-	0.001 (0.01)
Total (a to d)	0.00 (0.00)	0.00 (0.00)	1.89 (10.51)
Producer's sales price	15.00	16.00	18.00
Wholesaler's sales price	19.00	-	-
Cost incurred by wholesaler			
a. Packaging	0.87 (3.95)	-	-
b. Loading & unloading	0.86 (3.91)	-	-
c. Transportation	0.54 (2.45)	-	-
d. Spoilage	0.29 (1.32)	-	-
e. Shop rent	0.003 (0.01)	-	-
Total (a to e)	2.56 (11.65)	-	-
Wholesaler margin	1.44 (6.53)	-	-
Local trader's sales price	-	18.00	-
Cost incurred by Local trader			
a. Packaging	-	0.26 (1.18)	-
b. Loading & unloading	-	0.28 (1.27)	-
c. Transportation	-	0.15(0.68)	-
d. Spoilage	-	0.18 (0.82)	-
e. Market fee	-	-	-
Total (a to e)	-	0.87 (3.95)	-
Local trader margin	-	1.13 (5.14)	-
Retailer's sales price	22.00	22.00	-
Cost incurred by Retailer			
a. Packaging	0.79 (3.59)	1.48 (6.73)	-
b. Loading & unloading	0.04 (0.18)	0.00	-
c. Transportation	0.02 (0.09)	0.00	-
d. Spoilage	0.09 (0.41)	0.12 (0.55)	-
e. Shop rent	0.01 (0.03)	0.01 (0.03)	-
Total (a to e)	0.95 (4.30)	1.61 (7.30)	-
Retailer's margin	2.05 (9.33)	2.39 (10.88)	-
Price paid by consumer	22.00	22.00	18.00

Source: Prakash *et al*., 2023 [36]

Table 8: Channel wise price spread of gerbera flower. (₹/stem.)

Particulars	Channel-I	Channel-II	Channel-III
Price received by gerbera farmer	15.00 (68.18)	16.00 (72.73)	16.11 (89.50)
Marketing cost	3.51 (15.95)	2.48 (11.27)	1.89 (10.50)
Marketing margin	3.49 (15.86)	3.52 (16.00)	-
Price spread	7.00 (31.81)	6.00 (27.27)	1.89 (10.50)
Consumer's prices	22.00 (100.00)	22.00 (100.00)	18.00 (100.00)

Source: Prakash *et al*., 2023 [36]

Table 9: Market efficiency of gerbera flower marketing channels.(₹/stem.)

Particulars	Channel-I	Channel-II	Channel-III
Price paid by consumer	22.00	22.00	18.00
Total marketing cost	3.51	2.48	1.89
Total marketing margin	3.49	3.52	-
Price spread	7.00	6.00	1.89
Market efficiency	2.14	2.67	8.52
Producer share in consumer's rupee (%)	68.18	72.73	89.49

Source: Prakash *et al*., 2023 [36]

Anthurium

An attempt was made to analyse the efficiency of the existing marketing channels of anthurium cut flower in the country using Mizoram as case which contribute almost half of the total production during 2012-13. The study was conducted at Department of Economics, Mizoram University, Aizawl. For the study, 68 purposively identified growers provided the broad base for the assessment of primary level information of the study. The records of existing marketing institutions serve as the basis for calculation of the basic information in respect to marketing cost, cost margins and price spreads along the various channels. Three major institutions that were engaged in anthurium flower marketing in Mizoram, namely, Zopar Export Private Limited (ZEP), Zo-Anthurium Growers Society (ZAGS) and Anthurium Growers Society of Kolasib (AGSK). Retail prices and costs were obtained from the interview of retailers operating in Aizawl and main market destinations outside the state like Kolkata, Mumbai, Delhi, Bangalore and Guwahati. It was observed that, though limited in demand, the channel showing the marketing through the local retailers is most efficient followed by Kolkata which have direct and regular air connection. It was also found that marketing cost is directly proportional to the distance and the number of transits stops to reach market destinations.

Table 10: Marketing Channel of Anthurium Cut Flowers in Mizoram.

Particulars	Supply Chain
Channel-1	Producer - Marketing agencies - Retailers in Major Cities
Channel-2	Producer - AGSK - Milan Enterprise in Guwahati
Channel-3	Producer - Retailer - Local Consumer

Source: Rohmingliani and Thanga, 2014 [42].

Table 11: Estimated Monthly quantity of Cut Anthurium Flowers disposed through the three major Marketing Channels in Mizoram.

Particulars	No. of Farmers	Estd. No. Cut Flower	Percent (%)
Channel-1	45	36,626	56.67
Channel-2	12	11,964	18.51
Channel-3	17	16,040	24.82
Total		64,630	100

Source: Rohmingliani and Thanga, 2014 [42].

Table 12: Average marketing cost of anthurium flowers in various channels and destinations.

Particulars	Destinations	Marketing Cost (Rs/stem)			Marketing Cost (%)		
		Producers	Agency	Total	Producers	Agency	Total
Channel-1	Kolkata	0.80	10.24	11.04	7.25	92.75	100
	Bangalore	0.80	15.84	16.64	4.81	95.19	100
	Mumbai	0.80	15.84	16.64	4.81	95.19	100
	Delhi	0.80	15.04	15.84	5.05	94.95	100
Channel-2	Guwahati	3.97	1.91	5.88	67.52	32.48	100
Channel-3	Local Retailer	0.80	0.00	0.80	100	0.00	100

Source: Rohmingliani and Thanga, 2014 [42].

Table 13: Structure of Anthurium prices in different markets (₹/stem).

Channels/Prices	Price
Channel-1 (Marketing through ZEP & ZAGS)	
Farm Gate Price	10.1
Wholesale Price of producers (inclusive of MC)	10.9
Channel-2 (Marketing through Milan Enterprise)	
Farm Gate Price	6.9
Wholesale Price of producers (inclusive of MC)	10.9
Channel-3 (Marketing through local retailers)	
Farm Gate Price	8.7
Wholesale Price of producers (inclusive of MC)	9.5
Retail Prices in Major market destinations	
Kolkata	25.5
Bangalore	35.0
Mumbai	34.7
Delhi	33.3
Guwahati	20.0
Aizawl	11.5

Source: Rohmingliani and Thanga, 2014 [42].

Table 14: Producers in the Consumer Price.

Sl. No	Destinations	Percent
	Channel - 1 (Marketing through ZEP & ZAGS)	
1	Kolkata	39.61
	Bangalore	28.86
	Mumbai	29.09
	Delhi	30.30
2	Channel - 2 (Guwahati)	34.65
3	Channel-3 (through local retailers)	75.65
	Overall average	39.69

Source: Rohmingliani and Thanga, 2014 [42].

Table 15: Measurement of marketing efficiencies for various channels of anthurium flower market in Mizoram.

Sl. No	Particulars	Units	Ch-1				Ch-2	Ch-3
			Kolkata	Bangalore	Mumbai	Delhi	Guwahati	Local traders
1	Retailer selling price (RP)	₹/stem	25.5	35	34.72	33.33	20	11.5
2	Total marketing cost (MC)	₹/stem	11.04	16.64	16.64	15.84	5.88	10.8
3	Total market margin (MM)	₹/stem	4.36	8.26	7.98	7.39	7.19	2.0
4	Price received by farmers (FP) ₹/stem	₹/stem	10.1	10.1	10.1	10.1	6.93	8.7
5	Price Spread (1-4)	₹/stem	15.4	24.9	24.62	23.23	13.07	2.8
	Marketing Efficiency (MME) [4/(2+3)]		0.66	0.41	0.41	0.43	0.53	3.11

Source: Rohmingliani and Thanga, 2014 [42].

Orchid

Small farmers in Sikkim receive the lesser price compared to large scale farmers or farmers group. Large farmers and farmers group can sell directly to the traders, pack-house or to Siliguri market. However, small farmers sell to middlemen/consolidators and it moves further (Srivastava and Sihag, 2012) [47]. Cost build-up for a single orchid stem is given below:

Table 16: Cost build-up for a single orchid stem

Particulars	Amount (in Rs.)	Cost Mark-up (Rs/stem)
Average selling of small farmers	50.00	50.00
Aggregator charges (20%)	10.00	60.00
Transport to pack-house	2.00	62.00
Packaging cost	10.00	72.00
Pack-house/Trader's margin (40%)	29.00	101.00
Road transportation (Sikkim to Bagdogra)	5.00	106.00
Air transportation (Bagdogra to Delhi)	15.00	121.00
Handling charges in Delhi	10.00	131.00 (Landing Price)

Source: STPL analysis and discussion with farmers and pack-house owner.

In case of cymbidium orchid, landing cost in Delhi from Sikkim is approximately Rs. 130-150 per stem (including logistics, packaging, and handling etc.) and the average price at flower market in Connaught Place, near Rajiv Gandhi Handicraft Bhavan is approximately Rs. 200-250 per stem which depends on demand and supply. This price goes beyond Rs. 300 at the retail outlets spread over the city. Thus, there is a margin of Rs. 70-170. This shows that trader can also earn sufficient margin in trading if financial support or subsidy can bridge the gap and making it feasible for marketing the produces in distant markets.

Case study of flower business in Dimapur district, Nagaland

Floriculture sector is emerging as a lucrative business in the state yet it hasn't gained the status of an organized industry. As such, an attempt was made to study the market of flower business in Dimapur district of Nagaland. The study was done on primary data collected from 100 flower businessmen by following a multi-stage stratified random sampling using a standardized questionnaire. The study selected five main market areas in Dimapur where flower businesses are mostly concentrated, namely; new market, Super market, 3rd mile, 4th mile and Chumoukedima market. Statistical charts, averages, percentages and a 3-point Likert scale were used to analyze the data collected.

The study revealed that flower business appears to be actively taken up by the local entrepreneurs (62%) surpassing the number of non-locals (32%) with local inputs enabling to achieve substantial success in the sector. The study also revealed that majority (62%) of the flower businessmen falls in the active working group of 21-50 while huge majority (84%) had acquired education till high school and matriculation and a substantial (16%) are graduate qualified proving that the sector can be adopted as an effective means of employment generation. On the nature of operation of their business, large majority (67%) of them grow their entire flowers by themselves, huge (92%) sells their flowers both from home and market while only (8%) sell through online. The study also revealed that large majority (88%) conducts their business within the local and domestic market and (12%) of the total flower business owners trade their produce in international markets. On the account of income generation, (36%) receive monthly gross sale of 10k-30k, followed by (22%) of them between 30k-50k and a substantial (14%) of them getting gross earnings above 50k per month allowing the people to achieve desired level of economic prosperity and providing sustainable source of livelihood. The study also revealed that (31%) of flower businessmen admitted the severity of damage caused by rampant multiple taxations. A high majority (71%) of flower business owners feels that lack of storage facilities is also a serious limitation in their business and (14%) of the respondents disclosed that, finding the right staff, right skills and competencies is the most difficult challenge in the business.

Table 17: Age and Social Category of flower businessmen in Dimapur (in %)

Gender	Age composition				Social category		
	Below 20	21-50	Above 50	Total	ST	General	Total
Male	4	12	8	24	7	17	24
Female	20	50	6	76	61	15	76
Total	24	62	14	100	68	32	100

Source: Dr. Vinyuhu Lhoungu, Field survey, 2023 [9].

Table 18: Educational status (%)

Gender	Educational qualification				
	Illiterate	Below matriculate	Matriculate	Graduate and above	Total
Male	-	14	8	2	24
Female	-	43	19	14	76
Total	-	57	27	16	100

Source: Dr. Vinyuhu Lhoungu, Field survey, 2023 [9].

Table 19: Location and reason of venturing in flower business (in %)

Location	Male	Female	Total	Reason	Male	Female	Total
Both home and market	21	71	92	Profitable	20	24	44
				No alternative avenue	10	24	34
Online	3	5	8	Interest for flowers	8	14	22
Total	24	76	100	Total	38	62	100

Table 20: Sale per day and month (in %)

	Sale per day			Sale per month			
	Male	Female	Total	Amount	Male	Female	Total
Below 1k	2	4	6	Below 5k	-	4	4
1k-3k	6	28	34	5k-10k	-	24	24
3k-5k	6	23	29	10k-30k	11	25	36
5k-10k	8	9	17	30k-50k	7	15	22
Above 10k	2	12	14	Above 50k	6	8	14
Total	24	76	100	Total	24	76	100

Source: Dr. Vinyuhu Lhoungu, Field survey, 2023 [9].

Table 21: Home grown and exports (in %)

Gender	Home grown				Sell outside the state				Sell outside the country		
	Yes	No	Some	Total	Yes	No	Sometimes	Total	Yes	No	Total
Male	12	10	2	24	6	16	2	24	4	20	24
Female	55	-	21	76	14	54	8	76	8	68	76
Total	67	10	23	100	20	70	10	100	12	88	100

Source: Dr. Vinyuhu Lhoungu, Field survey, 2023 [9].

Table 22: Types and sources (in %)

Gender	Types					Sources				
	Seeds	Cuttings	Potted flowers	Cut flowers	Total	Other states	Other countries	Within state	From all	Total
Male	4	11	5	4	24	3	4	14	3	24
Female	10	25	35	6	76	19	5	43	9	76
Total	14	36	40	10	100	22	9	57	12	100

Source: Dr. Vinyuhu Lhoungu, Field survey, 2023 [9].

Table 23: Flower Business constraints in Dimapur (in %)

Variables	Affects	Male	Female	Total
Multiple taxation	Least	15	14	14.5
	Average	60	49	54.5
	Most	25	37	31
	Total (%)	100	100	100
Lack of transport	Least	39	46	42.5
	Average	25	37	31
	Most	36	17	26.5
	Total (%)	100	100	100
Lack of hi-tech facilities	Least	10	13	12
	Average	22	15	18
	Most	68	72	70
	Total (%)	100	100	100
Lack of financial markets and institutions	Least	39	42	40.5
	Average	45	48	46.5
	Most	16	10	13
	Total (%)	100	100	100
Lack of storage facilities	Least	8	11	9.5
	Average	26	13	19.5
	Most	66	76	71
	Total (%)	100	100	100

Source: Dr. Vinyuhu Lhoungu, Field survey, 2023 [9].

Table 24: Challenges of flower business in Dimapur (in %)

Variables	Difficulty level	Male	Female	Total
Financial management	Least	63	36	49.5
	Average	30	43	36.5
	Most	7	21	14
	Total (%)	100	100	100
Hiring employees	Least	50	48	49
	Average	40	34	37
	Most	10	18	14
	Total (%)	100	100	100
Time management	Least	50	3	26.5
	Average	40	14	27
	Most	10	83	46.5
	Total (%)	100	100	100
Self-dedication and discipline	Least	50	74	62
	Average	23	23	23
	Most	27	3	15
	Total (%)	100	100	100
Marketing strategy	Least	43	43	43
	Average	33	46	39.5
	Most	24	11	17.5
	Total (%)	100	100	100

Source: Dr. Vinyuhu Lhoungu, Field survey, 2023 [9].

Conclusion

Despite of the rapid advancement of the floriculture sector in the North-Eastern region, there are still some constraints. To achieve the vision and goals of further floriculture sector in the North Eastern region, strategies like ensuring availability of quality planting materials, access to certified quality planting material and ensuring the product quality can be implemented. The involvement of unemployed, educated youths can be a game changer for the development of floriculture sector in the NER. Contract farming of flower crops could be profitable for marginal and small farmers in the North-eastern states where availability of inputs and marketing of the product is still a problem due to lack of marketing infrastructure for perishables.

Perishable nature of cut flowers and lack of cold storage facilities create a problem of marketing. The players in the market are disaggregated, acted more on self interest in the absence of any credible marketing information, resulting in more wastage in the chain and less benefits to the farmers. The supply of most cut flowers is seasonal and their production is concentrated in few areas. The cut flower supply chain is still characterized by inefficiencies, diseconomies of scale, lack of investments and inadequate infrastructure, resulting in high cost and poor yields. Suggestions to overcome problems in existing supply chain: Standardized grading system based on the market needs has to be followed across the supply chain. Uniform packing size based on the transport facility must be designed. Packing and labelling should also be done to facilitate traceability. Small cold storage facilities must be created in marginal and small farm holdings. Cold chains should also be created to reduce loss in transit and maintain the freshness of the flowers. Access to market information was incomplete and inadequate. Government must take necessary steps to collect and disseminate market information so that the farmers and others could be benefited which will be crucial importance for the long-term sustainability of the industry in the region.

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