

Socio-Economic Dynamics and Profitability of Floriculture: A Study of Kamrup Metro, Assam

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Abstract: Floriculture in Assam holds significant potential, yet research in the Kamrup Metro region, particularly in Sonapur, remains limited. This study addresses the research gap by examining the socio-economic aspects, operational functioning, and profitability of floricultural businesses in Guwahati, Sonapur, and Azara. A mixed-methods approach was employed, involving 100 samples through surveys, interviews, and structured questionnaires administered to nursery owners and florists. Key findings reveal that Sonapur has the highest potential for floricultural growth due to its fertile soil, favorable climatic conditions, and efficient logistics. The study identifies orchids and marigolds as the most profitable floral plants, with benefit-cost ratios of 1.8 and 1.6, respectively, highlighting their financial sustainability. Despite these opportunities, challenges such as inadequate cold storage facilities and high transportation costs persist, particularly for marginalized farmers. The research underscores the role of education, religious practices, and employment generation in driving the industry's growth. By exploring these dimensions, the study concludes that floriculture in Kamrup Metro can significantly contribute to economic sustainability and job creation while encouraging policy interventions for infrastructural improvements. This study provides a foundation for further research and highlights the importance of floriculture as a key component of horticultural practices in Assam.

Keywords: Fertile Soil, Financial Sustainability, Floriculture, Horticultural Practices, Kamrup Metro

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1. Introduction

The most profitable and successful agricultural activity that offers a variety of approaches is horticulture. To minimize environmental degradation and maintain productivity, a wide range of traditional agricultural practices along with new efficient techniques, such as integrated nutrient management (INM), efficient water use, integrated pest management (IPM), crop rotation, and energy-efficient lighting systems like LEDs, are included in what is referred to as sustainable agriculture (M. A. Wani, 2018). Such systems have been proven to have an effective approach to showing concrete growth in the horticultural sector. This kind of technique has been highlighted in floricultural activity which forms a very small yet effective part of horticultural practice. Ancient Egypt is where floristry first appeared, and it later reached Greece and Rome. Rome is where greenhouses were first conceptualized. In the United Kingdom, the flower industry was founded in the 1800s. The sector has expanded by 6% each year even though it generated less than \$3 billion in sales in 1950 (Department of Agriculture & Farmers Welfare, n.d.). Soon after, it became widely commercialized in other nations, particularly India, the world's second-largest flower grower behind China. India produces around 20% of the world's floriculture products. According to economic forecasts, the total area under floriculture output in India will exceed 331,000 hectares by 2021-22. "Karnataka, Tamil Nadu, Andhra Pradesh, West Bengal, Maharashtra, and Uttar Pradesh are the leading floriculture-producing states" (Kayalvizhi et al., 2017). With appropriate strategy and technological advancements, India's floriculture business can develop by 25-30% and create more foreign exchange than cereals or other agricultural commodities (Sarkar. D, 2023).

In comparison to the other states of India, the North Eastern region of India has demonstrated better sustainable practices in floricultural production, despite its lower output in comparison to mainland India. Despite facing obstacles, this region of the country has shown potential due to positive growth variables. Addressing existing challenges may alleviate unemployment issues. To begin with, Assam has a stronger potential for large-scale floricultural production, which is aided by favorable environmental conditions. Moreover, old techniques of production promote the sustainable approach, which is eco-friendly and indicates the presence of beneficial externalities. Assam's Kamrup metro district is known for its agricultural

produce, particularly Sakurabori Gaon, Khetri, Kamarkuchi, Batakuchi Gaon, Guwahati, Fancy Bazaar, Panbazaar, Sukreswar, Panchim Nagaon, Pat Gaon, Sonapur and Mirza. Such places are involved in floricultural production but on a modest scale. However, traditional farming methods can be seen here, providing extra research opportunities. To achieve the necessary development needs, this study will focus on the socio-economic aspect of floriculture, highlighting the financial sustainability of the laborer's and florist's economic conditions.

2. Literature Review

The area of study is confined to studying the literature of floricultural study which provides the backbone and a base of the previous research conducted in this field. Sustainable floriculture research concentrates on indoor energy efficiency, non-chemical expansion control, and organic fertilizer regimens. Some institutes focus on water conservation and organic substrates (Burnett et al., 2011) which are necessary for achieving a sustainable approach to farming. Despite good views and adoption of sustainable methods, sustainable floriculture certification confronts risks in terms of profitability, economic feasibility, prior experience, operation size, education, and consumer kinds (Hall, T et al., 2010).

Floriculture originated in ancient Egypt, where flowers were produced and used for ceremonial and decorative purposes. The practice quickly spread to other parts of the world, including classical Greece and Rome. The concept of greenhouses started in the Vatican in Rome when it was discovered that many different types of flower plants were being grown. Another greenhouse was built around 100 years later, in the 14th century, in Salerno, Italy, when floriculture had reached its peak since its inception. The production, distribution, and retailing of flowers became part of the floral industry in the United Kingdom in the nineteenth century (CEIC, n.d.). In the 1950s, the global floral industry generated less than \$3 billion in sales. Its commercial value was estimated at over \$100 billion in 1994. Even though worldwide trade was valued at 101.84 billion USD in 2003, the flower industry has recently expanded by 6% annually.

When it comes to India, floriculture has a vast history that dates to prehistory. It was originally utilized for temple decorations, gardening, and ceremonial purposes. Early Vedic Sanskrit mentions important plantings such as lotus, musk rose, and begonia. The Ramayana mythological history also mentions the technique of gardening. However, the British introduced the economic significance of floriculture, leading to commercialization and exports. With increasing export value, India aims to hold the second position after China in floral cultivation (Kalmegh, 2016). Previously regarding market share, India contributed only about 0.61 %, recorded in 2014 and 0.89% in 2015, but due to the extensive range of flower species and agreeable environment found throughout India, its contribution towards the market has increased over the years (National Horticultural Board).

The changes brought in floricultural cultivation throughout the world market, and the Indian market also spread its horizon in the North Eastern part of India, bringing more opportunities. This is because the North Eastern part of India is rich in its floral coverage, and due to this, floral prospects can be expanded by looking at its environmental richness. However, according to (Pal., 2017), despite their richness in natural resources and climatic variety, the North Eastern states have the weakest economic development in the country. Climate change and constant flooding decreased agriculture output, poverty, and unemployment are putting a strain on natural resources. As a result, the region's natural resources are being depleted at an alarming rate. Such a result has led to widespread poverty, especially in the states of Assam with a 20.5 poverty ratio, Manipur with 32.6, and Arunachal Pradesh with a 20.3 poverty ratio (Dutta, D., & Dutta, S., 2022). Thus, to decrease the incidence of poverty in these areas, there was a genuine requirement for an advanced plantation that would contribute enough through marketing can help to curb unemployment.

In comparison to other Indian states, Assam is relatively new to commercial floriculture however it has much potential to curb unemployment through floricultural production and marketing. According to Amarendra Kalita (2019), floriculture in Assam is considered a profitable industry that generates income, creates jobs, and benefits the rural community. The presence of a diverse flora, including rare and endangered species, indicates the region's floricultural potential. He estimated that approximately 80% of the population in Assam were Hindus who worked in the floriculture industry (A. Kalita, 2019). It has recently gained popularity among farmers in Kamrup's Hajo and Sonapur regions. Hajo is well-known for its temples, such as "Madhav Mandir" and "Kedar Mandir." Flowers are produced in these areas primarily for the temple's worshippers. Guwahati's contemporary flower retail mart is also situated near the "Sukreswar Mandir." A

floriculture product market is emerging in Guwahati. Because floral goods are in short supply locally, they are imported via Kolkata. Religious activity in the State is on the increase. There are thousands of Hindu temples around the state, many of which are well-known. According to Barua (2020), flower production in the Kamrup Metro District of Assam has increased due to the sale of floricultural products such as wreaths, cut flowers, foliage, cut green garlands, and loose flowers from improvised stalls on the sidewalks. The increasing revenues from the floricultural sector are predicted to result in a significant increase in production in the periphery of Kamrup Metro district, such as Azara, Chandrapur, and so on, during the next 10 years.

3. Research Gap

Assam is a place where floriculture has been researched but it is limited to some places like Kamrup, Nalbari, Jorhat, Dibrugarh, and Sonitpur districts. The information about the socio-economic dynamics of the Kamrup Metro region of Assam in general and the Sonapur area, in particular, remains unknown up till now because there have been not enough studies so far conducted on it which specified the socio-economic status of the laborers working under this horticultural branch. This study aimed to highlight various socio-economic dynamics related to flower growers around Guwahati City, Sonapur, and Azara under the Kamrup Metro District of Assam. Hence apart from looking into profitable plants for cultivation among these people, other economic dimensions such as marketing chains were also considered since they equally contribute towards employment creation opportunities within this sector. This research will allow us to gain knowledge about profitability and financial sustainability too.

4. Objectives

- To Explore the Socioeconomic Status of Florists within the Study Area.
- To Examine the Operations of Floricultural and Nursery Businesses within the Study Areas.

5. Methodology

This study employs a mixed-methods approach to assess the socioeconomic status of local floral enterprises, focusing on the profitability, land usage, and financial sustainability of floral nurseries in specific regions. The methodology integrates both qualitative and quantitative techniques to provide a comprehensive understanding of the subject.

Study Area and Sample Selection

Geographic Scope: The study covers floral enterprises located in Assam, specifically Sonapur, Guwahati and Assam.



Figure 1: Source: (Wikiwand),
North Eastern Part of India Map

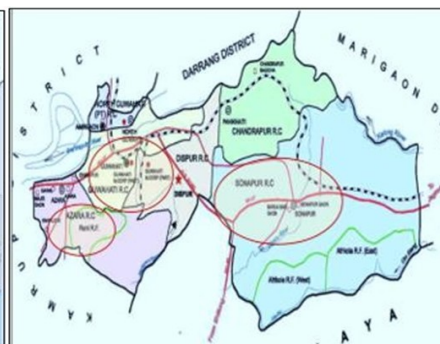


Figure 2: Source: (Gazeis),
Kamrup Metropolitan District, Assam Map

Sampling Method: A total of 100 floral enterprises, including nurseries, florists, and nursery operators, were selected for this study. These were chosen through random purposive sampling to ensure a diverse representation of businesses from different regions.

Data Collection

Primary Data:

- **Surveys and Interviews:** Structured questionnaires were administered to florists and nursery operators to gather data on various aspects such as operational costs, revenue, business practices, and profit margins. These interviews were conducted in person to facilitate in-depth understanding and clarification of responses.
- **Land Assessment:** The land used for floriculture was surveyed using the customary unit of "Bigha," the standard measurement in the study areas. For each nursery, the total area under cultivation was recorded, and a detailed cost analysis for every 1000 square feet of land was done.
- **Secondary Data:** Data from relevant government reports, industry publications, and previous research studies were used to supplement the primary data and provide context to the findings.

Data Analysis

Quantitative Analysis:

The Net Present Value of an investment is the sum of all future cash flows discounted to present value during the life of the investment. It is important to do a discounted cash flow (DCF) assessment before calculating NPV. Three important aspects must be addressed when doing a DCF valuation: the discount rate, the cash flows, and the number of periods. The discounted cash flow formula is:

The discounted cash flow formula is:

$$DCF = \sum_{n=1}^n \frac{CF^n}{(1+r)^n}$$

Where,

CF – Cash flow for n period of years

r – is the discount rate

n – is the period of years

Thus, for the calculation of the Net Present Value, we will use the following formula:

$$NPV = DCF - \text{Initial Investment}$$

Based on the value of NPV a business can be predicted to be either profitable or at a loss by considering the value of the NPV. These three cases for the NPV, namely

If $NPV > 1$ The business for the organization will be profitable

If $NPV < 1$ The business for the organization is most likely to face loss.

If $NPV = 1$ The business is considered to be in a neutral position earning no loss and profit in the stipulated time.

Benefit-Cost Ratio (BCR) was calculated to determine the financial sustainability of floral businesses. A BCR greater than 1.0 indicates a financially viable and sustainable business. The study also calculated the profit margin of floral plants offered by business owners in the market. A typical profit margin of 20-30% was considered as a benchmark for assessing profitability.

$$BCR = \frac{\text{Total Benefits (Revenue + Monetary Benefits)}}{\text{Total Cost (Operational and Investment Cost)}}$$

Qualitative Analysis:

Thematic analysis was conducted on the qualitative data from interviews to identify patterns and trends related to business challenges, market strategies, and perceptions of financial sustainability in floriculture.

6. Findings and Discussions

This section of the study seeks to provide a detailed summary of the analysis carried out to meet the research objectives. The study's findings and results are organized into the following segments:

a) Background of the Study Areas. b) Socio-Economic Background of Florist. c) Operational Functioning of the Study Areas.

a) Background of the Study Areas

The overall population of the Kamrup Metro District is 1,253,938. The rural population is 216,927, whereas the urban population is 1,037,011 (OneFiveNine, n.d). Kamrup Metro District is located in the state of Assam. Kamrup Metro District is made up of numerous sub-districts with diverse populations. The Kamrup metro sub-district is divided into five regions (OneFiveNine, n.d.) Guwahati, Azara, Dispur, Sonapur and Chandrapur.

The Kamrup Metro District's demographics and socioeconomic development are influenced by sub-districts, with three unique economic zones: Sonapur, Guwahati, and Azara, focusing on floriculture. These zones, once rural, have grown into jobs in floriculture, crucial for sectors like fragrance, cosmetics, and medicine. Farmers and nursery owners find it profitable and offer job opportunities. These areas also have significant temples requiring floral plants. The following considerations contributed to the selection of these areas:

- An abundance of environmental resources and forest coverage.
- Potential for employment generation.
- Fertile soil with improved pH levels.
- Cultural and religious significance.
- Availability of labor for farming.

The profile highlights the study areas that give rise to the aforementioned factors and are described individually.

Sonapur: Sonapur is located in Assam's Kamrup Metropolitan District and covers 402 square kilometers. Its population is 143,371. It is an administrative division that comprises both urban and rural regions; only 7.68 square kilometers of this total area are urban, with the remainder classified as rural land. The population density here is approximately 356.6 inhabitants per square kilometer. Sonapur is made up of various villages or locations, including Sakurabori, Khetri, Kamarkuchi, Batakuchi village, Panchim Nagaon, and Jorabat, all of which are being studied in this research. Various villages or localities in Sonapur, such as Sakurabori Village and Khetri Village, have been investigated (Indian Village Directory). The literacy rate of Sonapur is reported to be 67.02%. Sonapur has the largest share of floral coverage at 46.46 percent, surpassing Guwahati and Azara. This can be understood from a large amount of land in Sonapur that is dedicated to growing floral plants whose soil content is rich mostly alluvial soil, silty clays, clayey silts, and sandy soils. The production process involves importing seedlings from other places, which are then cultivated and sold at wholesale and retail prices.

Guwahati: Guwahati is a subdivision of Assam's Kamrup Metropolitan District. It covers 100 square kilometers and has a population of 433,771 people. Unlike Sonapur, Guwahati is primarily urban, with no rural areas or villages inside its bounds. Guwahati's population density is roughly 4,343 persons per square kilometer. The subdivisions covered in this area include the commercial areas of Fancy Bazaar and Pan Bazaar, as well as Lal Ganesh, Garchuk, Chandmari, Lokhra, and Maligaon which are the focus of this research. The literacy rate in Guwahati is 82.90 percent, with a higher literacy rate among men compared to women (Indian Village Directory). Guwahati is a thriving area for the industrial use of floral plants, such as perfumery, medicine, cosmetics, and more. It serves as the main selling hub for floral plants produced in Sonapur, selling them at retail prices to consumers. Guwahati is also known for its famous temples like Navagraha Temple, Kamakhya Temple, Doula Gobinda Temple, Umananda Temple, Sukreshwar Temple, etc. Florists outside these temples prominently sell cut flowers. These cut flowers are used mostly for religious offerings. The floral business is not only limited to religious offerings but also the floral plants are sold in the market, which is stocked in the showroom from whom other business endeavors, such as party planners, wedding planners, etc., also purchase to run their business. The places in the Guwahati area have a maximum florist who sells floral plants after purchasing them from the nursery owners at wholesale prices. Thus, the coverage of the floral business within the Guwahati area constitutes 29.29 percent, as seen in Figure 3.

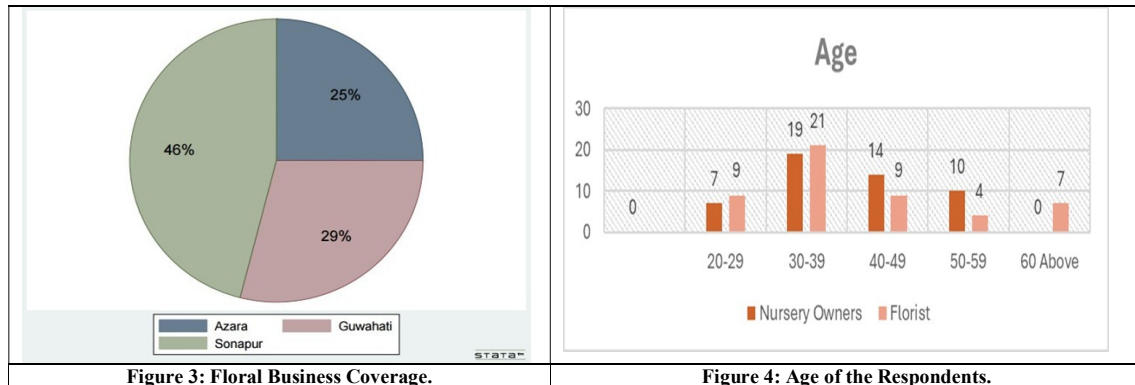


Figure 3: Floral Business Coverage.

Figure 4: Age of the Respondents.

Source: Primary Study by the Author

Azara: Azara is a subdivision of Assam's Kamrup Metropolitan District. It has a total area of 142 square kilometers, with 20.44 square kilometers classed as urban and the remainder as rural. The subdivision has a population of 64,247 people, with 35,966 living in urban areas and 28,281 in rural communities. The population density is about 453.9 per square kilometer. Azara is home to villages and regions such as Pat Gaon, Dharapur, Rani, and Kahi Kuchi, which are the subject of the study. The literacy rate of Azara is 78.76 percent, with males having a higher literacy rate than females (Indian Village Directory). Azara is an area that includes many idle land areas. Therefore, if industries such as cosmetics or medicine develop that utilize floral plants as raw materials, Azara may also witness an increase in floriculture.

b) Socio-Economic Backgrounds of Florists

When analyzing socioeconomic conditions, it is important to consider various factors that can have an impact on floral businesses within the study areas. These factors include age, gender, caste, religion, education, employability, and experience. All these aspects play a role in shaping the operation and dynamics of the floral industry in the given regions.

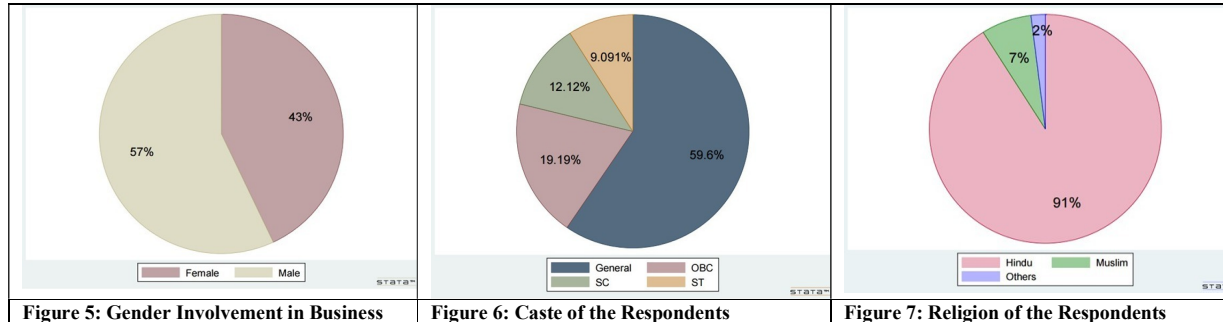
Age: Age is the crucial factor that determines the existence of the floral business. For instance, older floral businessmen may have accumulated a wealth of experience and expertise in the industry. Their extensive knowledge of floral cultivation, handling, and market trends can contribute to the success and growth of their businesses. The Analysis of the respondents based on age is represented in the form of a histogram in *Figure 4*.

It is found from the analysis that the respondents of the age group involved in the floral business are 30-39. Since floriculture is a labor-intensive work therefore the respondents of this group are much more active compared to other age groups. Furthermore, people in this age bracket may have had more time to save money, invest in infrastructure, and form long-term ties with financial institutions. This stability can provide a solid foundation for business operations and expansion.

Gender: The floral business may tailor its marketing strategies and product offerings based on customer preferences, specifically targeting certain gender demographics. For example, flower shops may create campaigns and products that align with the tastes and purchasing habits of a particular gender. Additionally, in the field of floriculture, there may be programs promoting women's empowerment. For instance, the Women's Empowerment program in the Ethiopian floriculture sector addresses gender-related issues in Ethiopian Horticulture Producer Exporters Association (EHPEA) member farms and implements welfare programs in the workplace. This program helps build capacity for gender responsiveness, enhances understanding of the legal framework for gender equality, and integrates the business benefits of inclusive practices at the management level, fostering a stronger, more reliable, and healthy workforce. The Analysis of gender involvement is represented in the form of a pie chart in *Figure 5*.

Caste: The floricultural business faces challenges due to caste-based discrimination and social biases, particularly for marginalized individuals. This can limit their representation and upward mobility. The impact of caste on the industry varies depending on cultural context, geographical location, and social dynamics. Efforts towards inclusivity, equal opportunities, and breaking caste-based barriers can foster a more equitable and diverse floral industry. A pie chart in *Figure 6* shows that approximately 59.6% of respondents in the general category are active in floricultural activity.

Religion: Floricultural business involves diverse religious ethics. This is because, many religious traditions and festivals involve the use of flowers as symbols of beauty, purity, or devotion. These occasions often drive increased demand for flowers, leading to a surge in sales for florists and growers. For example, events like Easter, Diwali, Christmas, and weddings or funerals within different religious communities may significantly impact the demand for flowers. The religion of the respondents is shown in the form of a pie chart in *Figure 7*.



Source: Primary Study by the Author

From *Figure 7* it is found that 91 percent of the Hindu respondents are engaged in the floricultural business compared to other religions this is because the study area is composed of the Hindu population. According to the Population census of 2011, the Kamrup Metropolitan City comprises 84.89 percent of the Hindu population which covers a huge population in comparison to the Muslims constituting 12.05 percent. Since the use of flowers is deeply ingrained in Hindu culture. Different flowers are associated with various deities, and their use in religious and cultural practices has been an old tradition. Flowers such as Marigold, jasmine, and lotus flowers, among others, are commonly used in Hindu rituals. This cultural tradition contributes to the preference for flowers and the involvement of Hindus in floricultural activities.

Education - Education plays a vital role in the success of the floricultural business as it equips individuals with the knowledge, skills, and expertise needed to thrive in the industry. Understanding plant biology, cultivation techniques, pest and disease management, soil science, and irrigation systems is crucial in floriculture. Education, whether through formal degrees or specialized courses, provides individuals with the technical knowledge required for effective flower cultivation, leading to optimized production, improved crop quality, and increased yields. According to the findings in Table 1, the educational data of respondents highlights that Sonapur, among the three areas examined, exhibits greater potential for the floricultural business. This can be attributed to several factors. Firstly, Sonapur benefits from a more fertile area for cultivation, providing favorable conditions for growing flowers. Additionally, there is an increasing interest among the local population in floriculture, which has motivated individuals to pursue education in the field of agriculture. By gaining knowledge and skills in floriculture, they can enhance their career prospects and contribute to the growth of the industry in Sonapur.

Education	Sonapur		Guwahati		Azara		Total
	Nursery Owner	Florist	Nursery Owner	Florist	Nursery Owner	Florist	
Below Matriculation	5	6	1	1	3	5	21
Matriculation	8	8	1	3	2	8	30
High School	1	5	7	9	0	0	22
Graduation	10	2	6	1	5	2	26
Post Graduation	1	0	0	0	0	0	1
Total	25	21	15	14	10	15	100

Table 1: Educational Analysis

Employability: Regarding employment factors, individuals involved in the floricultural business are predominantly self-employed. They independently operate their businesses, bearing the expenses themselves, and generate employment opportunities for others to sustain their livelihoods. A detailed analysis of the employment of males and females in the floricultural industry is presented in the form of a pie chart in *Figure 8*.

Experience: Floriculture is a labor-intensive agricultural practice that requires practical skills. Through experience, individuals gain valuable knowledge about planting, nurturing, and harvesting various flower species. They learn about the specific requirements of different plants, effective cultivation techniques, and how to deal with challenges such as pests, diseases, and environmental factors. Practical experience allows farmers to improve their skills and make valuable decisions to increase their productivity. In this analysis respondents' information related to their experience in the field of floriculture are represented in the form of a pie chart in *Figure 9*.

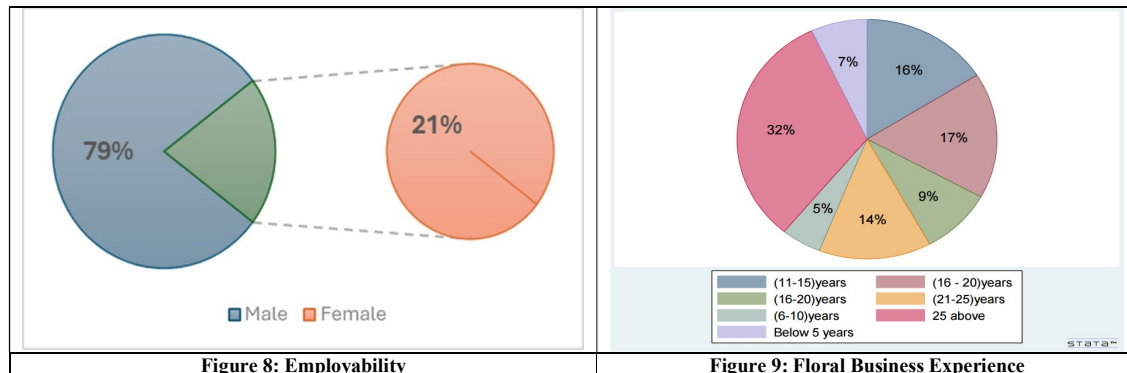


Figure 8: Employability

Figure 9: Floral Business Experience

Source: Primary Study by the Author

c) Operational Functioning of the Study Areas.

To comprehensively study the operational aspects of floral businesses, it is crucial to analyze the business outlook in terms of comparison of the nursery owners and the florists in the designated study areas. This examination includes gender involvement, area of the business, land ownership, and type of family involvement in the floral business. *Figure 10* presents a visual representation of the Business Outlook of Nursery Owners and Florists in the Study Areas, providing insights into these aspects.

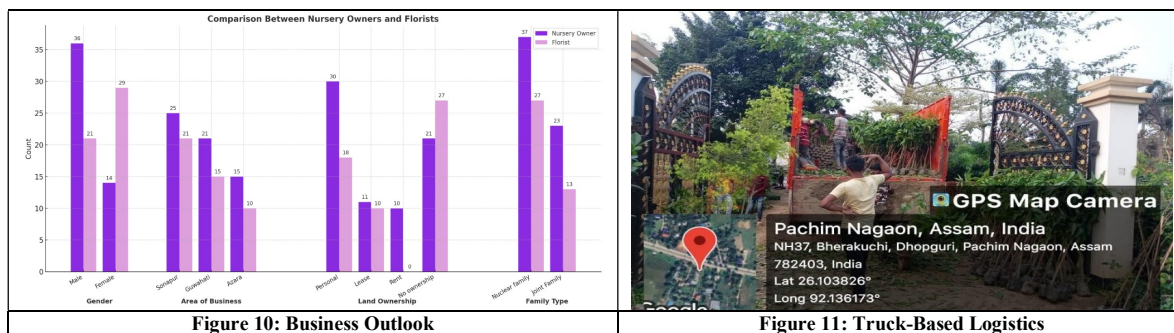


Figure 10: Business Outlook

Figure 11: Truck-Based Logistics

Source: Primary Study by the Author

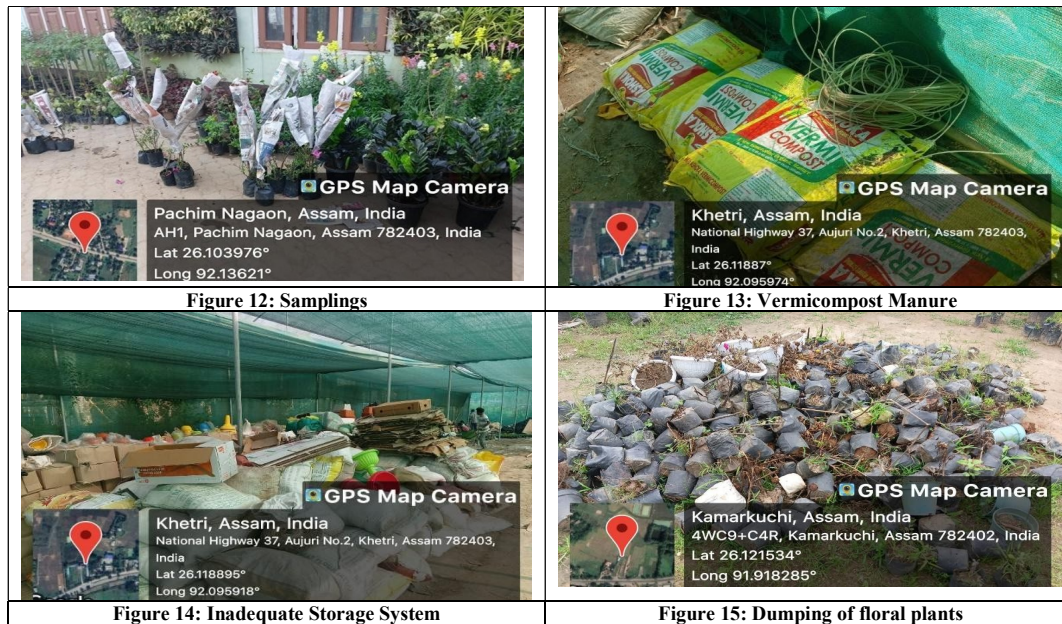
As shown in *Figure 10*, the flower business operation varies throughout the three study locations in the Kamrup Metro District. According to the Figure, Sonapur has the most potential for floricultural growth of the three areas. The lush ground of Sonapur allows for the growth of a variety of crops, including flowers. The appropriate climatic conditions, which may include temperature, rainfall, and sunlight, provide an environment conducive to agricultural production. Furthermore, the availability of water resources, such as the river Digaru and its connections to the Kalang River and the Brahmaputra, can offer irrigation for agricultural regions, thereby promoting agricultural activity.

Sonapur's location near National Highway 37 provides convenient transportation and connectivity, making it an ideal hub for the distribution and marketing of agricultural products, including flowers. Its proximity to Meghalaya, known for its floriculture industry, facilitates knowledge exchange and market opportunities. Sonapur's seedlings are mainly imported from West Bengal, Karnataka, Andhra Pradesh, and Madhya Pradesh. Moreover, the floral business in Sonapur relies on truck-based logistics for efficient transportation of plants, with deliveries to local nurseries occurring four to five times per month, according to a survey.

The cost of truck-based logistics varies from place to place since, being a variable cost, a fixed assumption cannot be made for the requirements of the plants.

Figure 12 the samplings that are being imported through truck-based logistics from other parts of India mostly from West Bengal.

Manures and soil are imported annually for floricultural plantations due to monthly expenses on transportation. Business owners benefit from yearly transportation of these materials, such as vermicompost and cow dung, to minimize overall transportation costs.



Source: Primary Study by the Author

Despite the thriving floricultural practice in Sonapur, there exists a challenge in terms of an adequate storage system. The cold storage facilities available are technologically advanced but also costly. This poses a problem for marginalized farmers who cannot afford the expenses associated with storing their surplus produce. Consequently, the perishable flowers go bad, resulting in unsold plants being discarded, leading to a loss of 5 to 10 percent in their business. Figure 14 illustrates the inadequate storage system for floral plants and manures, where materials are haphazardly kept without proper arrangement while Figure 15 depicts the dumping of floral plants that are unsold.

Tissue culture is a popular practice among farmers which yields an annual turnover of 4 to 5 crore, transforming dried or unsold plants into hybrid plants. This technique is particularly prevalent in Sonapur, where it allows efficient cultivation of diverse ornamental plants and introduces innovative traits, improving quality, yield, structure, and disease resistance. Small and marginal farmers also use other methods to store surplus floral production.

Water Storage: Many flowers can be stored by keeping their stems hydrated in water. Trim the stems at an angle and remove any foliage that would be submerged. Place the flowers in clean containers filled with water and change the water regularly to prevent bacterial growth. Keep the containers in a cool, dark location.

Drying: Some flowers, such as lavender or dried Roses, can be preserved by drying them. Hang the flowers upside down in a dark, well-ventilated area until they are completely dry. Once dried, store them in airtight containers in a cool, dry place away from direct sunlight.

The floricultural market structure in Guwahati and Azara differs from Sonapur, with some nursery owners based in Sonapur but primarily selling produce in these areas. Guwahati's central marketplace and temples create major flower-selling hubs, such as Fancy Bazaar, Pan Bazar, and Maligaon. The prices in these areas are higher than in Sonapur, as florists purchase flowers at wholesale prices and sell them at retail prices. Azara, located on the outskirts of the main city, has fewer nurseries and florists but has a high potential for development due to unused land and increasing demand for floral products. The AAU-Horticulture Research

Station in Kahikuchi aims to develop horticultural technologies tailored to local demands and climate challenges, enabling Azara to become a floral hub.

The supply chain for floral plants in the study areas involves various channels, with participants varying based on the specific needs of nurseries in each location. In Sonapur, the supply chain operates through interconnected channels, with local growers directly interacting with retailers and input suppliers exporting seedlings or samplings. Hajo, a significant hub in Assam, is a significant location for plant exports. Producers then sell the plants to retailers at retail and wholesale prices, with intermediaries purchasing and distributing them. Retailing units in Sonapur serve as the final point of sale, catering to individual preferences and requirements.

Guwahati relies heavily on the Sonapur area for its floral supply, with nursery units and florists acting as intermediaries in the supply chain. In the Azara circle, florists and nursery units rely on the Sonapur and Guwahati regions for their supply, as small-scale and marginalized farmers often import materials from these areas due to lower transportation costs. By procuring input supplies from these regions, florists and nursery units can effectively meet their needs and provide a diverse range of floral products to their customers.

Profitability: The profitability of the flower industry is determined by a variety of elements that influence a producer's success. Some of the varieties grown and marketed in the study areas which have huge demand in the market according to the florist include roses, orchids, gerberas, and marigolds. Understanding demand, production costs, and market prices is critical. Each flower's profitability is determined by costs, yield, and quality. Cultivation methods, supply costs, and harvesting processes all have an impact on these. Staying on top of trends, consumer preferences, and seasonal changes enables companies to alter their tactics for optimal profitability. Diversifying products, implementing sustainable practices, and investing in research and innovation all help to increase competitiveness and profitability in the flower sector.

SI No-	Average Aggregate Yearly Cost (N=100)	
	Cost involved	14400 sq ft (1bigha) (in Rupees)
1	Cost of Greenhouse Construction	Rs. 2,50,000
2	Wage of Male Labor	Rs. 72,000
3	Wage of Female Labor	Rs. 60,000
3	Cost of Irrigation	Rs. 20,000
4	Cost of Transportation	Rs. 60,00,000
5	Cost of Manures	Rs. 20,000
6	Cost Fertilizers	Rs. 75,000
7	Cost of Soil	Rs. 2,00,000
8	Miscellaneous cost (ceramic pots, etc)	Rs. 25,000
9	Cost of Electricity	Rs. 36,000
10	Cost of Machinery	Rs. 15,000
11	Rental Cost	Rs. 3,60,000
12	Interest payment of Loan @10%	Rs. 20,000
13	Initial Investment (one-time investment) *	Rs. 4,65,000

Table 2: Average Aggregate Yearly Cost (N=100)

The average yearly estimates for 1 bigha of land are shown in Table 2 which was mostly calculated after taking the average of land and all the cost components. According to the study, there are at least 2 bighas of land found commonly for floral production, hence the cost for cultivating 2 bighas of land was converted to the cost per bigha (14400 square feet). The 1 bigha constitutes 14400 Square feet of Land. Therefore, all the cost components are then converted to 1000 square feet cost which is a standard measurement. This conversion is made by applying the formula: -

$$\text{Cost Per 1000 square ft} = \frac{\text{Total cost}}{\text{Available Area}} \times 1000$$

The calculation of the Initial investment which signifies the one-time investment made by the nursery owner is as follows: -

Initial Investment = Initial cost invested on purchasing a land + amount of loan taken initially + personal investment + Cost of Machines+ Cost of greenhouse construction + Cost of Irrigation

The study investigates the profitability of four large plantations by splitting an investment over five years and assuming constant cash flows throughout the period. The Net Present Value is determined for the near term, assuming that a company's cash flows would be comparable for five years. Cash flows for five consecutive years are considered to be constant for each plantation. The discounting rate used in the research is 10%, which is similar to the interest rate offered by banks if respondents choose to hold the investment as a fixed deposit. Furthermore, the original investment of Rs. 4,65,000 is shared across the four planters calculations, as each production contributes to the overall cost. To determine the profitability of floral plantations, the Net Present Value of Floral Plantation is determined.

Net Present Valuation of Rose Plantation

$$\begin{aligned} DCF &= \frac{CF^1}{(1+r)^1} + \frac{CF^2}{(1+r)^2} + \frac{CF^3}{(1+r)^3} + \frac{CF^4}{(1+r)^4} + \frac{CF^5}{(1+r)^5} \\ &= \frac{77323.33}{(1+0.10)^1} + \frac{77323.33}{(1+0.10)^2} + \frac{77323.33}{(1+0.10)^3} + \frac{77323.33}{(1+0.10)^4} + \frac{77323.33}{(1+0.10)^5} \\ &= 293116.25 \\ NPV &= 293116.25 - 116250 \\ &= \text{Rs. } 176866.26 \end{aligned}$$

Net Present Valuation of Orchid Plantation

$$\begin{aligned} DCF &= \frac{CF^1}{(1+r)^1} + \frac{CF^2}{(1+r)^2} + \frac{CF^3}{(1+r)^3} + \frac{CF^4}{(1+r)^4} + \frac{CF^5}{(1+r)^5} \\ &= \frac{273263.33}{(1+0.10)^1} + \frac{273263.33}{(1+0.10)^2} + \frac{273263.33}{(1+0.10)^3} + \frac{273263.33}{(1+0.10)^4} + \frac{273263.33}{(1+0.10)^5} \\ &= 1035883.01 \\ NPV &= 1035883.01 - 116250 \\ &= \text{Rs. } 919633.01 \end{aligned}$$

Net Present Valuation of Gerbera Plantation

$$\begin{aligned} DCF &= \frac{CF^1}{(1+r)^1} + \frac{CF^2}{(1+r)^2} + \frac{CF^3}{(1+r)^3} + \frac{CF^4}{(1+r)^4} + \frac{CF^5}{(1+r)^5} \\ &= \frac{45363.33}{(1+0.10)^1} + \frac{45363.33}{(1+0.10)^2} + \frac{45363.33}{(1+0.10)^3} + \frac{45363.33}{(1+0.10)^4} + \frac{45363.33}{(1+0.10)^5} \\ &= 171962.71 \\ NPV &= 171962.71 - 116250 \\ &= \text{Rs. } 55712.71 \end{aligned}$$

Net Present Valuation of Marigold Plantation

$$\begin{aligned} DCF &= \frac{CF^1}{(1+r)^1} + \frac{CF^2}{(1+r)^2} + \frac{CF^3}{(1+r)^3} + \frac{CF^4}{(1+r)^4} + \frac{CF^5}{(1+r)^5} \\ &= \frac{124203.33}{(1+0.10)^1} + \frac{124203.33}{(1+0.10)^2} + \frac{124203.33}{(1+0.10)^3} + \frac{124203.33}{(1+0.10)^4} + \frac{124203.33}{(1+0.10)^5} \\ &= 470828.35 \\ NPV &= 470828.35 - 116250 \\ &= \text{Rs. } 354578.35 \end{aligned}$$

The profitability analysis for the floral plants in the study area of Sonapur, Guwahati City, Azara reveals valuable insights into the potential of various plantations for nursery owners and florists. Orchids emerge as the most lucrative option, with an annual revenue of Rs. 600,000 and a net benefit of Rs. 273,263.33, resulting in a high benefit-cost ratio (BCR) of 1.8 and a substantial profit margin of 46%. Following closely behind is Marigold, generating an annual revenue of Rs. 350,000 and a net benefit of Rs. 124,203.33, with a BCR of 1.6 and a profit margin of 35%. While Roses and Gerbera also show profitability, their net benefits, and BCRs are comparatively lower. Orchids and Marigolds stand out further in the Net Present Value (NPV) analysis over 5 years at a 10% discount rate. Orchids exhibit the highest NPV of Rs. 919,633.01, indicating significant profitability and positive returns on investment, closely followed by Marigold with an NPV of Rs. 354,578.35. Despite their positive NPV values, Roses and Gerbera show lower potential compared to Orchids and Marigold. Overall, Orchids and Marigold emerge as the most promising options for the floricultural business in Sonapur, offering nursery owners and florists considerable opportunities for profitability and financially sustainable growth.

7. Conclusion

The study on sustainable floricultural development in Kamrup Metro, Assam, examines the socio-economic aspects of the flower industry. It reveals the potential for profitability and financial sustainability in the sector. The research focuses on orchids and marigolds as the most profitable options. It also examines the socio-economic background of the regions, considering factors like environmental resources, employment generation, soil fertility, and religious importance. The study also examines the profitability and financial sustainability of florists in Kamrup Metro. This research will highlight the aspects of floricultural development that can be subject to more research and help the policy analyst look into more lucrative opportunities to develop floriculture as an integral part of horticultural practices.

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Contribution: Alorika Deb, the first corresponding author and research scholar, conceptualized the study, conducted the analysis, and prepared the primary manuscript draft. Dr. Durba Dutta, the second author, provided critical guidance, refined the final draft, and supervised the overall research process. Both authors have approved the final version of the manuscript.

Appendix: Questionnaire and Research Data has been verified and available at the first Author, **Alorika Deb** (alorika199720deb@gmail.com).