**Floriculture for Climate Mitigation and Urban Greening: Scope and Strategies**

**Abstract**

Climate change, urbanization, and the destruction of natural green infrastructure have become key global environmental challenges, especially in urban settings where the built environment is predominant and ecosystem services are compromised. Floriculture, which is the art and science of growing ornamental plants, flowers, and decorative landscaping species, presents a multidimensional solution to these challenges due to its ability to make important contributions towards climate change mitigation and green urbanization. By increasing vegetation cover, floriculture can contribute significantly to mitigating the urban microclimate, alleviating the urban heat island effect, and capturing atmospheric carbon. Ornamental crops, when correctly placed in urban settings, can also enhance air quality by taking in pollutants and emitting oxygen, while at the same time promoting urban biodiversity through the provision of habitats for pollinators and beneficial organisms.

**1. Introduction**

Urbanization is growing at a pace never seen before, with more than 56% of the global population already living in cities a number projected to hit almost 70% by 2050 (Anestis, and Stathakis, 2024). Such increased urban growth is accompanied by a host of environmental problems, ranging from the destruction of habitats to higher pollution levels, rising surface temperatures, and a considerable drop in green areas (Mukherjee, and Bairwa, 2025). The conversion of natural ecosystems into non-permeable urban form wrecks ecological equilibrium and heightens the urban heat island (UHI) phenomenon, exposing cities to climate-related risks like heatwaves, air pollution, and floods (Singh et al., 2020). In addition, cities are disproportionately responsible for global greenhouse gas (GHG) emissions, with over 70% of energy-related carbon emissions, hence worsening the worldwide climate emergency (Colenbrander, et al., 2019).

As an effort to address these problems, urban greening, or the incorporation of vegetation within urban areas, has been recognized as an important mitigation and adaptation strategy against climate change (Mees, and Driessen, 2011). Green infrastructure not only aids carbon sequestration and microclimate regulation but also ecosystem recovery, public health improvement, and overall quality of urban life (Coutts and Hahn, 2015). Within this larger context of urban greening, floriculture the area of horticulture with a focus on the cultivation of flowers, ornamental crops, and landscaping varieties has a significant but as-yet under examined position (Round et al., 2007).

**Table 1. Floriculture and Plant Species Diversity**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Plant Diversity** | | | | | | |
|  | **Ornamental trees species** | **Ornamental Shrubs** | **Ornamental Climber** | **Ornamental Palm** | **Ornamental Cactus** | **Ornamental bulbus**  **plants** |
| 1. | *Acacia suma* | *Abutilon striatum* | *Derris scandens* | *Bactris gasipaes* | *Myrtillocactus geometrizans* | *Alpinia* spp*.* |
| 2. | *Acer caesium* | *Acalypha* spp. | *Passiflora edulis* | *Bactris major* | *Neogomesia agaviodes* | *Alstomeria spp.* |
| 3. | *Adansonia digitata* | *Acalypha hispida* | *Petrea volubilis* | *Elaeis oleifera* | *Pelecyphora asseliformis* | *Amaryllis belladonna* |
| 4. | *Careya arborea* | *Beloperone guttata* | *Gloriosa superba* | *Euterpe edulis* | *Pereskia* spp*.* | *Gloriosa superba* |
| 5. | *Cassia excelsa* | *Datura chlorantha* | *Dioclea glycinoides* | *Nypa fruticans* | *Wilcoxia viperiana* | *Gloxinia speciose* |
| 6. | *Delonix regia* | *Ixora*  *aliporensis* | *Hiptage*  *madablota* | *Chamaerops*  *humilis* | *Zygocactus*  *Truncactus* | *Gladiolus*  spp*.* |
| 7. | *Gustavia augusta* | *Jacobinia carnea* | *Antigonon leptopus* | *Actinorhytis calapparia* | *Frailea castanea* | *Freesia refracta* |
| 8. | *Erythrina variegata* | *Eranthemum laxiflorum* | *Aristolochia elegans* | *Hyphaene coriacea* | *Gymnocalycium*  spp*.* | *Dahlia variabilis* |
| 9. | *Barringtonia racemosa* | *Brunfelsia americana* | *Camoensia maxima* | *Kerriodoxa elegans* | *Haageocereus versicolor* | *Heliconia*  spp*.* |
| 10. | *Barringtonia acutangula* | *Daedalacanthus*  spp*.* | *Bougainvillea spectabilis* | *Acrocomia aculeata* | *Acanthocalycium violaceum* | *Hemerocallis fulva* |

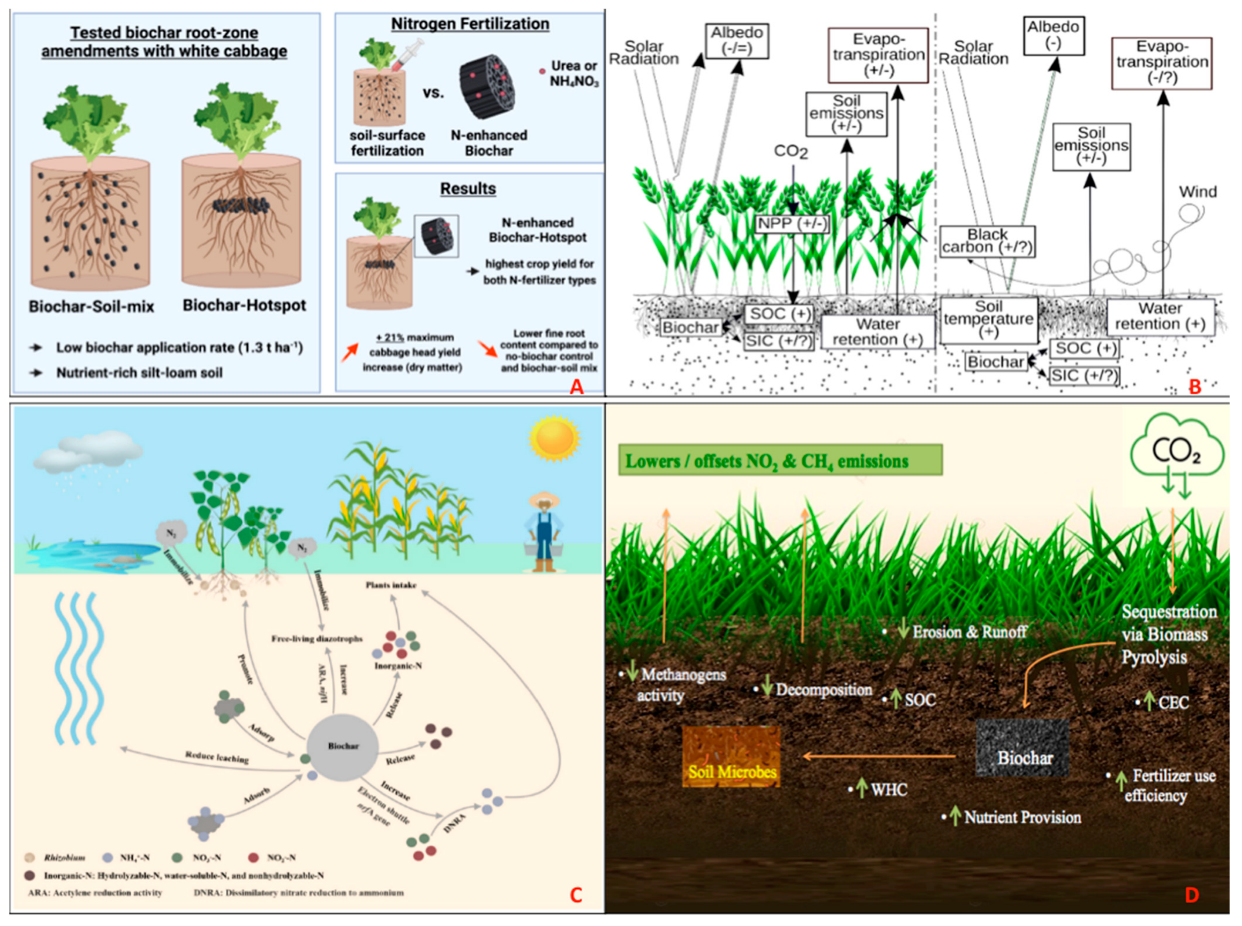
Floriculture makes more than its beauty contribution; it provides tangible ecological services like carbon sequestration, air filtration, stormwater runoff management, noise attenuation, and maintenance of urban biodiversity, including pollinators and other beneficial wildlife (Patel, et al., 2024). In addition, flower gardens and landscaped environments are recreational and healing landscapes that provide psychological benefits and facilitate social integration in urban society (Sahu et al., 2023).The multiple-purpose advantages of floriculture are in complete agreement with the principles of sustainable urban development, especially in climate-resilient urban planning. From rooftop landscapes and vertical gardens to roadside flowerbeds and neighborhood flower parks, floriculture offers scalable, affordable solutions that can be adapted to different urban settings (Sumalatha, et al., 2024). Floriculture also benefits the green economy through the employment opportunities it creates in nursery management, landscaping, urban forestry, and eco-tourism (Busungu, 2022).

Even with its promise, the inclusion of floriculture in urban planning is currently restricted by institutional, economic, and technical constraints. It is urgently necessary to assess and market floriculture as a strategic element of urban climate action plans (Ljubojević, et al., 2022).

In this review paper, the vast potential of floriculture in promoting climate-resilient urban ecosystems is examined. It evaluates its contributions not just to environmental rehabilitation but also to increasing aesthetic worth, mental health, and social unity in crowded cities (Roe, and McCay, 2021). The major strategies addressed include the use of green roofs and walls, vertical and terrace gardens, median strip landscaping and roadside landscaping, creation of therapeutic and community gardens, and propagation of native and drought-resistant ornamental plants to help maintain environmental sustainability (Green, 2004). In addition, floriculture contributes to the green economy by creating jobs, encouraging eco-tourism, and enabling small-scale urban businesses.

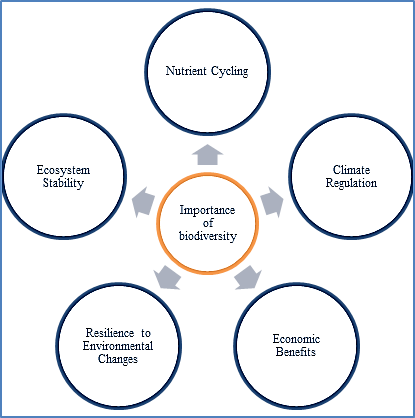
Notwithstanding its promise, a number of challenges impede the urban floriculture mainstreaming into climate strategies. These are limited awareness, poor policy frameworks, lack of integration with urban planning, and further research in plant species selection, climate adaptability, and optimizing ecosystem services (Ahern, et al., 2014). The paper concludes by establishing future directions for research, policy encouragement, and inter-sectoral action, to set floriculture as an integral part in climate-smart urban development.

**Picture 1 : Effects of Biochar: Increasing Crop Yield, Health of Soil, and Reducing Greenhouse Gas Emissions**

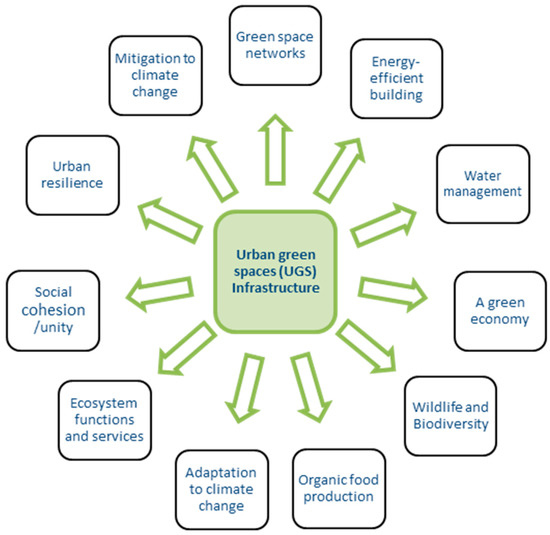


(Source, Bibi and Rahman, 2023)

**Picture 2 : Importance of biodiversity**



### Fig. 1. Importance of biodiversity preservation

(Source, Rayan et al., 2022)

**2. Scope of Floriculture for Climate Mitigation and Urban Greening**

Floriculture goes beyond mere beauty, providing substantial ecological, environmental, and social returns, especially in the case of sustainable urban planning (Zhang, et al., 2024). The presence of ornamental crops, flowering shrubs, and landscaping elements within urban landscapes helps counterbalance the negative effects of climate change and improve the livability of cities. The subsequent subsections present the multi-dimensional extent of floriculture for urban greening and climate resilience (Larcher, 2017).

**2.1 Carbon Sequestration and Air Quality Enhancement**

Ornamental plants, like all green plants, are crucial to the global carbon cycle by removing atmospheric carbon dioxide (CO₂) through photosynthesis (Wang, and Lin,2012). Trees, shrubs, and herbaceous ornamentals store carbon in their biomass and enhance soil organic carbon via leaf litter and root biomass. Some floriculture plants like *Bougainvillea* spp., *Tabebuia rosea*, *Delonix regia*, and *Jacaranda mimosifolia* grow rapidly, have a high leaf population density and wide root spread, hence are highly effective in sequestering carbon (Kaur, 2022).

Other than carbon sequestration, landscaping flowers are biofilters that collect airborne pollutants like sulfur dioxide (SO₂), nitrogen oxides (NOₓ), and particulate matter (PM2.5 and PM10). Most flowering plants are tolerant to urban pollution, thus being ideal for roadside landscaping and buffer strips. They trap dust and chemical pollutants through their leaves, leading to cleaner, healthier air in densely populated cities.

**2.2 Urban Heat Island Mitigation**

The urban heat island (UHI) phenomenon when the temperature in urban areas is appreciably higher than in rural areas is a major issue in climatically exposed cities. The dominance of heat-conducting surfaces like concrete and asphalt supports the effect. Floriculture measures like the planting of flowering trees, hedges, and ground covers counteract UHI by providing shade and evapotranspiration (Saraswati, 2024).

**2.3 Stormwater Management**

Urban infrastructure tends to disrupt natural hydrological processes by generating impermeable surfaces that enhance stormwater runoff and diminish groundwater recharge (Bonneau, et al., 2017). Floriculture-based green infrastructure like rain gardens, bioretention swales, and permeable landscape buffers presents a viable solution. These systems not only mitigate runoff but also enhance water quality by filtering out pollutants (Malindretos et al., 2024).

Sowing native and deep-rooted flowering species like Asclepias, Salvia, and Echinacea in these elements improves infiltration and aids ecological processes. Such systems also lessen the risks of urban flood occurrences and lower the strain on municipal drainage infrastructure, particularly during rare extreme rainfall events exacerbated by climate change.

**2.4 Biodiversity Enhancement**

Urban landscapes often suffer from a decline in biological diversity due to habitat fragmentation, pollution, and intensive land use. Floriculture has the potential to reverse this trend by creating microhabitats for a wide range of fauna, particularly pollinators such as bees, butterflies, and hummingbirds. The strategic use of native, nectar-rich, and seasonally diverse flowering plants supports urban biodiversity corridors and enhances ecosystem services (Sahu, et al., 2023).

**2.5 Psychological and Social Benefits**

Floriculture also plays a major role in the mental welfare and social lives of people living in cities. Being exposed to beautiful, colorful flowers and pleasing landscapes has been found to minimize stress, boost mood, and enhance cognitive function. Therapeutic gardens in schools, memory care facilities, and hospitals are now gaining momentum in applying floriculture for mental and emotional wellbeing (Yeshiwas and Workie, 2018).

Beyond personal benefits, floriculture promotes community engagement, social bond, and sense of place through communal gardening spaces, community floral activities, and volunteer-initiated landscaping works. Public flower gardens, rooftop floral decks, and floral artworks in business districts also increase recreational and tourism value, making cities more culturally vibrant and attractive.

**3. Floriculture-Based Urban Greening Strategies**

There is a need for focused strategies that integrate ornamental flora into multi-layered green infrastructure to successfully leverage the potential of floriculture towards urban greening and climate change mitigation. Such strategies should be scalable, efficient in resource use, and translatable to local climatic and socio-economic conditions. Some of the most important strategies towards mainstreaming floriculture in sustainable urban development are described below (Singh, et al., 2020).

**3.1 Green Roofs and Living Walls**

Green roofs rooftop gardens built with soil substrate and plants are insulating layers that minimize building energy use and urban heat gain (Trepanier, et al., 2009). Planted with tough, low-maintenance ornamental plants like sedums, succulents, Lantana, and Portulaca, green roofs can thrive even under restricted irrigation and intense sun exposure.

Living walls or vertical gardens offer greening in a vertical direction on building façades or freestanding structures using flowering climbers such as *Thunbergia*, *Quisqualis indica*, Bougainvillea, and Ipomoea. Space-limited urban environments are best suited for these installations, which can significantly enhance air quality, block noise, and enhance insulation while beautifying buildings. Modular vertical garden systems also enable simple maintenance and species replacement with changing seasonality or ecological role. Cumulatively, these methods turn what was once idle surface into active green infrastructure that serves to sequester carbon, manage microclimate, and promote urban biodiversity (Sharathkumar et al., 2016).

**3.2 Urban Roadside Landscaping**

Roadside urban environments tend to be polluted, noisy, and unsightly. Introducing flowering ground covers, shrubs, and trees into roadside medians, sidewalks, and traffic islands has the potential to redesign these spaces into multipurpose green corridors. Diseases and pests-resistant ornamental plants such as *Tecoma stans, Cassia fistula, Plumeria* spp., *Calliandra*, and *Tagetes* would be best suited because they are tolerant to pollution, produce blooms during seasons, and are drought-tolerant (Li, 2020).

Successful roadside landscaping also needs to be painstakingly designed to prevent obstructions of visibility, accommodate pedestrian movement safely, and facilitate ecological connectivity. Apart from its aesthetic appeal, such greening interventions help to capture vehicular exhaust emissions, retain dust, regulate temperature, and enhance psychological comfort for motorists and pedestrians.

**3.3 Public Parks and Community Gardens**

Public greens and open green spaces are the lungs of urban ecosystems. Allocating a part of these parks to ornamental horticulture such as flower beds, rose gardens, and theme floral landscapes can add significantly to their ecological and recreational value (Middle, 2014).

Floriculture-based community gardens present possibilities for civic participation, environmental literacy, and neighborhood care. These gardens create a spirit of ownership among residents and encourage inclusive urban greenery, particularly in under-served or densely populated neighborhoods. Community-led floriculture projects can be used as platforms for eco-literacy, healing gardens, and neighborhood makeover initiatives.

**3.4 Institutional and Commercial Landscaping**

Universities, hospitals, and office buildings are some of the institutions that provide ample space to be transformed into climate-resilient floral environments. Landscaping with ornamental plants in these institutions adds up to microclimate regulation, well-being among employees, as well as visual branding. Additionally, it aids organizations in their efforts towards getting green building certifications like LEED (Leadership in Energy and Environmental Design) or GRIHA (Green Rating for Integrated Habitat Assessment) that encourage sustainability standards in the built environment (Albrechts et al., 2017).

Species choice within such environments should be towards low-maintenance, non-invasive, and water-conserving ornamentals in order to reduce maintenance and resource requirements while maximising ecological returns.

**3.5 Home Gardens and Container Floriculture**

At home, container gardening makes it easy to engage in urban greening even in areas with very little space. Terraces, balconies, window sills, and tiny backyards can be easily converted into green plots using pots, hanging baskets, railing planters, and vertical supports. Chrysanthemum, Petunia, Marigold, Coleus, and Alyssum are favored for their dwarf growth habit and colorful blooms (Chavan, 2023).

These micro-gardens not only enhance indoor air quality and thermal comfort but also encourage mental well-being, horticultural expertise, and environmentally friendly lifestyles. At scale, home-based floriculture can make a substantial impact towards decentralized urban greening and climate resilience.

**4. Ornamental Species Choice for Climate Resilience**

The success of urban greening operations based on floriculture is greatly influenced by proper choice of ornamental plant species. These should be capable of withstanding the tough and dynamic conditions of the urban environment. The urban environment is usually noted for high temperatures, uneven rainfall, contaminated air, and poor soil quality, all of which can affect plant survival and ecosystem operations. The choice of tough ornamental species is thus a strategic measure toward long-term sustainability, ecological effect, and less maintenance (Monder, et al., 2024).

**Criteria for Choice**

The following are the criteria that should be used when selecting ornamental plants for climate-resilient urban environments:

**Low Water Needs and Drought Tolerance**

As water scarcity is becoming an increasing issue in most cities, especially in dry and semi-arid areas, ornamental species with low irrigation requirements and good drought tolerance are the best choice. These plants minimize the ecological impact of urban water consumption and are appropriate for xeriscaping (Leotta et al., 2023).

**High Carbon Sequestration Capacity**

Species that have heavy canopies, high growth rates, and deep root penetration are more effective in carbon sequestration in the biomass and soil. Such species have the potential to boost the role of urban parks in reducing greenhouse gas emissions (Marble et al., 2011).

**Pollution Tolerance**

Plants with the ability to survive in contaminated conditions tolerant of automobile exhaust, industrial smoke, and dust are vital for roadside and commercial garden maintenance. Leaves with great surface area and waxy coverings are able to capture particulate matter and decontaminate air pollutants.

**Support for Pollinators and Biodiversity**

Flowering plants that are sources of nectar, pollen, and habitat contribute to urban biodiversity. These species maintain bee, butterfly, bird, and other beneficial organism populations, thus contributing to the ecological function of green spaces.

**Examples of Appropriate Ornamental Species**

According to the above criteria, various climate-resilient ornamental plants are available to apply in different spatial contexts. Here are examples organized by growth habit:

**Table-2. List of annual flowers**

|  |  |  |
| --- | --- | --- |
| **Name** | **Common name** | **Botanical name** |
| **Summer/ rainy season** |  |  |
| **Amaranthus** | Love lies bleeding | ***Amaranthus caudatus*** |
| **Gaillardia** | Blanket flower | ***Gallardia pulchella*** |
| **Gomphrena** | Globe Amaranthus | ***Gomphrena globosa*** |
| **Kochia** | Foliage annual, Summer cypress, Burning bush | ***Kochia spp.*** |
| **Portulaca** | Sunplant | ***Portulaca grandiflora*** |
| **Tithonia** | Mexican Sunflower | ***Titthonia spp.*** |
| **Balsam** |  |  |
| **Cock’s comb** |  |  |
| **Sunflower** |  |  |
| **Zinnia** |  |  |
| **Winter annual** |  |  |
| **Acroclinum** | Paper flower, Everlsting flower | ***Acroclinum roseum*** |
| **Ageratum** | Floss flower | ***Ageratum spp.*** |
| **Annual chrysanthamum** | Crown daisy, Garland chrysanthamum | ***Chrysanthemum coronarium*** |
| **Arctotis** | African daisy | ***Arctotis stoechadifolia*** |
| **Brachycome** | Swan river daisy | ***Brachycome spp.*** |
| **Daisy** | English daisy | ***Bellis perennas*** |
| **Calendula** | Pot marigold | ***Calendula officinalis*** |
| **Ice plant** | Living stone daisy, Fig marigold | ***M. Criniflorum*** |
| **Dimorphotheca** | African daisy, Cape marigold | ***Dimorphotheca aurantiaca*** |
| **Candy tuft** | Hyacinth flower | ***Iberis spp.*** |
| **Antirrhinum** | Snap dragon, dog flower, bunny rabbit, bunny mouth | ***Antirrhinum majus*** |
| **Cineraria** | **Shade loving plant** | ***Senecio cruentus*** |
| **Clarkia** | **Semi shade situation** | ***Clarkia elegans*** |
| **Clianthus** | Parrot’s bill | ***Clianthus spp.*** |
| **Corn flower** | **Hurt sickle, Blue bottle, bachelor’s button** | ***Centaurea cyamus*** |
| **Cosmos** | **Short day plant** | ***Cosmos bipinnatus*** |
| **Gypsophila** | **Babys breath** | ***Gypsophila elegans*** |
| **Linaria** | **Trod flax** | ***Linaria bipartita*** |
| **Linum** | **Flax** | ***Linum grandiflora*** |
| **Mimulus** | **Monkey flower** | ***Mimulus tigrinus*** |
| **Nigella** | **Love in a mist** | ***Nigella domascena*** |
| **Pansy** | **Viola** | ***Viola wittor chikana*** |
| **Phlox** | **Star flower** | ***Phlox drummondii*** |
| **Salvia** | **Sage flower** | ***Salvia splendens*** |
| **Rudbeckia** | **Cone flower** | ***Rudbeckia bicolour*** |
| **Saponaria** | **Soapwart** | ***Saponaria vaccaria*** |
| **Schizanthus** | **Butterfly flower, Poorman’s orchid** | ***Schizanthus wistonensis*** |
| **Shirley poppy** | **Corn poppy** | ***Papaver rhoeas*** |
| **Statica** | **Sea lavendra** | ***Limonium sinuatum*** |

**Trees**

Trees provide long-term structural vegetation, carbon sequestration, and shade.

*Cassia fistula* (Golden Shower Tree): Drought-resistant, deciduous, bee- and butterfly-attracting.

*Delonix regia* (Gulmohar): Fast-growing ornamental canopy tree, excels under dry climates.

*Tabebuia rosea* (Pink Trumpet Tree): Highly decorative, moderate drought tolerance, useful for pollution areas.

**Table-3. List of tree**

|  |  |  |
| --- | --- | --- |
| **Name** | **Common name** | **Botanical name** |
| **Queen of flower tree** | Vermillion flower colour | ***Amherstia nobilis*** |
| **Flame of forest or Palas** | Dhak, Palas | ***Butea monosperma*** |
| **Tree of life** |  | ***Guaiacum officinalis*** |
| **Tree of heaven** | (Folliage) | ***Ailanthus excels*** |
| **Tree jasmine or Indian cork tree** |  | ***Millingtonia hortensis*** |
| **Devils tree** | Sept parni | ***Alistonia scholaris*** |
| **Australiawattle** |  | ***Acacia auriculiformis*** |
| **Siris** |  | ***Albizzia lebbek*** |
| **Monkey puzzle** |  | ***Auracaria cockii*** |
| **Bauhinia** |  | ***Bauhinia spp.*** |
| **Golden Rain Tree** |  | ***Koelreutaria pannniculata*** |
| **Semal or red cotton silk** |  | ***Bombax malabaricum*** |
| **Bottle brush** |  | ***Callistemon lanceolatus*** |
| **Amaltas** | Golden laburnum, *Tree of prosperity* | ***Cassia fistula, pink amaltas (Cassia nodosa)*** |
| **Beefwood** | (Dioecious tree) | ***Casuarina equistifolia*** |
| **Maxima ma** |  | ***Chorisis speciosa*** |
| **Saru** | **Cypress, foliage plant** | ***Cupressus semiperuirense*** |
|  | **Weeping cypress** | ***Cupressus funebris*** |
| **Gulmohar** | Peacock or Flameboyant flower | ***Delonix regia*** |
| **Blue gulmohar** |  | ***Jacaranda acutifolia*** |
| **Blue gum** |  | ***Eucalyptus spp.*** |
| **Bodhi tree** | **Pipal** | ***Ficus religiosa*** |
| **Banyan tree** | **Bor kaiklpavriksha, Symbol of fertility** | ***Ficus bengalensis*** |
| **Pavar** |  | ***Ficus infectoria*** |
| **Rubber plant** |  | ***Ficus elestica*** |
| **Silver oak** |  | ***Grevillea robusts*** |
| **Jangal jalebi** |  | ***Inga dulcis*** |
| **Juniper** |  | ***Juniper spp.*** |
| **Balam khira** | **Sausage tree** | ***Kigelia pinnata*** |
| **Queen flower** | **Pride of India** | ***Lagerstroemia speciosa*** |
| **Bara champa** |  | ***Magnolia grandiflora*** |
| **Swarn champa** | **Sone champa** | ***Michelia champaka*** |
| **Kanak champa** |  | ***Peterospermum acerifolia*** |
| **Molsari** |  | ***Mimusops elengi*** |
| **Kadam Tree** |  | ***Nauclea cadamba*** |
| **Pagoda tree** | **Temple tree** | ***Plumeria species*** |
| **Ashok** | **Scholars tree** | ***Polyanthia longiflora*** |
| **Weeping ashoka** |  | ***Polyanthia pendula*** |
| **Sita Ashok** |  | ***Saraca asoca*** |
| **Karanj** | **Sukh chain** | ***Pongamia pinnata*** |
| **Traveller’s palm** | **Dancing peacock** | ***Ravenala madagas*** |
| **Weeping willow** |  | ***Salix babylonica*** |
| **Fountain tree** |  | ***Spathodea spp.*** |
| **Tecoma** |  | ***Tecoma spp.*** |
| **Teak** | **Sagwan** | ***Tectona grandis*** |
| **Badam** | **False almond** | ***Terminalia catappa*** |
| **Chalta/ elephant Apple** |  | ***Dillenia indica*** |

**Shrubs**

Shrubs are best suited for medians, boundaries, and mass planting.

Bougainvillea spp.: Thorny flowering climber/shrub; very drought-resistant and pollution-tolerant.

*Hibiscus rosa-sinensis* (Chinese Hibiscus): Floral year-round, provides support for pollinators.

*Plumbago auriculata* (Cape Leadwort): Spreading, low-maintenance shrub, for warm climates.

**Table-4. List of Shrub**

|  |  |  |
| --- | --- | --- |
| **Name** | **Common name** | **Botanical name** |
| **Mogra** |  | ***Jasminum sabac*** |
| **Kamini** |  | ***Murraya paniculata*** |
| **Malti/Chandni** |  | ***Tabernaemontana spp.*** |
| **Weeping merry** | Fountain bush | ***Russelia juncea*** |
| **Night Queen** |  | ***Cestrum nocturnum*** |
| **Day King** |  | ***Cestrum diurnum*** |
| **Lady of night** |  | ***Brunfelsia Americana*** |
| **Kund** | Bela | ***Lantana spp.*** |
| **Ghanari** |  | ***Lantara*** |
| **Mussaendra** | Colourful Bractus |  |
| **Tecoma** |  | ***Tecoma spp.*** |
| **Buddleia** | Summer lilac, Butterfly bush | ***Buddleia asiatica*** |
| **Malti** | Chandni | ***Ervatamia divaricate*** |
| **Poinsettia** | Colourful Bractus | ***Poinsettia spp.*** |
| **Tree of sadness** | Night jasmine, Harshingar | ***Nyctanthus spp.*** |
| **Gardenia** | Cape jasmine | ***Gardenia jasminoides*** |
| **Lal Kaner** |  | ***Nerium spp.*** |
| **Pili Kaner** |  | ***Thevetia peruviana*** |
| **Duranta** | Pigon berry | ***Duranta spp.*** |
| **Jatropha** |  |  |
| **Dancing lady** |  | ***Fuchshia hybrid*** |
| **Cup and Saucer** |  | ***Holmskioldia sanguinea*** |
| **Show bush** |  | ***Phyllanthus spp.*** |
| **Peacock flower** |  | ***Casalpinia spp.*** |
| **December flower/ Barleria** |  | ***Barleria cristata*** |
| **Butter fly bush/ Summer lilac** |  | **Buddleia spp.** |

**Herbs and Groundcovers**

They are useful for filling bare ground, stopping soil erosion, and attracting pollinators.

*Lantana camara*: Drought- and pollution-tolerant, fast-growing, butterfly-attracting.

*Portulaca grandiflora* (Moss Rose): Drought- and heat-tolerant groundcover.

*Verbena hybrida*: Seasonal flowering groundcover, a source of nectar.

**Table-5. List of Groundcovers**

|  |  |
| --- | --- |
| **Ategory** | **Plant Names** |
| **Green Colour Foliage** | Wadelia trilobata, Alternanthera ficoidea, Cuphea hyssopifolia, Ophiopogon japonicas |
| **Red Colour Foliage** | Iresine lindenii, Oxalis spp., Ipomoea tricolor, Alternanthera versicolor, Tradescantia fluminensis, Zebrina pendula |
| **Golden Colour Foliage** | Duranta 'Goldiana', Ipomoea 'Chartreuse', Alternanthera variegata |
| **Flowers Used as Cut Flower** | Rose, Carnation, Orchid, Anthurium, Gladiolus, Dahlia, Gerbera |
| **Flowers Used as Loose Flower** | Marigold, Jasmine, Tuberose, Hibiscus, Crossandra, Chrysanthemum |

**Climbers and Creepers**

Ideal for green covers on walls, arbors, fences, and pergolas.

*Quisqualis indica* (Rangoon Creeper): Scented, decorative, cold-hardy in urban environments.

*Passiflora* spp. (Passionflower): Ecologically valuable climbers, attract butterflies and bees.

**Table-6. List of Climber**

|  |  |  |
| --- | --- | --- |
| **Name** | **Common name** | **Botanical name** |
| **Coral vine** | Lovers chain | ***Antigonon leptopus*** |
| **Duck flower** |  | ***Aristolochia grandiflora*** |
| **Bauhinia** |  | ***Bauhinia vahlii*** |
| **Nepal trumpet creeper** |  | ***Beaumentia grandiflora*** |
| **Trumpet climber** |  | ***Campsis grandiflora*** |
| **Vernonia** |  | ***Vernonia elaegnifolia*** |
| **Virgin flower** | Clematis, Queen of climber | ***Clematis grandiflora*** |
| **Grape flower vine** |  | ***Wisteria sinensis*** |
| **Butterfly pea creeper** |  | ***Clitoria ternate*** |
| **Indian joy** |  | ***Ficus repens*** |
| **Madhavi lata** |  | ***Hiptage bengalensia*** |
| **Railway creeper** |  | ***Ipomoea palmate*** |
| **Rangoon creeper** |  | ***Quisqulis indica*** |
| **Morning glory** |  | ***Ipomoea learii*** |
| **Cypress vine** |  | ***Ipomoea quamoclit*** |
| **Jasminum** | Chameli | ***Jasminum grandiflora*** |
| **Spanish jasminum** |  | ***Jasminum officinalis*** |
| **Sky flower** |  | ***Thumbergia grandiflora*** |
| **Star jasmine** |  | ***Trachelospermum jasminoidis*** |
| **Japanese honey suckle** |  | ***Loncera japonica*** |
| **Watch flower** | **Phoolghari** | ***Passiflora lauriflora*** |
| **Golden Shower** |  | ***Pyrostegia vensuta*** |
| **Purple wreath** |  | ***Petrea volubuitis*** |
| **Blue potato creeper** |  | ***Solanum seaforthianum*** |
| **Honey suckle** |  | ***Passiflora lauriflora*** |

**Indoor and shade loving plants**

Indoor or shade-loving ornamental plants are those that thrive in **low to moderate light conditions**, making them ideal for indoor environments such as homes, offices, verandahs, patios, and shaded garden areas. These plants are primarily grown for their **attractive foliage, aesthetic appeal, and sometimes for their flowers**. Many also offer benefits such as **air purification, stress reduction, and interior beautification.**

**Table-7. List of shade loving plant**

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Plant Name** | **Common Use/Remarks** |
| 1 | Moses-of-cradle | Decorative foliage |
| 2 | Purple Heart Plant | Ornamental trailing plant |
| 3 | Spiderwort Plant | Hardy, shade-tolerant |
| 4 | Syngonium | Popular indoor foliage plant |
| 5 | Dieffenbachia (Dumb Cane) | Large-leaved indoor plant |
| 6 | Pedilanthus | Tolerates low light, zigzag stems |
| 7 | Aglaonema Plant | Air-purifying, colorful foliage |
| 8 | Money Plant (Pothos) | Very popular and easy to grow indoors |
| 9 | China Money Plant (Pilea) | Compact and ornamental |
| 10 | Peace Lily | Shade-loving and flowering |
| 11 | Canna Lily | Shade-tolerant with bold flowers |
| 12 | Amaryllis | Large blooms, suitable for partial shade |
| 13 | Philodendron | Classic indoor climber |
| 14 | Umbrella Plant | Compact and elegant foliage |
| 15 | Rubber Plant | Popular for offices and indoor corners |
| 16 | Aloe Vera | Medicinal and shade-tolerant |
| 17 | Rosemary | Aromatic herb, partial shade |
| 18 | Mint Plant | Culinary use, thrives in moist shade |
| 19 | Crown of Thorns | Semi-shade, succulent with flowers |
| 20 | Anthurium | Attractive spathes, loves filtered light |
| 21 | Snake Plant | Very hardy, grows in low light |
| 22 | Yucca Plant | Tolerates shade and drought |
| 23 | Jasmine Plant | Fragrant flowers, tolerates light shade |
| 24 | Dracaena Plant | Easy care, variety of leaf colors |
| 25 | Begonia | Bright foliage and flowers |
| 26 | Ribbon Plant (Chlorophytum) | Excellent hanging plant |
| 27 | Coleus | Vibrant leaf colors, shade-loving |
| 28 | Shrimp Plant | Attractive bracts, does well in partial shade |
| 29 | Crotons | Colorful foliage, prefers indirect light |
| 30 | Ferns | Thrive in humid, shady environments |
| 31 | Foxtail Fern | Unique texture, shade-tolerant |
| 32 | Cordyline | Bright foliage, prefers filtered sunlight |
| 33 | Heliconia | Tropical plant, prefers indirect light |
| 34 | Kalanchoe | Shade-tolerant succulent |
| 35 | Monstera | Iconic leaves, loves low light |
| 36 | Pepper Face (Peperomia) | Compact and attractive foliage |
| 37 | Algerian Ivy | Good for hanging baskets, shade-friendly |
| 38 | Song of India (Dracaena reflexa) | Variegated foliage, indoor star |
| 39 | Wandering Jew (Tradescantia) | Fast-growing and attractive |

These plants offer a rich color palate for landscape architects, city planners, and property owners to design resilient, beautiful, and sustainable urban parks and gardens. Local environmental conditions, aesthetic objectives, and maintenance levels should also be taken into account to guarantee maximum plant performance and public involvement.

**5. Policy and Institutional Support**

More than ecologic consciousness is needed for the integration of floriculture into urban greening and climate change mitigation to succeed; it needs a strong support system of policy, strategic planning, institutional coordination, and community involvement. While the environmental advantages of floriculture are being widely recognized, its full potential is only possible through proactive governance, well-focused incentives, and efficient multi-stakeholder interaction. This section identifies the critical policy and institutional interventions required to mainstream floriculture as a strategic element of climate-resilient urban development.

**5.1 Policies for Green Roofs and Landscaping in Cities**

Urban and metropolitan governments must introduce overall green infrastructure policies with compulsory regulations for the inclusion of green roofs, vertical gardens, and landscaped open spaces in both public and private development schemes. Building bylaws may mandate a minimum proportion of rooftop or terrace spaces to be transformed into green areas through the use of ornamental vegetation, particularly in high-density urban zones. In addition, landscaping regulations must be incorporated in city master plans so that roadsides, institutional campuses, residential colonies, and public parks are greened.

Cities like Singapore and Copenhagen provide great examples where regulatory requirements for rooftop vegetation and façade landscaping have resulted in a strong increase in urban vegetation cover and urban resilience to climate-related stress.

**5.2 Developers' and Homeowners' Incentives**

In order to encourage the implementation of floriculture-based greening, governments must provide developers, housing societies, and homeowners with both financial and non-financial incentives. These can involve tax rebates or subsidies for the establishment of green roofs, vertical gardens, and eco-sensitive landscaping. Support can also be extended through grants or co-funding for the development and upkeep of community gardens and biodiversity-friendly landscapes.

Other incentives, including non-monetary ones like fast-track approvals of projects or the offer of bonus floor area ratios (FAR) for green-certified structures, can be strong drivers. Such incentives not only minimize the cost of undertaking green infrastructure but also push stakeholders to embrace sustainable ornamental planting.

**5.3 Capacity-Building and Training Programs**

Reliance on the availability of professional expertise in the form of skilled horticulturists, landscape architects, urban forestry specialists, and maintenance personnel is essential for the growth and perpetuation of urban greening initiatives based on floriculture. Government departments, educational institutions, and horticultural societies need to come together and evolve systematic training courses, certification programs, and technical manuals dealing with different aspects of ornamental horticulture.

Major capacity-building areas should consist of species choice and nursery production, climate-adapted landscape design, efficient irrigation and maintenance systems using water, and ecological incorporation of native biodiversity within ornamental plantings. These capacity development initiatives are necessary for promoting high-quality implementation and long-term success of floriculture interventions in urban areas.

**5.4 Public-Private Partnerships**

Public-private partnerships (PPPs) provide a viable and replicable model for urban green space planning, development, and maintenance. In such arrangements, private sector stakeholders—such as corporations, property developers, and non-governmental organizations (NGOs)—can collaborate with municipal governments in the design, financing, and maintenance of landscaped spaces like roadside medians, parks, flower installations on intersections, and green belts along transportation corridors.

Corporate Social Responsibility (CSR) initiatives can be integrated into urban floriculture goals so that private firms can support the greening efforts in exchange for publicity and public favor. These collaborations facilitate bridging the funding and implementation gaps, increase accountability, and provide regular maintenance of floral displays in the public space.

**5.5 Integration into Climate Action Plans and Biodiversity Strategies**

To maximize its climate and ecological advantages, floriculture needs to be integrated systematically into overall city-level climate action plans, disaster risk reduction strategies, and urban biodiversity conservation measures. Municipal climate resilience plans must also clearly recognize the contribution of ornamental vegetation towards carbon sequestration, temperature control, and ecological rehabilitation.

In addition, city biodiversity plans must prioritize the use of indigenous flowering plants, pollinator-friendly garden designs, and seasonally rich plant species to create robust ecological corridors in urban areas. Incorporating floriculture into these policy documents not only guarantees institutional acceptance and fiscal support but also facilitates interdepartmental coordination between urban planning, environment, and horticulture departments.

**6. Challenges**

Despite increased awareness of the value of floriculture in urban climate mitigation and urban greening, numerous practical, ecological, and institutional challenges impede its full-scale take-up and sustainability over time. These need to be addressed to ensure the optimal effectiveness and inclusivity of floriculture-based interventions in urban development.

**6.1 Limited Availability of Spaces in Compact Urban Settlements**

One of the main hindrances in the development of floriculture in urban environments is a lack of open, accessible land, especially in highly urbanized cities. In highly populated and highly developed cities with tight pressure on land use for housing and infrastructure, space for ornamental planting is usually relegated to lower priorities. Vertical greening and roof gardens can certainly help obviate the problem to some extent, but their provision is constrained by structural limitation, expense, and technical practicability in older buildings or slums.

**6.2 Inadequate Awareness and Technical Expertise of Stakeholders**

Most urban dwellers, builders, and city planners are not well informed about the climatic and ecologic advantages of floriculture. Because ornamental plants are perceived as mere decorations, they are kept out of climate planning. Besides this, there usually is a lack of technical know-how for species choice, design, upkeep, and incorporation with local biodiversity and microclimate demands. In the absence of professional advice, ill-designed floriculture projects can flop or underachieve.

**6.3 Water Scarcity and Maintenance Expenses**

Floral landscaping in urban areas particularly under heat stress and irregular rainfall regimes—means regular watering, pruning, and soil maintenance. In water-scarce regions, ornamental species are viewed as luxuries and not necessities. Excessive maintenance expenses, particularly in public parks, median strips, and green roofs, frequently result in neglect, resulting in low-quality landscapes and decreased public confidence in greening efforts. This situation requires the choice of drought-resistant species and the use of water-efficient technology such as drip irrigation, rainwater collection, and mulching.

**6.4 Invasive Ornamental Species Affecting Native Vegetation**

Certain exotic ornamental crops, although beautiful and rapidly growing, possess invasive features that degrade local biodiversity by dominating indigenous vegetation, changing soil chemistry, or interfering with ecological interactions. *Lantana camara* and *Eichhornia crassipes* (water hyacinth) are cases in point. The indiscriminate application of these plants in urban landscape gardens could eventually result in ecological degradation and disprove the environmental ambitions of floriculture.

**6.5 Fragmented Institutional Responsibilities**

Urban greening programs are usually plagued by duplicating or split jurisdiction among various organizations municipal corporations, urban development authorities, public works departments, and environmental boards. This leads to inadequate coordination, a lack of accountability, and scarce budgeting for floriculture-based initiatives. The lack of a coordinated strategy or a focal agency to promote urban floriculture also hinders planning, implementation, and monitoring.

In short, while floriculture has vast potential for sustainable urban development, actualizing its contribution demands overcoming space, knowledge, ecological, resource, and governance constraints. Interdisciplinary proactive efforts are essential to resolve these issues and integrate floriculture as a vital part of resilient city systems.

**7. Future Directions and Suggestions**

The increasing imperative of climate change, ecosystem degradation, and urban livability decline presents a strong reason to reinvent floriculture as an aesthetic practice alone to a strategic sector promoting sustainable and climate-resilient urbanization. Proper planning, funding, and people participation can help floriculture contribute meaningfully to ecological rehabilitation, job creation, and enhanced urban quality of life. The following future directions and practical suggestions are suggested to assist policymakers, urban planners, horticulturists, and communities in integrating floriculture into urban climate action plans.

**7.1 Formulate City-Level Floriculture Master Plans**

Urban local governments should be motivated to formulate standalone floriculture master plans as part of their overall green infrastructure plans. These plans need to pinpoint and plot possible ornamental plantation areas, such as rooftops, road medians, traffic islands, vertical faces, and public parks. Frameworks for choosing species according to local climate, soil type, and ecological conditions should be set. The plans also need to delineate precise maintenance guidelines, budget lines, and systems for regular monitoring and assessment. Establishing measurable goals based on vegetation cover, carbon sequestration, and biodiversity increase will guarantee systematic and scalable incorporation of floriculture within urban ecosystems.

**7.2 Encourage Native, Low-Input Ornamental Species**

Native ornamental species that are well-suited to local environments and do not need intensive irrigation, fertilization, or pest control should be used to promote ecological sustainability and lower resource use. These species not only reduce maintenance costs but also provide higher levels of support to native biodiversity, such as pollinators and beneficial insects. Government nurseries and private sector horticulture businesses should be encouraged to plant, market, and distribute such species, thus promoting biodiversity-friendly planting habits in public as well as private urban areas.

**7.3 Integrate Floriculture with Rainwater Harvesting and Renewable Energy Systems**

The sustainability of floriculture ventures can be largely improved with incorporation of nature-based solutions and renewable energy technologies. Rainwater harvesting systems must be incorporated into the design of green roofs and vertical gardens to provide low-cost, secure irrigation. Moreover, solar-powered pumps and lighting systems, combined with sensor-based monitoring of soil and plant health, can enhance the energy efficiency of floriculture landscapes. These integrative solutions not only save valuable resources but also enhance the overall resilience and environmental functionality of ornamental plant installations.

**7.4 Employ IoT and Smart Irrigation Systems for Effective Management**

The implementation of smart technologies like the Internet of Things (IoT), computerized drip irrigation systems, and soil moisture sensors can transform floriculture management from manual to data-based and cost-effective practices. These technologies allow for real-time tracking of plant health, water requirements, and local microclimatic conditions. They also facilitate precision irrigation, avoiding wastage of water, and timely scheduling alerts for operations like pruning, fertilization, or pest control. In addition, data collected from these systems can be merged into urban environmental dashboards to aid in large-scale tracking and decision-making for green infrastructure planning.

**7.5 Encourage Community-Based Floriculture Enterprises to Generate Green Jobs**

Urban floriculture has great scope for livelihood development and entrepreneurship, especially among young people, women, and marginalized communities. Municipal authorities, NGOs, and horticultural departments must provide support to the setting up of community nurseries, cooperative flower production units, and neighborhood landscaping programmes. Concurrently, training programmes must be initiated to transfer skills in producing ornamental plants, floral arrangement, landscape care, and container gardening. Furthermore, micro-enterprise support for the manufacture of environmentally friendly planters, seedling kits, and rooftop garden services can spur the local green economy. Such initiatives can create significant green jobs, improve local stewardship of urban spaces, and foster collective pride and ownership of urban climate action and beautification.

In sum, the future of floriculture is in its strategic coordination with sustainable urbanization, technological innovation, and public participation. Under an enabling policy framework, participative planning procedures, and a priority on environmental awareness, floriculture can be turned into a mass, multifunctional tool for climate change mitigation, urban resilience, and better quality of urban living.

**8. Challenges and Constraints in Mainstreaming Floriculture for Urban Climate Action**

Although floriculture provides significant socio-economic and environmental advantages, its integration into mainstream urban climate strategies is constrained by a number of key challenges and structural obstacles. These challenges are rooted in physical, institutional, ecological, and socio-economic constraints that need to be recognized and responded to for floriculture to be adopted as a transformative urban development tool. The following are the main barriers to the effective uptake and scalability of urban greening based on floriculture.

Maintaining floriculture installations in public areas involves long-term upkeep, routine maintenance, and public engagement. If there are no assigned maintenance budgets, staff capacity, or citizen stewardship, most urban floral initiatives fall into disrepair over time. Neglected landscapes may lower the public's level of trust and deter future investments in green infrastructure.

These challenges mirror the intricate socio-economic and institutional context in which urban floriculture has to function. Overcoming these limitations requires an integrated, multi-disciplinary response of distinct policies, capacity development, ecological study, financial innovation, and active citizen participation. It is only by surmounting these impediments that floriculture can be successfully mainstreamed as a climate-smart, inclusive, and sustainable urban growth strategy.

**8.1. Restricted Space in Densely Populated Urban Regions**

One of the strongest constraints is the limited availability of land in densely populated urban areas. High-speed urbanization has resulted in the vertical expansion of cities, diminishing open and green areas customarily employed for floriculture. Housing, infrastructure, and commercial development demands commonly leave no space for integrating ornamental landscapes. Vertical gardens and rooftop floriculture, though available alternatives, are not broadly adopted because of construction, technical, and economic hurdles (Akbari et al., 2001).

**8.2. Inadequate Public Awareness and Participation**

Urban planners, policymakers, and the general public tend to view floriculture as an aesthetic or luxurious feature and not as a fundamental aspect of climate adaptation and ecological renewal. This limited perception leads to its low priority in urban planning initiatives. Besides, public involvement in the establishment and upkeep of floral environments tends to be poor, particularly in deprived districts where elementary services are given priority over ecosystem beautification (Gill et al., 2007).

**8.3. Water Scarcity and Resource Demands**

Urban floriculture, particularly when based on exotic or water-demanding species, may create huge burdens on already limited urban water supplies. In the absence of effective irrigation systems and appropriate species choice, ornamental landscape maintenance may become non-viable. The high input cost of water, fertilizers, and labor also deters long-term investment in floriculture unless counteracted by low-input technologies or locally adapted drought-resistant species.

**8.4. Non-Native Ornamental Plants and Ecological Threats**

Some non-indigenous ornamental plants widely employed in urban landscapes, e.g., *Lantana camara* or *Ipomoea carnea*, are invasive. They can replace indigenous vegetation, modify soil structure, and disturb local communities. Uncontrolled use and the lack of scientific criteria for the selection of species will usually lead to extensive employment of such ecologically disruptive plants. Lack of urban floriculture biodiversity standards aggravates the problem.

**8.5. Fragmented Institutional Roles and Weak Governance**

Urban greening activities, including floriculture, tend to come under the control of more than one department e.g., municipal corporations, horticulture boards, environment agencies, and public works departments resulting in fragmented planning, coordination difficulties, and duplication of roles. Lack of a central authority or an integrated urban green policy framework impedes effective decision-making, budgeting, and project implementation.

**8.6. Financial and Policy Constraints**

Most city authorities in developing nations are subject to budget constraints that limit investment in non-essential infrastructure, such as decorative landscaping. Without specific incentives, subsidies, or tax credits, private developers and residents will not invest in massive floriculture. Moreover, a lack of explicit policy guidance and budgetary allocation keeps floriculture out of urban master plans and climate resilience programs (Kumar, et al., 2023).

**8.7. Limited Technical Capacity and Research Support**

Mainstreaming floriculture within urban systems demands technical skills in the selection of plants, landscape design, urban ecology, and sustainable irrigation systems. The availability of trained experts and research-based design standards, nonetheless, is usually low. Urban planners and landscape practitioners might lack sufficient exposure to the environmental aspects of floriculture, resulting in misdesigned or underproductive green projects.

**9. Conclusion**

Floriculture is poised to revolutionize urban spaces into hardened, carbon-zero, and aesthetically rich places that enhance ecological equilibrium and human welfare. As cities globally face the twin curse of climate change and accelerated urbanization, the strategic application of ornamental plantings presents itself as a solution that addresses both ecological sustainability and quality of life.

This review has underscored the ways in which floriculture supports carbon sequestration, urban heat island mitigation, air purification, stormwater regulation, and biodiversity enhancement, all of which are essential pillars of climate-resilient cities. In addition to its ecological functions, floriculture offers psychological, cultural, and social advantages, enhancing mental well-being, social cohesion, and urban beauty.

To realize the complete potential of floriculture in urban climate action, it is crucial to install it within policy structures, fund it through institutional coordination, and encourage it through incentive schemes. Floriculture master plans at the city level, mainstreaming into climate action and biodiversity policy, and the cultivation of indigenous, low-input ornamental species are key starting points. In addition, using technological advancements like IoT-based smart irrigation and combining floriculture with rainwater harvesting and renewable energy systems can make it more efficient and sustainable.

Just as crucial is the necessity for capacity development among stakeholders such as urban planners, horticulturists, landscape architects, and local communities so that implementation is scientific-based, inclusive, and context-based. Public-private partnerships and community-driven floriculture businesses can be highly leveragers of scaling up green infrastructure and the creation of green jobs and local income.

In summary, floriculture is much more than a decorative activity; it is a sustainable and strategic part of urban climate action. Through imaginative planning, long-term investment, and large-scale community involvement, floriculture can be developed into a mainstream means of urban greening, climate mitigation, and socio-environmental transformation.

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Green roofs and vertical gardens composed of vibrantly colored ornamental flowers such as Portulaca, Lantana, and Petunia have been reported to lower roof surface temperature by 30–40°C and ambient temperatures by 2–5°C. These values can decrease building cooling energy consumption towards more sustainable urban living (Larcher, 2017).

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Incorporating floriculture into urban parkland, schoolyards, home grounds, and institutional grounds can create stepping-stone habitats that allow for species movement and survival in urban areas. Multiseason floral plantings involving species such as Zinnia, Cosmos, Tithonia, and Tagetes are attractive to pollinators and enhance ecological resilience (Patel, et al., 2024).

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