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Bee Corridors: A Novel Need for Tamil Nadu to Transform Highways into Pollinator Pathways

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Rapid infrastructure expansion across Tamil Nadu offers undeniable socioeconomic perks but drives severe habitat fragmentation, threatening vital insect pollinators. To safeguard agricultural sustainability, establishing Bee Corridors along the state's expanding road networks is an urgent necessity. By replacing purely ornamental roadside plants with a structured, staggered-flowering mix of native trees (like Neem and Jamun), shrubs, and herbs, these routes become continuous ecological bridges. This initiative directly boosts crop yields and fruit quality for regional staples like mango, coconut, and moringa. Emulating successful models like Odisha, Tamil Nadu can merge environmental stewardship with rural prosperity, securing its food future.

Introduction

Agriculture has always been the backbone of Tamil Nadu's economy, culture, and rural livelihoods. The state supports a remarkable diversity of crops ranging from coconut, mango, sunflower, sesame, cotton, and moringa to numerous fruits, vegetables, spices, and plantation crops. While advancements in irrigation, crop improvement, mechanization, and nutrient management have significantly enhanced agricultural productivity over the years, one of the most crucial contributors to crop production often remains overlooked pollinators. Among all pollinating organisms, bees occupy a unique position due to their extraordinary efficiency in transferring pollen between flowers. Their contribution extends far beyond honey production. Bees directly influence fruit set, seed formation, crop quality, biodiversity conservation, and ecosystem stability. It is estimated that a substantial proportion of flowering plants and many agricultural crops depend partially or completely on insect pollination. Consequently, the decline of pollinator populations poses a serious threat not only to natural ecosystems but also to agricultural sustainability and food security. In recent decades, rapid urbanization, industrial expansion, habitat fragmentation, excessive pesticide use, and changing climatic conditions have significantly reduced the availability of natural forage resources for pollinators. These factors have disrupted ecological connectivity and contributed to the decline of both managed honeybee colonies and wild bee populations. Recognizing this growing challenge, India has begun exploring innovative conservation approaches that integrate ecological restoration with infrastructure development. Among these approaches, the concept of Bee Corridors has emerged as one of the most promising solutions. Bee corridors are continuous networks of flowering vegetation strategically established across landscapes to support pollinator movement, feeding, and survival. They transform fragmented habitats into connected ecological pathways that allow pollinators to access nectar and pollen resources throughout the year. More importantly, they represent a practical strategy through which environmental conservation and agricultural development can progress together. For Tamil Nadu, where agriculture and biodiversity are deeply interconnected, the development of bee corridors offers a unique opportunity to strengthen pollinator populations, improve crop productivity, enhance farmer livelihoods, and build climate-resilient agricultural systems.

The Emergence of Bee Corridors in India

India is currently experiencing unprecedented growth in transportation infrastructure. Thousands of kilometres of national highways, state highways, and rural roads are being developed to improve connectivity and support economic development. While this expansion brings undeniable socioeconomic benefits, it also contributes to habitat fragmentation, one of the most significant threats to pollinator conservation. Traditionally, roadside plantations have focused primarily on aesthetics, shade provision, or erosion control. However, recent environmental thinking has emphasized the potential of these spaces to serve broader ecological functions. Recognizing this opportunity, the National Highways Authority of India (NHAI) introduced pollinator-friendly initiatives under the Green Highways Programme, encouraging the establishment of flowering vegetation along transportation corridors. The Bee Corridor Initiative seeks to transform highways from simple transportation routes into ecological assets. By planting nectar and pollen rich species along roadsides, highways can become continuous pollinator pathways that support bees, butterflies, and other beneficial insects. These corridors help reconnect fragmented habitats, improve biodiversity, and strengthen ecosystem services that directly support agriculture. The concept reflects a broader shift in infrastructure planning, where development projects are designed not only for economic efficiency but also for environmental sustainability. Rather than viewing highways as barriers to wildlife movement, bee corridors reimagine them as opportunities for ecological restoration and conservation.

Odisha: A Model for Pollinator-Friendly Infrastructure

Among Indian states, Odisha has emerged as an important example in promoting pollinator supportive landscapes. The state's initiatives have demonstrated how roadside vegetation can be transformed into productive ecological corridors rather than merely ornamental green spaces. The Odisha experience highlights several important principles. First, the selection of native flowering species ensures better adaptation to local climatic conditions while providing reliable nectar and pollen resources. Second, the adoption of staggered flowering patterns guarantees continuous forage availability throughout the year. Third, community participation involving farmers, local bodies, environmental agencies, and educational institutions enhances long-term sustainability. Most importantly, Odisha has shown that pollinator conservation can be successfully integrated with broader biodiversity and infrastructure programmes. This model offers valuable lessons for Tamil Nadu, which possesses even greater agricultural diversity and ecological potential for implementing large-scale bee corridors.

Why Tamil Nadu Needs Bee Corridors

Tamil Nadu is uniquely positioned to benefit from bee corridor development. The state possesses a remarkable range of ecosystems, including the Western Ghats, Eastern Ghats, coastal plains, river basins, dryland farming systems, urban landscapes, and intensive agricultural regions. This ecological diversity supports numerous pollinator species and provides an excellent foundation for establishing interconnected pollinator pathways. The importance of pollinators in Tamil Nadu extends across multiple agricultural sectors. Mango orchards in Krishnagiri and Salem, coconut plantations in Pollachi and Coimbatore, sunflower cultivation in Erode and Tiruppur, sesame fields across the Cauvery Delta, and moringa growing regions of Dindigul all depend significantly on insect pollination. Despite this dependence, pollinator habitats continue to shrink. Urban expansion has reduced natural vegetation, monocropping systems have limited floral diversity, and pesticide exposure has negatively affected bee populations. Research observations have suggested that some bee species increasingly rely on alternative food sources due to declining availability of natural forage plants, indicating a growing ecological imbalance. Bee corridors offer a practical solution by restoring habitat connectivity and ensuring year-round access to floral resources. They can function as ecological bridges linking forests, agricultural fields, urban parks, water bodies, and roadside plantations into a single integrated network.

Potential Districts for Bee Corridor Development in Tamil Nadu

The successful implementation of bee corridors requires careful identification of regions where pollinator conservation can generate maximum ecological and agricultural benefits. The Coimbatore-Pollachi region represents one of the most promising locations. Pollachi is internationally recognized for its extensive coconut cultivation and thriving beekeeping activities. The combination of agricultural diversity, existing pollinator populations, and proximity to the Western Ghats makes this region an ideal candidate for pilot bee corridor projects. Krishnagiri and Dharmapuri districts constitute another priority zone. These districts form the heart of Tamil Nadu's mango industry, and improved pollination could significantly enhance fruit set, quality, and yield. Flowering vegetation established along transportation corridors could provide critical support to pollinator populations during mango flowering seasons. Erode, Salem, Dindigul, Tiruppur, and Namakkal districts also offer substantial opportunities due to their diverse cropping systems and strategic transportation networks. Similarly, the Cauvery Delta districts, including Thanjavur, Tiruvarur, and Nagapattinam, could benefit from pollinator-friendly vegetation along canal bunds, roadsides, and agricultural landscapes. In southern Tamil Nadu, Tirunelveli, Tenkasi, and Kanyakumari possess unique ecological advantages due to their proximity to the Western Ghats and rich biodiversity. Bee corridors in these regions could simultaneously support agricultural productivity and biodiversity conservation.

National Highways Suitable for Bee Corridor Development

Several transportation corridors in Tamil Nadu offer exceptional opportunities for establishing bee corridors. National Highway 44, which traverses Kanyakumari, Tirunelveli, Madurai, Dindigul, Salem, and Krishnagiri, passes through multiple agricultural and ecological zones. A pollinator-friendly plantation programme along this route could create one of South India's most extensive bee corridors. National Highway 544 connecting Coimbatore and Pollachi passes through major coconut-growing regions and could serve as a model corridor linking agricultural landscapes with biodiversity-rich ecosystems. Similarly, National Highway 48 connecting Chennai, Vellore, and Krishnagiri traverses important horticultural zones, while National Highway 79 connecting Salem and Ulundurpet offers opportunities to support mango-growing regions. These highways, combined with state highways, railway corridors, irrigation canal bunds, and village roads, can collectively form an integrated statewide network of pollinator pathways.

Crop-Specific Benefits of Bee Corridors in Tamil Nadu

The establishment of bee corridors in Tamil Nadu has the potential to significantly enhance agricultural productivity by strengthening pollination services across diverse cropping systems. Pollination is a critical ecosystem service that directly influences fruit set, seed formation, crop quality, and yield. By providing continuous forage resources and safe movement pathways for pollinators, bee corridors can increase the abundance and diversity of bee populations, thereby improving pollination efficiency in agricultural landscapes. Tamil Nadu cultivates several economically important crops that depend partially or substantially on insect pollination. Mango, one of the state's major horticultural crops, benefits greatly from bee activity, which improves fruit set and fruit retention. Similarly, sunflower and sesame rely heavily on insect pollination for enhanced seed development, higher yield, and improved oil content. In coconut-growing regions such as Pollachi and Coimbatore, bee visitation contributes to effective pollen transfer, supporting better nut set and overall plantation productivity. Vegetable crops belonging to the cucurbit family, including cucumber, watermelon, pumpkin, bitter melon, and snake gourd, are particularly dependent on pollinators for successful fruit formation. Inadequate pollination often results in poor fruit development and reduced marketable yield. Bee corridors can help ensure the availability of pollinators throughout the flowering period, thereby improving both productivity and quality. The state's extensive cultivation of moringa, cotton, guava, papaya, citrus, sapota, and various horticultural crops can also benefit from increased pollinator activity. Enhanced pollination

not only improves yield but often contributes to superior fruit size, shape, uniformity, and seed quality, thereby increasing market value and farmer income. Beyond individual crops, bee corridors support agricultural sustainability at the landscape level. By maintaining healthy pollinator populations throughout the year, they provide a reliable pollination service that strengthens crop resilience and reduces the risk of pollination deficits. Consequently, bee corridors should be viewed not merely as biodiversity conservation measures but as essential ecological infrastructure that supports the long-term productivity and profitability of Tamil Nadu's agricultural sector.

Major Tamil Nadu crops likely to benefit most from bee corridors:

- Mango
- Coconut
- Sunflower
- Sesame
- Moringa
- Cotton
- Watermelon
- Cucumber
- Pumpkin
- Bitter gourd
- Snake gourd
- Guava
- Papaya
- Citrus
- Sapota
- Various vegetable and horticultural crops

Recommended Plant Species for Tamil Nadu Bee Corridors

The effectiveness of any bee corridor depends largely on the plant species selected. Merely increasing vegetation cover is insufficient; the chosen species must provide nectar and pollen resources throughout the year while remaining well adapted to local environmental conditions. Native and locally adapted species are generally preferred because they require less maintenance, exhibit greater resilience, and support a broader range of pollinators. Important tree species include Neem (*Azadirachta indica*), Pungam (*Pongamia pinnata*), Jamun (*Syzygium cumini*), Indian Coral Tree (*Erythrina indica*), Indian Beech, Mahua (*Madhuca longifolia*), and *Albizia* species. These trees not only provide floral resources but also contribute to shade, carbon sequestration, and habitat creation. Shrubs such as Hibiscus, Clerodendrum, Cassia, Vitex, and Tecoma can serve as important nectar sources. Herbaceous plants including sunflower, sesame, cosmos, marigold, zinnia, basil, coriander, and indigenous wildflowers can further enhance floral diversity. The most important consideration is staggered flowering. Different species should bloom during different seasons so that pollinators always have access to food resources. Continuous flowering is essential for sustaining healthy bee populations throughout the year.

Ecological Benefits of Bee Corridors

The significance of bee corridors extends far beyond agricultural production. They represent an important strategy for restoring ecological connectivity across fragmented landscapes. Habitat fragmentation is one of the greatest threats facing pollinator populations. Urban expansion, industrial development, and transportation infrastructure often divide natural ecosystems into isolated patches. Such isolation restricts pollinator movement, reduces genetic exchange, and increases vulnerability to environmental disturbances. Bee corridors function as ecological bridges connecting these fragmented habitats. By facilitating movement between feeding, nesting, and breeding sites, they improve the long-term survival prospects of pollinator populations. The benefits are not limited to bees alone. Butterflies,

moths, hoverflies, birds, and numerous beneficial insects also utilize flowering corridors. Consequently, bee corridors contribute to broader biodiversity conservation efforts while enhancing ecosystem resilience. In addition, increased vegetation cover helps reduce soil erosion, improve water infiltration, moderate local temperatures, and contribute to carbon sequestration. These environmental services become increasingly valuable under changing climatic conditions.

Socioeconomic Benefits for Farmers and Rural Communities

Bee corridors have the potential to generate substantial socioeconomic benefits. Enhanced pollination services directly contribute to increased crop yields and improved produce quality, resulting in higher farm income. The development of bee corridors can also stimulate growth in the beekeeping sector. Tamil Nadu already possesses considerable potential for apiculture, particularly in districts such as Coimbatore, Nilgiris, Erode, Dindigul, and Tirunelveli. Improved forage availability can strengthen honeybee colonies, increase honey production, and create additional livelihood opportunities for rural households. Furthermore, bee corridors can promote ecotourism, environmental education, and community participation in conservation programmes. Schools, universities, farmer organizations, self-help groups, and local bodies can all play active roles in maintaining pollinator-friendly landscapes. By integrating conservation with economic development, bee corridors create a rare win-win scenario in which both people and ecosystems benefit.

Policy Recommendations for Tamil Nadu

The successful implementation of bee corridors requires coordinated efforts involving multiple stakeholders. The Government of Tamil Nadu can integrate pollinator conservation objectives into existing programmes related to agriculture, forestry, highways, rural development, biodiversity conservation, and climate adaptation. Roadside plantations under the State Highways Department and National Highways Authority of India should prioritize pollinator-friendly species over purely ornamental plants. Canal bunds, railway margins, village roads, and urban green spaces can also be incorporated into the broader corridor network. Agricultural extension programmes should encourage farmers to establish flowering field margins and reduce indiscriminate pesticide use during flowering periods. Incentives may be provided for pollinator-friendly farming practices. Collaboration with Tamil Nadu Agricultural University, research institutions, beekeeping associations, and environmental organizations can facilitate scientific monitoring and adaptive management of corridor projects.

Future Prospects for Tamil Nadu

Tamil Nadu can become a national leader in pollinator conservation. By integrating bee corridors with sustainable agriculture initiatives, biodiversity programmes, and climate resilience strategies, the state can develop a model that other regions of India may emulate. Future corridors could connect agricultural landscapes with protected areas, urban green spaces, wetlands, and forest ecosystems, creating a statewide network of ecological connectivity. Emerging technologies such as geographic information systems (GIS), remote sensing, and pollinator monitoring tools can further improve planning and management. As awareness of pollinator importance continues to grow, bee corridors may evolve from isolated projects into essential components of landscape planning and agricultural policy.

Conclusion

Bee corridors represent far more than a conservation initiative; they are a strategic investment in the future of agriculture, biodiversity, and rural livelihoods. Inspired by India's Bee Corridor Initiative and the successful examples emerging from states such as Odisha, Tamil Nadu possesses both the ecological foundation and institutional capacity to implement a large-scale pollinator conservation network. The state's diverse agricultural systems, extensive highway infrastructure, rich biodiversity, and growing interest in sustainable development provide ideal conditions for establishing bee corridors. Regions such as

Pollachi, Coimbatore, Krishnagiri, Salem, Erode, Dindigul, Tirunelveli, and the Cauvery Delta offer particularly promising opportunities for implementation. By connecting fragmented habitats, ensuring year-round floral resources, supporting pollinator populations, and enhancing agricultural productivity, bee corridors can contribute significantly to food security, farmer prosperity, and ecological sustainability. Their establishment would symbolize a progressive vision in which infrastructure development and environmental stewardship work together rather than in opposition. The future of Tamil Nadu's agriculture depends not only on improved technologies and management practices but also on the conservation of the natural systems that sustain crop production. Protecting pollinators through the creation of bee corridors is therefore not merely an environmental responsibility it is an agricultural necessity and an investment in the well-being of future generations.

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