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Urban Tree Plantation and Green Infrastructure: A Review of Trends, Practices, and Challenges in Vidarbha's Growing Cities

Dr. Shrikant Prakash Patil

Department of Botany, Adarsha Science, J. B. Arts & Birla Commerce Mahavidyalaya, Dhamangaon Railway, District Amravati, Maharashtra, India

Corresponding Author - Dr. Shrikant Prakash Patil

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Abstract:

Urbanization in Vidarbha's cities—Nagpur, Amravati, Akola, and Wardha—has led to environmental challenges, including reduced green cover and increased pollution. This review examines urban tree plantation initiatives and green infrastructure developments in these cities, focusing on their environmental and social impacts. The paper discusses recent afforestation efforts, evaluates their effectiveness, and identifies challenges such as species selection and community involvement. It also highlights successful case studies and offers recommendations for enhancing urban forestry practices in Vidarbha.

Keywords: Urban Forestry, Tree Plantation, Green Infrastructure, Vidarbha, Environmental Sustainability

Introduction:

Vidarbha, a region located in the eastern part of Maharashtra, India, is home to several growing cities such as Nagpur, Amravati, Akola, and Wardha. Over the past few decades, rapid urbanization, industrial expansion, and increasing population density in these urban centers have led to severe ecological degradation. Among the most pressing challenges is the substantial reduction in tree cover, which has exacerbated air pollution, increased surface temperatures, and contributed to the urban heat island effect.

Tree plantations within urban areas have emerged as one of the most effective solutions to counteract the negative impacts of urbanization. Urban green infrastructure—comprising parks, roadside plantations, forest patches, and residential greenery—not only enhances ecological balance but also improves the quality of life by providing psychological and recreational benefits. Numerous studies across Indian cities have underscored the importance of green spaces in improving air quality, mitigating climate change impacts, supporting urban biodiversity,

and fostering social cohesion (Godbole & Pawar, 2021; Kumar & Sharma, 2019).

Maharashtra has implemented large-scale afforestation initiatives, such as the 33 Crore Tree Plantation Drive, with significant activities in Vidarbha. Yet, questions remain about the long-term impact and sustainability of these efforts, especially in urban landscapes that demand thoughtful species selection, community involvement, and consistent maintenance. With cities like Nagpur leading innovative projects such as the Nagar Van scheme and Akola experimenting with Miyawaki methods, Vidarbha provides a unique landscape to evaluate both traditional and modern approaches to urban tree plantation.

This review aims to investigate and synthesize the current status, achievements, and obstacles in urban tree plantation across these cities. The paper evaluates governmental and community-led efforts, assesses ecological benefits using quantifiable indicators like carbon sequestration and tree cover loss, and outlines future directions to strengthen green infrastructure in the region.

Methodology:

This study is a literature-based review that synthesizes information from peer-reviewed journals, government reports, and reputable online sources. The selection criteria included relevance to urban forestry in Vidarbha, publication within the last decade, and contributions to understanding urban tree plantation practices and their impacts. Data were analyzed to identify common themes, successful initiatives, and prevailing challenges in the region's urban forestry efforts.

Results:

Table 1: Summary of Urban Tree Plantation and Environmental Indicators in Vidarbha Cities

City	Tree Cover Loss (ha)	Estimated Tree Deficit (trees)	Urban Forest Project	Plantation Drive Success	CO_2 Emissions from Tree Loss (kt)
Nagpur	30	700,000	Yes (Koradi Nagar Van)	High	15.2
Amravati	25	950,000	Partial (Under Planning)	Moderate	12.7
Akola	20	600,000	Yes (Miyawaki Forest)	Ongoing	10.3
Wardha	67	400,000	No	Low/Needed	33.6

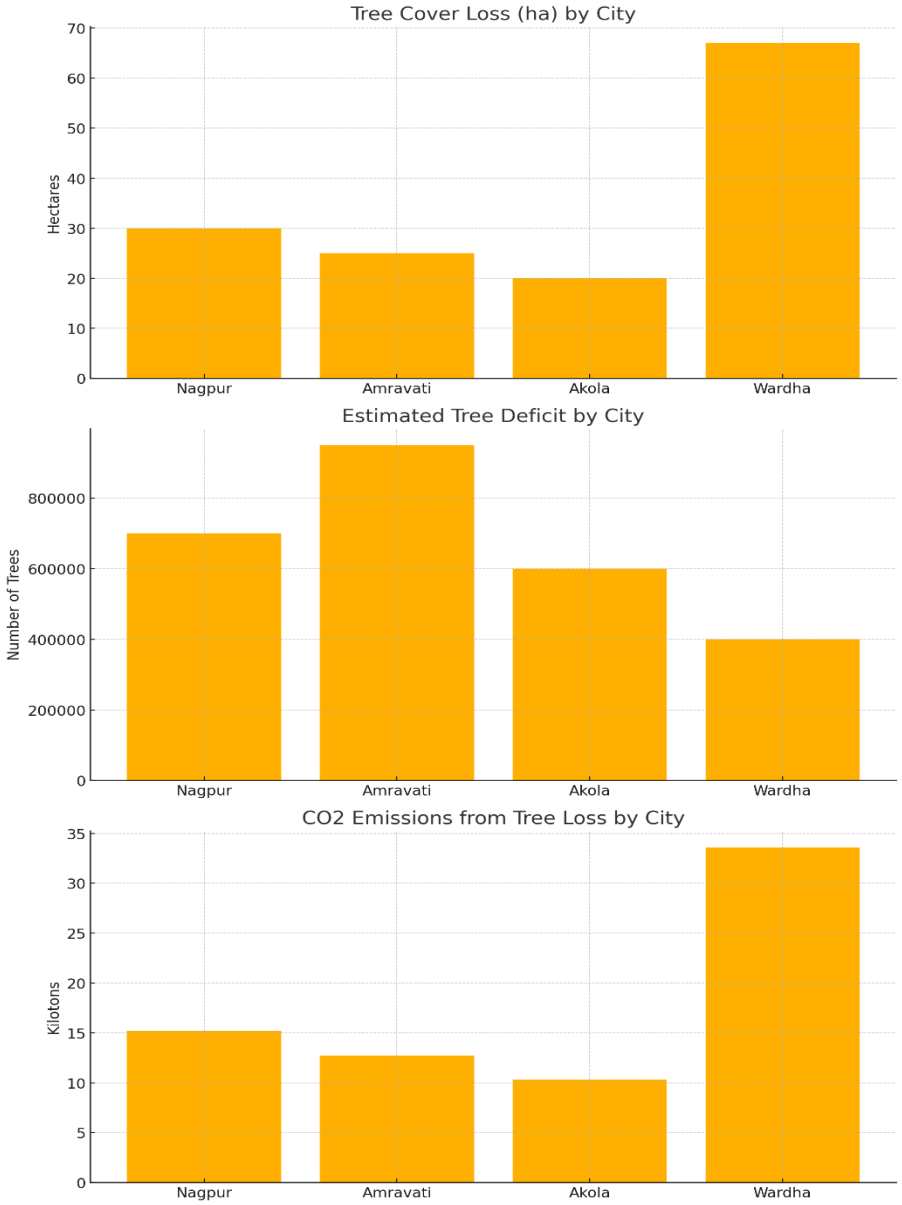

Figure 1. Tree Cover Loss (ha) by City in Vidarbha

This graph shows the extent of tree cover loss in four major cities of Vidarbha. Wardha recorded the highest tree loss at 67 hectares.

Figure 2. Estimated Tree Deficit by City

The bar chart illustrates the estimated tree deficit in urban environments. Amravati shows the highest shortfall with a deficit of nearly 950,000 trees.

Figure 3. CO_2 Emissions from Tree Loss by City

This figure highlights the environmental cost of tree loss in the form of CO_2 emissions. Wardha contributes the highest emission of 33.6 kilotons.

1. Urban Tree Plantation Initiatives in Vidarbha:

Maharashtra's ambitious 33 Crore Tree Plantation Drive aimed to combat climate change and drought by planting over 33 crore saplings across the state's districts, including those in Vidarbha. The initiative surpassed its target, with a reported survival rate of 81% for the planted trees (Maharashtra Forest Department, n.d.).

In Nagpur, the Public Works Department (PWD) implemented a successful plantation project along the Pachgaon-Kuhi Road, achieving a survival rate exceeding 75%. Approximately 180 trees per kilometer have thrived, primarily neem (*Azadirachta indica*) and karanji (*Pongamia pinnata*), chosen for their resilience to grazing and environmental adaptability (Times of India, 2022).

Amravati has also undertaken significant tree plantation drives. The Social Forestry Department reported that the city had approximately 500,000 trees, whereas the ideal number should be over 1.45 million to maintain ecological balance. This indicates a substantial need for increased plantation efforts (Times of India, 2010).

In Akola, the adoption of the Miyawaki method—a technique for creating dense, fast-growing forests—has been promoted to enhance urban green cover. This approach involves planting native species close together, resulting in rapid canopy development and increased biodiversity (Grow Billion Trees, n.d.).

Wardha has experienced a 12% decrease in tree cover since 2000, losing 67 hectares of tree cover from 2001 to 2023, leading to 33.6 kilotons of CO_2 emissions. This underscores the urgent need for effective afforestation strategies in the area (Global Forest Watch, n.d.).

2. Environmental and Social Benefits:

Urban tree plantations offer numerous environmental benefits, including carbon sequestration, air pollution reduction, and mitigation of the urban heat island effect. A study in Nagpur assessed the city's urban green spaces and found significant carbon stock potential, emphasizing the importance of preserving mature trees and promoting diverse species plantations. The study reported an average carbon sequestration of 7.94 tons per hectare across various plantation densities (Nagpure & Ghosh, 2020).

Socially, green spaces contribute to improved mental health, recreational opportunities, and community cohesion. The development of urban forests and parks in Vidarbha's cities provides residents with areas for leisure and promotes environmental awareness.

3. Challenges in Urban Tree Plantation:

Despite these benefits, urban tree plantation initiatives in Vidarbha face several challenges:

- **Species Selection:** The choice of tree species is critical for the

success of urban forestry projects. Studies have shown that certain species have higher ozone-forming potential due to volatile organic compound emissions, which can negate some environmental benefits (Singh & Chandrawanshi, 2014).

- **Maintenance and Survival Rates:** Ensuring the survival of planted saplings requires ongoing maintenance, protection from grazing animals, and adequate watering. The PWD's success along Pachgaon-Kuhi Road was attributed to adherence to expert protocols, including prompt replacement of mortalities and regular watering (Times of India, 2022).
- **Community Involvement:** Active participation from local residents is essential for the sustainability of urban forestry projects. Programs such as the 'Green Army' in Maharashtra have been established to involve volunteers in plantation and conservation efforts (Mungantiwar, n.d.).

Discussion:

The success of urban tree plantation in Vidarbha's cities depends on strategic planning, appropriate species selection, and community engagement. While large-scale initiatives have made significant progress in increasing green cover, challenges related to maintenance and species suitability remain. Integrating scientific research into species selection and fostering public participation can enhance the effectiveness and sustainability of these efforts.

Comparing Vidarbha's urban green efforts with other urban regions in India highlights both promising advances and areas for improvement. For instance, cities like Bengaluru and Chandigarh have higher per capita tree cover—28.5 sq.m and 55 sq.m respectively—compared to Vidarbha cities like Nagpur, which lags with about 10–15 sq.m (Forest Survey of India, 2021). Moreover, CO_2 emissions from tree loss in Vidarbha's Wardha (33.6 kt) significantly surpass urban districts in Tamil Nadu and Gujarat of similar size, pointing to an urgent need for focused afforestation strategies.

In terms of community participation, Pune's model of ward-level green budgeting and Delhi's Miyawaki-based urban forests show that sustained civic engagement and funding transparency can lead to more resilient urban forests (Gole & Niphadkar, 2020). While Nagpur has shown promise with its Nagar Van initiative, scaling similar models to Amravati, Akola, and Wardha

requires not only replicable planning but also grassroots advocacy and localized species selection.

In conclusion, Vidarbha's experience presents valuable insights into the opportunities and obstacles faced by tier-2 and tier-3 cities in India striving for ecological balance amid rapid development. Cross-regional learning, national benchmarking, and adaptive forest planning are key to expanding and sustaining urban green infrastructure. in Vidarbha's cities depends on strategic planning, appropriate species selection, and community engagement. While large-scale initiatives have made significant progress in increasing green cover, challenges related to maintenance and species suitability remain. Integrating scientific research into species selection and fostering public participation can enhance the effectiveness and sustainability of these efforts.

Conclusion:

Urban tree plantation and green infrastructure development are crucial for addressing the environmental challenges posed by rapid urbanization in Vidarbha's cities. This review has shown that cities like Nagpur, Amravati, Akola, and Wardha face varying degrees of green cover loss, tree deficit, and CO_2 emissions due to developmental pressures. However, the success stories from projects like Nagar Van and Miyawaki plantations indicate the region's potential to restore ecological balance through proactive efforts.

To realize this potential, urban forestry strategies in Vidarbha must be rooted in scientific species selection, adaptive management, public participation, and region-specific policies. Collaboration between government bodies, academic institutions, and local communities will be essential for maintaining the momentum of existing efforts and expanding them effectively. Additionally, benchmarking against greener Indian cities such as Bengaluru and Chandigarh provide a valuable roadmap for long-term planning.

Sustained investment in urban green infrastructure will not only contribute to environmental sustainability but also improve public health, enhance biodiversity, and foster a sense of environmental stewardship among citizens. The findings of this review underscore the importance of integrating ecological considerations into urban planning for a greener, healthier future in Vidarbha.

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