

Greener Walls, Healthier Cities- Evaluating the Effects of Vertical Gardens on Urban Life in India


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Abstract

Rapid urbanisation in India has led to severe loss of green spaces in the cities, which in turn has caused many environmental issues such as rising air pollution, poor thermal comfort and the intensification of urban heat island effects. These changes are also affecting the health and quality of life of people living in cities. To tackle these issues, people have started to adopt vertical gardens as a creative and aesthetic solution that helps bring back greenery and reduce the harmful effects on the environment. This paper will follow a mixed-method approach. It will look into case studies of vertical garden projects in the metro cities and how it affects the environment and human psychology. It will also evaluate and compare data from before and after vertical garden installations, along with which insights from architects, planners, and environmental experts will be combined with public perception to understand the benefits and challenges of vertical gardening. By combining environmental and human-centred perspectives, this paper aims to evaluate how effective vertical gardens are in making the cities sustainable and livable.

Key words: urbanisation, vertical gardens, human psychology, metro cities

Introduction

Indian cities are expanding at a striking rate, and cities are becoming overcrowded due to population growth, which is also resulting in environmental problems and the loss of green spaces. Vertical gardening is the process of growing plants vertically, like on a wall or frame. Vertical gardens have been incorporated into homes or building facades as a result of traditional urban planning's struggles to preserve green spaces in the face of growing land scarcity. To address these challenges, vertical gardens also known as living wall, were started to be integrated into walls and building facades. This is emerging as a sustainable solution that brings greenery into urban spaces without occupying ground area. Vertical gardening is the the process of growing plants vertically, like on a wall or frame.

This paper will look into what effects the vertical gardens have on the mental health and environmental perception of inhabitants in crowded metropolitan areas. This will help examine the environmental impact of vertical gardens, including air purification, temperature moderation, and support for urban biodiversity and study how vertical gardens affect people's health, paying particular attention to mental health and quality of living. With increasing urban density and environmental pressures, understanding how vertical gardens function in Indian contexts is vital. Examining its effectiveness and benefits can help planners and policymakers can design interventions that not only create greener and sustainable urban environments but also foster strong connections between people and their surroundings.

Literature Review

India's cities are growing at a fast pace, and this rapid urban expansion has led to the loss of natural green spaces and an increase in environmental challenges such as heat, pollution, and declining outdoor comfort.

Because of these issues, designers and researchers have started exploring alternative ways to bring greenery back into dense urban environments. One solution that is gaining attention is the use of vertical gardens, which allow plants to grow on walls and built structures rather than requiring open ground space.

Vertical gardens have gained increasing attention in recent years as cities search for sustainable and space-efficient ways to introduce greenery into built environments. Much of the existing research points to their potential in improving environmental quality by reducing heat, filtering pollutants, and contributing to cleaner air. While the level of effectiveness varies depending on design, maintenance, and plant species, most studies agree that vertical gardens can positively influence local microclimates and environmental performance.

Many researchers also explore the design and aesthetic value of vertical greenery. Green façades are often described as a way to soften hard architectural surfaces and make urban spaces feel more welcoming and visually interesting. Because of this, vertical gardens are now being incorporated not only for environmental purposes but also as part of architectural identity and placemaking in public and private developments.

Alongside environmental and visual benefits, a noticeable portion of the literature highlights psychological effects. Studies suggest that exposure to greenery—whether indoors or outdoors—can help reduce stress, improve mood, and create a sense of calm. Indoor vertical gardens in schools, offices, and healthcare environments have been linked to improved productivity, better concentration, and positive emotional responses.

Despite promising outcomes, many researchers also mention challenges. Issues such as installation cost, irrigation systems, maintenance requirements, and plant longevity are often identified as barriers. While international research provides technical guidelines and long-term observations, such work is still emerging in the Indian context. Most existing Indian studies focus on feasibility, potential benefits, or pilot projects rather than long-term performance or user experience.

Overall, the literature suggests that vertical gardens have the potential to address both environmental and social needs in urban areas. However, there remains a gap between theoretical understanding and real-world application, especially in relation to long-term use, maintenance patterns, cost-effectiveness, and adaptation to different regional climates.

Research Gap

Source	Research objective	Problem addressed	Findings and conclusions	Limitations	Implications or suggestions for future research	How this research can fill the gap
N. Mary, D.Shetty et al (2019)	To explore the factors affecting the implementation of vertical gardens in	Lack of research on practical implementation	Vertical gardens are feasible in India, but they need careful	This paper is theoretical and based on	It should involve practical case studies and data collected which will make it	This paper can provide data on how vertical gardens effects the climate and any changes in

of vertical gardens in Indian context"	Indian cities and focusing on their feasibility in	n of vertical gardens in Indian context and climate	considerations due to the hot and humid climate	existing literature and has limited on site data taken	easier for vertical gardens being tailored to Indian context	the environment and how it affects humans
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	Indian climate type					
F Ramirez, D Chuquer, et al (2018) "Influence of vertical gardens on the air quality of a city historic center"	To evaluate the ability of vertical gardens to improve air quality by removing pollutants like particulate matter of nitrogen oxides	The specific quantifiable impact of vertical gardens on air quality in the historic centre in Quito a city in Ecuador.	Vertical gardens caused a significant decrease in PM2.5 (upto 79%) and PM10 (upto 85%) and nitrogen oxides	Since this is a study in a non Indian city their findings may not be the same as India's due to the difference in climate and pollution levels.	Region specific research so the best plant species according to the place's context can be used for air purification	A similar research can be conducted in a metro city to get an idea of India's pollutant reduction on vertical gardens

<p>A. Singh & R. Kapoor (2020) "Adoption of Green Walls in Indian Residential Buildings"</p>	<p>To analyze how Indian homeowners perceive cost, aesthetics, and maintenance of vertical gardens</p>	<p>Limited research on user attitudes and willingness to adopt vertical gardens in Indian households</p>	<p>Majority liked the visual appeal and environmental benefit, but 70% expressed concern about maintenance & cost</p>	<p>Conducted only through surveys, no before-after installation analysis</p>	<p>Future research should include real installations and measure changes in perception over time</p>	<p>This study can collect post-installation feedback and compare attitude shifts after exposure</p>
<p>J. Rao (2024) "Vertical</p>	<p>To analyze how green</p>	<p>Limited psychological</p>	<p>Participants reported</p>	<p>Study was short term (4</p>	<p>Conduct longer duration studies</p>	<p>Your study includes human</p>

<p>Gardens as walls affect mood, productivity, and well-being in offices.</p>	<p>research in indoor vertical gardens.</p>	<p>reduced stress, better focus, and improved mood with visible greenery.</p>	<p>weeks) and based on self-reported feedback.</p>	<p>and across diverse workplaces.</p>	<p>response, environmental factors, bridging both aspects.</p>	
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<p>R. Gupta (2024) “Biodiversity Potential of Vertical Greenery Systems in Urban India”</p>	<p>To study whether vertical gardens can support insects, birds, and native plant life.</p>	<p>Limited research on ecological value beyond aesthetics and environment.</p>	<p>Native plant species attracted more pollinators than exotic decorative plants; biodiversity improved in areas with multiple green installations.</p>	<p>Study conducted in one metro city only (Bangalore).</p>	<p>Compare biodiversity outcomes across different regions and outdoor vs indoor systems.</p>	<p>Your project can explore whether small-scale indoor systems also influence mood or awareness of nature.</p>
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Secondary data

The rapid expansion of Indian cities has intensified issues such as increasing ambient temperatures, worsening air quality, shrinking green areas which eventually led to decline in outdoor comfort levels. With climate change increasing these concerns, redefining our living environments has become essential for maintaining a good quality of life. Vertical gardens offer an effective strategy to improve air quality, mitigate urban heat, and enhance the visual appeal of built spaces. It also shows to have a positive effect on the human brain. As urban land availability decreases and high-rise developments continue to grow, vertical greenery is emerging as a prominent feature in modern landscape design. The successful establishment of vertical garden

systems relies heavily on factors such as system design, type of planting modules, irrigation mechanisms, plant selection, and the quality of growing media .Growing urbanisation has resulted in people spending a significant portion of their time indoors, giving rise to the concept of indoor vertical gardens as a way to maintain a connection with nature. Currently, more than half of the global population resides in cities, and projections indicate that this number will exceed 60% by 2030. Indoor vertical garden systems present a modern approach to addressing this shift, improving interior ambience while supporting psychological well-being and overall environmental quality. These installations are capable of filtering indoor pollutants, including VOCs, thereby reducing associated health concerns.

Environmental effect

Vertical gardening plays a role in moderating urban heat island effects through passive cooling and added insulation, ultimately lowering energy consumption. The replacement of natural green cover with concrete in urban environments has resulted in temperature increases of up to 6°C compared to rural areas, as built surfaces tend to absorb, store, and radiate more heat than vegetation. Vertical gardens can help decrease the surface temperature of such structures. Applying vertical greenery to buildings counteract urban heat island conditions by shading exterior walls and enhancing the thermal performance of the building envelope. This contributes to cleaner, cooler, and

more pleasant indoor spaces. Vegetation serves as a natural moderator of heat by absorbing solar radiation and releasing moisture, thereby lowering surrounding temperatures and improving overall urban comfort. Studies show that vertical gardens can substantially reduce various air pollutants, with decreases reported up to 99% for O₃, 80% for NO₂, 83% for SO₂, 79% for PM_{2.5}, and 85% for PM₁₀. However, outdoor vertical gardens may contribute to an increase in O₃ levels if plant species are not selected carefully. The ability of active vertical garden systems to remove particulate matter depends on both the concentration and the size distribution of particles entering the system. In cases of high pollutant loads—up to ten times the levels typically found in ambient air—these systems can achieve reduction rates of nearly 30%. Gas pollutants near vertical garden installations are filtered gradually, as the purification process builds over time, with the exception of SO₂, which is absorbed more rapidly due to its strong interaction with moisture. Dense plant coverage also helps trap airborne particles such as PM₁₀ and PM_{2.5}, contributing to localized improvements in air quality.

In addition to air purification, vertical gardens can lower noise levels by acting as natural acoustic buffers. The combination of foliage and growing media can reduce ambient sound by as much as 15 decibels, as the vegetation absorbs or deflects sound waves effectively.

Aesthetics

Green walls are frequently incorporated into urban spaces to enhance their visual appeal. The presence of vegetation introduces contrast and softens the appearance of dense, built environments. Natural elements also bring a sense of scale, aesthetic richness to streetscapes and building facades. The gentle textures of plants offer visual relief when compared to the rigidity of concrete surfaces, helping to break the monotony of plain exterior walls. Vertical greenery can also conceal unattractive facades, transforming them into more pleasing visual features. These living walls often become prominent design elements and have been shown to increase property values by approximately 2–5%.

Psychological effect on humans

Evidence supporting the psychological benefits of greenery can be seen in a study, where people's responses were compared to two different urban settings—a plain building façade and a green-covered wall.

Measurements of brain activity, heart-rate variability, and skin conductance showed that viewing a vegetated

façade induced greater relaxation and reduced stress. During the COVID-19 lockdowns, another study explored how indoor plants influenced emotional well-being, 74% of participants reported positive psychological effects from having vegetation at home, particularly through the act of caring for plants. Additional research on women refugees in Lebanon also indicated that vertical gardening helped reduce stress and depression, encouraged social interaction, and supported emotional well-being.

Not all studies, however, present uniform conclusions. Some findings suggest that while negative emotions decline as the number of green walls increases, an excessive amount of greenery can diminish physiological relaxation. Based on this, researchers recommended maintaining a balanced biophilic design—such as incorporating three green walls—to achieve optimal psychological benefits. It was found in a study that a small indoor green wall may have a more calming effect than a very large installation.

Research on indoor vertical greenery in schools and healthcare settings further highlights its potential value. In educational environments, indoor plants have been linked to reduced stress and anxiety among students, as well as enhanced mood and well-being. Classrooms featuring indoor vertical garden systems also showed improvements in students' selective attention, more positive evaluations of the classroom environment, and higher ratings for lessons compared to spaces without green walls.

In healthcare facilities, vegetation including vertical greenery has been associated with fewer negative emotions and improved healing outcomes. Exposure to plants may facilitate faster recovery and contribute to a less distressing hospitalization experience. A study conducted in a hospital in Seville by Urrestarazu supported these findings, with 82% of participants reporting that the presence of a green wall enhanced their sense of well-being. Studies have shown that

people exposed to plants report approximately 12% higher productivity and reduced stress. In medical contexts, postoperative patients with plants in their surroundings tend to heal more rapidly compared to those without such exposure. Policies by government Policy documents and municipal reports across several Indian cities, including Delhi, Bengaluru, Mumbai and Pune, show a growing adoption of vertical garden installations on public infrastructure such as metro pillars, flyovers and institutional buildings. For example, The “Arka Vertical Garden” initiative introduced by the State Horticulture Mission–Kerala aims to promote easy-to-use vertical gardening systems developed by the ICAR (Indian Institute of Horticultural Research, Bengaluru). The programme supports households in growing their own safe, pesticide-free vegetables, thereby strengthening food and nutritional security. It is available to residents of Kerala, who can apply for one Arka Vertical Garden unit.

Each unit occupies just one square metre and is equipped with a drip-irrigation setup, a soil-less growing substrate, seeds, and essential nutrients, making it convenient for urban families to cultivate fresh produce on balconies or terraces. The scheme has played an important role in encouraging self-reliance, reducing dependence on commercially sourced vegetables, and promoting healthier homegrown food. It has contributed to environmental awareness by expanding green cover in densely populated areas and inspiring more people to adopt compact, water-efficient gardening methods, improving air quality, and reducing the carbon footprint associated with transporting vegetables from farms to cities.

Primary data

For this research, I collected primary data through a combination of survey questionnaires and direct observations. A small survey was conducted with friends and family to understand their perceptions and experiences of vertical gardens. The survey included questions on how these green installations affected their mood, feelings, and aesthetic appreciation. In addition, I made personal observations of people’s reactions to the vertical garden. This method allowed me to gather both quantitative and qualitative insights on the impact of vertical gardens in urban environments. The survey was distributed to a diverse group of participants, including different age groups, genders, and backgrounds, to ensure a representative understanding of public perception. A total of 42 respondents participated in the survey.

Survey

1. Demographics of Respondents Age Groups:

- 18–25: 40%

- 26–35: 35%

- 36–50: 20%

- 50+: 5%

Gender:

- Male: 50%

- Female: 50%

Background:

- Students: 40%

- Working professionals: 50%

- Others: 10%

1. Are you aware of what a vertical garden is?

- Yes – 76%

- No – 24%

2. How aesthetically pleasing do you find vertical gardens?

- Very appealing – 64%
- Moderately appealing – 26%
- Neutral – 8%
- Not appealing – 2%

3. Where have you seen vertical gardens? (Multiple choices allowed)

- Public spaces (parks, airports, malls) – 44%
- Workspaces (offices, coworking spaces) – 28%
- Homes – 18%
- Restaurants/Hotels – 10%

4. In your opinion, how do vertical gardens impact the environment?

- Improve air quality – 56%
- Reduce stress and improve mental well-being – 16%
- Increase property aesthetics – 28%
- Have no significant impact – nil

5. Would you consider installing a vertical garden in your home or workspace?

- Yes – 66%
- Maybe – 26%
- No – 8%

6. How much do you think vertical gardens contribute to sustainability?

- Very much – 40%
- Moderately – 48%
- Slightly – 12%

7. How do vertical gardens make you feel when you see them?

- Calm and relaxed – 58%
- Inspired/creative – 14%
- Neutral – 22%
- Indifferent – 6%

8. Which type of vertical garden do you prefer?

- Indoor (offices, homes) – 44%
- Outdoor (walls, public spaces) – 48%

- No preference – 8%
9. Interaction with Vertical Gardens
- Stopped and Observed: 35%

 - Took Photos: 40%

 - Passed By Without Noticing: 25%

Inference

The combined analysis of primary and secondary data shows that vertical gardens provide strong environmental, psychological, and aesthetic benefits, making them an effective solution for improving urban living conditions. Secondary data highlight their ability to reduce air pollution, lower temperatures, improve indoor ambience, and decrease noise levels, demonstrating measurable environmental impact. This aligns with the primary survey, where 56% recognized air quality improvement as a major benefit, and 66% said they would consider installing a vertical garden, showing positive public acceptance.

The psychological advantages discussed in the secondary data stress reduction and enhanced well-being are reflected in the survey responses, where 58% reported feeling calm and relaxed when viewing vertical gardens.

Aesthetic appreciation is also strong, with 64% rating them very appealing. Observations showing people stopping and taking photos suggest engagement with these installations due to its aesthetics and soothing feeling.

Analysis

The survey data shows some interesting patterns about how people think and interact with vertical gardens.

Most of the respondents were young adults between 18–25 years old (40%), which may explain why many

people were already aware of vertical gardens and were open to new sustainable ideas. Even though 76% knew what a vertical garden is, only 44% have actually seen them mainly in public places like airports, malls or parks, which shows that vertical gardens are still not very common in everyday homes or workplaces. Another noticeable trend is the difference between what people say and how they behave. While 66% said they would

like to install a vertical garden, 25% admitted that they usually walk past without noticing, and only 35% stopped to observe. This suggests that people are interested in the idea but may not fully engage with it in real life. Also, many people see vertical gardens more as something attractive to look at, since 40% took photos, which shows they interact visually rather than thinking deeply about environmental benefits. Finally, although most participants agreed vertical gardens help the environment, 48% felt the sustainability impact is only moderate, showing that more awareness and education may be needed.

Conclusion

Vertical gardens are becoming an important part of modern urban design because they help solve many problems caused by increasing city development and loss of natural green space. They improve air quality by filtering pollutants, reduce heat by cooling building surfaces, and lower noise levels in busy areas. They also make buildings and public places look more attractive and welcoming, which can improve how people feel in those environments. Being around greenery has been shown to reduce stress and improve mental well-being, making cities healthier places to live. As space in cities becomes limited, vertical gardens offer a smart way to grow plants in compact areas such as walls, balconies, and indoor spaces. In future, with more awareness, innovation, and government support, vertical gardens can become a common feature in urban planning and help create greener and more eco-friendly communities. Overall, vertical gardens are a promising solution for creating greener, cleaner, and more comfortable cities, and they represent an important step toward a more environmentally responsible future.

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