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# Vertical Greening: A Decisive Approach to Mitigate the Rising Temperature in Chennai Due to Land use Change and Land cover Change

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***Abstract:*** The environment's ecological balance has been completely disrupted as a result of the fast urbanization that has been taking place over time. The volume of vegetation has been steadily declining as a result of various development operations. Today's changing patterns in urban sprawl and the diverse character of the urban vegetation cover make it difficult to monitor the loss of vegetation cover. To satisfy human needs, buildings are being built at an alarming rate, endangering the environment and resulting in the rise of urban temperature. Bringing back the lost greenery is very important to provide a comfortable environment by lowering the urban temperature. However, as the land has been taken up for construction activities, replanting all trees on the ground is impossible due to a shortage of space and growing trees requires lots of time. To address the above issue, Vertical greening is a feasible and sustainable approach to bringing back the lost greenery on the vertical surface of the buildings. To take full advantage of a Vertical Greening System (VGS) in terms of thermal performance in a hot and humid climate like Chennai, a research series was conducted to establish the need for vertical greening due to land use change, to widen the knowledge on vertical greening, analyze on different types of VGS to come out with an efficient VGS for hot and humid climate along with exploring the efficiency of native species in reducing the air temperature. This paper establishes the need for vertical greening due to land use and land cover change in Chennai.

***Keywords:*** *loss of vegetation, Urban sprawl, urban temperature, Vertical greening.*

## 1. Introduction

Chennai Metropolis is the 30th-largest urban area in the world and a flat coastal city that is located between latitudes 12°50'49" and 13°17'24"N and longitude 79°59'53" and 80°20'12"E. The city experiences a tropical climate, more precisely, a tropical wet and dry climate. For the majority of the year, it is warm and humid weather. From October through December, the post-monsoon/northeast monsoon winds bring the majority of the city's seasonal rainfall. In the past 20 years, there has been an excessive increase in population as a result of major industrialization and rapid growth in Chennai. [1]. Urbanization and land use change primarily affect the microclimate and minimum temperature of cities; annual temperature variance is higher in urban areas than in rural areas. Chennai's land-use patterns, damage to natural resources, population stress, and climate has changed enormously in the last few years. Climate-induced issues like floods, drought, torrential rains, and winds are evident in the city. The maximum and minimum temperature has risen to 1.9 °C and 1.3 °C, respectively in the past 60 years. [2] The impact of climate change on natural ecosystems, agriculture, and human health makes it the most significant environmental threat to humanity. [3]

## 2. Land Use Change and Rising Temperature

Chennai has grown dramatically during the past ten years. But the threat to the current green spaces has increased as a result of these changes. The area of south Chennai is facing rapid changes in land use and land cover as a result of urbanization and industrial growth, according to remote sensing and GIS studies. According to quantitative estimates received from multi-date remote sensing data on land use and land cover changes; there has been an expansion in settlement areas and a simultaneous decline in

agricultural land. In the research region, which includes Velachery, Perumbakkam, Pallikaranai, Tambaram, Karanai, Perungudi, and Madipakkam, the majority of the pasture land has been transformed for new urban development.[4] Chennai's urban sprawl since 1991 and analyzed the satellite imagery of 1991, 2003, and 2016 to evaluate the various indicators of urban expansion. The study demonstrates that city has lost its bare land, Valuable vegetation, water bodies, and agricultural lands and converted mangrove forest area that promotes essential services of the ecosystem. (Figure 1)[5]

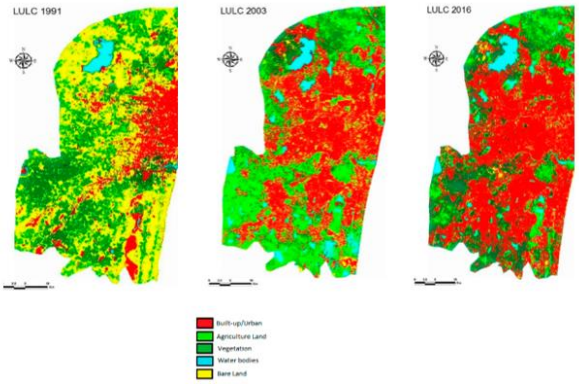


**Fig. 1.** Land use land cover map for 1991, 2003, and 2016 in Chennai

The area used for agriculture has gradually shrunk. The entire area used for agriculture in 1990 was 17.4 km2. In 1998, it reduced to 9.3 km2. In 2005, there were just 6 km2 of agricultural land. Additionally, the forest area grew. Nearly 11% of the total area was made up of forests in 1990. It increased by 3 percent in 1998, reaching 14 percent. A recent survey shows about 16% of the reserved forest area, is because of the specialized forestry and enhanced plantations of eucalyptus in this region.[4] However, a minimum of 33% of tree cover is required for a city in size of Chennai, as per National Forest policy 1952. The loss of vegetation cover and urbanization affects Chennai's micro temperature. The maximum temperature was observed in the center of the city and north Chennai which had more commercial and residential areas. The temperature difference between the city center and the fringes was around 3–4.5 °C. There is an immense need for the city administration, policymakers, and architects to consider mitigation measures and decisive strategies to create a comfortable environment for people [6]

## 3. Vertical Greening - A Sustainable Solution

The practice of greening different types of vertical surfaces with plants is known as vertical greening or vertical garden. The incorporation of ecological ideas into current engineering practices is a crucial solution. Urban gardening is the term used to describe it because they are suited for urban environments where there is a lot of vertical space but very little available ground space. As it connects several functionalities, vertical greening integrates nature and buildings. By growing a range of plants as beautiful green envelopes on a minimal amount of growth media, ecological and environmental problems in crowded metropolitan areas can be addressed [7].

## 4. History of Vertical Greening

The concept of the vertical garden dates back to 600bce,

**600** B.C.E - first seen on, one of the seven wonders of the ancient world, the Hanging Gardens of Babylon,

**3000bce** - Climbing roses were utilized as a sign of hidden gardens by the Romans, who also trained grapevines on garden trellises and villa walls.

**The 1920s** - The use of self-climbing plants, pergolas, and other garden elements and plants was supported by both the British and Americans.

**1980's** - The French botanist Patrick Blanc discovered Mur Vegetal

**1988**- The stainless-steel cable for green facades was first introduced.

**In the 1990s** - Modular trellis panel systems, wire rope net systems, and cable systems were introduced.

**1993** - The Universal City Walk in California served as the first significant location for the innovative trellis panel system.

**1994** - A bio-filtration system was developed as an indoor living wall, in Life Building Toronto, Canada.

**2005** - There were over thirty distinct modular systems for vertical gardening. [8]

## 5. Benefits of Vertical Greening

Vertical greening has numerous benefits which include, [9]

| | |
|---|---|
| Environmental | • Reduce the impact of the urban heat island and control the microclimate.<br>• Enhance the quality of the air both inside and outside by removing pollutants and controlling CO2 levels.<br>• Enhance environmental beauty and biodiversity. |
| Social | • Enhance human health and mental well-being<br>• provide aesthetic value for urban environments<br>• Adds to a building's identity |
| Economic | • Improve energy efficiency with greater shade and insulation.<br>• Reduce noise,<br>• safeguard building structures,<br>• Improves property values. |

## 6. Conclusion

Restoring the environmental conditions in densely populated urban areas can be accomplished by greening the building exterior with vegetation. The façades can be designed more innovatively rather than just tinted glass barriers or concrete structures. The advantages of green facades on both new and old buildings in terms of the environment have been established by several studies. In addition to improving air quality for city people, they can be used to mitigate the impacts of urban heat islands, promote the value of biodiversity and ecology, protect against environmental damage, improve indoor and outdoor comfort, and promote social and psychological wellbeing.

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