

A SURVEY STUDY ON THE PERCEPTION OF THE VERTICAL GARDEN AMONG THE PUBLIC OF CHENNAI

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Abstract

Vertical gardens (VG) has proved to have numerous environmental, economic, and social benefits. However, implementing VG is not common in a highly developed city like Chennai due to various reasons. This study aims to examine public perspectives on VG and the challenges preventing their broad adoption in Chennai, Tamil Nadu. This research uses a sociotechnical strategy to encourage the adoption of VG. A survey approach was used for the investigation. An online questionnaire was given access to the public of Greater Chennai Corporation to come out with a quantitative understanding of the perception of VG. There were four 4 parts with 11 close-ended multiple-choice questions. Part 1 included socio-demographic factors, while part 2 collected information on awareness of VG and the desire to adopt it in Chennai. Part 3 examined the understanding of the environmental, economic, and aesthetic benefits of the VG. Part 4 focused on the barriers to the usage of VG in Chennai. The survey report analysis makes it clear that the following are the barriers to its widespread adoption in Chennai; the VG is still at a conceptual stage in the mind of the public due to a lack of clear understanding of its maintenance, irrigation, and the thought that vertical greening would cause structural damages. The purpose of vertical greening is prioritized for its aesthetic benefits rather than its environmental and social benefits. The maintenance and irrigation issues are also among the reasons discussed in this paper.

Keywords: Vertical Garden, Public, Perspective, Survey, quantitative, Barriers

1. INTRODUCTION

The foremost issues due to urbanization in Chennai are the rising urban temperature (urban heat island effect) and the increasing energy consumption. The urban heat effect describes a difference in temperature between the urban area with higher temperatures and the nearby rural area with lower temperatures. The sun's rays are absorbed and stored by the exterior building materials and hard surfaces during the day and slowly released back to the atmosphere during the night, increasing the nighttime temperature in urban areas. The city center and north Chennai had the maximum temperature as it had more commercial and residential areas and a difference in temperature of 3–4.5 °c was noticed between the city center and fringes [1] By expanding the city's green space, this detrimental effect can be compensated, as they help to reflect sunlight.VG helps in minimizing the urban heat island effect and rising energy use due to evaporation and by reflecting solar radiation. The removal of green cover on the horizontal plane led to increased application of vertical garden, to bring back the removed urban greenery. The

concept of using plants on structures was first seen in the hanging gardens of Babylon, (Fig 1) where the plants were rooted on layered terraces. The modern version of the vertical garden, which uses the plant on the surface of the wall, was founded by the French botanist Patrick Blanc. Patrick Blanc introduced the first VG at the science and industry museum in Paris in 1986. [2] Even though many countries are working towards a greener environment, Singapore is the pioneering city in the concept of the vertical garden due to its strict regulation and policies launched on different vertical greenery. Landscape Replacement Area (LRA) Policy of Singapore initiates replacing 100% of the site greenery on the new building with 10% of the area mandatorily for a vertical greening system. [3]

Fig 1: Hanging Garden of Babylon



2. VERTICAL GARDEN AND ITS BENEFITS

A vertical garden can be created in two different ways called Green facades and living walls. When the climbing plants grow to cover the surface of the wall from the growing medium placed at the bottom is called green facades. Green facades include two types, direct greening, and indirect greening. The direct greening system requires no additional structural support, as the roots fix to the wall and climb to cover the surface of the wall (Fig 2) while the indirect greening system uses additional support (mesh or cables) with an air gap to support the climbing plant (Fig 3). On the other hand, when the plants and the growing medium are placed along the wall's surface it is called a living wall. Living wall is divided into two types continuous and modular living wall systems. The continuous living wall includes felt fabric with pockets to support the growth of the plants and it is a hydroponic-based system (Fig 4). Modular living wall uses organic and inorganic growing mediums in containers along the surface of the wall to support the growth of the plant. [4](Fig 5)

Fig 2: Direct Greening



Fig 3: Indirect Greening



Fig 4: Continuous Living Wall



Fig 5: Modular Living Wall



In the built Environment, benefits offered by green walls are numerous in environmental, social, and economic aspects as mentioned below,

Environmental	<ul style="list-style-type: none"> • Provides a cooling effect by shading and evapotranspiration • Improve air quality • Storm water runoff management • Promotes biodiversity • Improves oxygen level in the air • Sound barrier
Economic	<ul style="list-style-type: none"> • Protects the building façade from harsh weather • Energy saving benefits • Increases property value
Social	<ul style="list-style-type: none"> • It offers a sense of comfort and closeness to mother nature in the middle of the hard concrete jungle in the city • Reduces stress • patient recovery rate is improved • Higher resistance to illness.[5]

3. CHALLENGES IN VERTICAL GREENING

Although vertical gardens have many advantages, it has some delimiting factors. The operations are not as simple as common greening infrastructures, especially due to their vertical condition [6]. Vertical gardens have a few risks, as well as many benefits. These risks can be examined under three main headings as follows

- Irrigation systems problems
- High cost
- Maintenance frequency and difficulty
- Structural damage

3.1. Irrigation

A vertical garden commonly adopts drip-watering systems with automated timing devices. Based on the type of vertical garden the technique of irrigation varies. In a green façade, the irrigation is carried out at the base or in the planter box placed at different levels. The network is more intricate in living walls and often consists of many irrigation lines at various heights. The substrate that is being utilized must have the ability to hold water. Due to the difference in humidity along the living wall, it is essential to place the plant species considering their water demand [7]. The vertical garden applied in the south façade requires additional water than the plants in the north façade because of the excessive evaporation. [2]

3.2. Cost

More expensive components are used on a vertical surface than a horizontal one. The living wall systems are comparatively more expensive than direct and indirect greening systems; due to the maintenance and materials used along with the complexity of the configuration. As the living wall incorporates a wide variety of plant species, it offers much more creative and aesthetic potential than green facades, which uses a simple structure and a single variety of climbing plant at one time. [8] The expensive materials and technology included in the vertical garden are as follows,

- Plant Species
- Structural support
- Irrigation System
- Drainage System
- Growing media
- Waterproof layer
- Routine Maintenance Costs for the above materials [9]

3.3. Maintenance

The VG's design should adhere to the owner's maintenance requirements to remain in healthy condition. When constructing the VG, it is important to take periodic maintenance into account. This includes things like replacing plants and structural components, trimming, and watering. It is important to choose plants that are appropriate for the location and environment. A plant species resistant to drought and disease should be chosen along with easy maintenance structural system. Slow-growing plants with little need for trimming should be chosen when maintenance costs are an issue. The support system should be inspected frequently to avoid loosening and metal corrosion on the VG's supporting structure, including connections to walls and paneling. Drainage should be planned with the appropriate levels to prevent water stagnation and the growth of mosquitoes. If the vertical garden has several floors, each level should have access to its inspection and maintenance. [10]

3.4 Structural Damages

The use of green walls implies the need to consider several variables for the plant species and supporting system choices suitable for every situation to avoid maintenance problems and damage.

3.4.1. Direct greening

The potential risks associated with using climbing plants include,

1. The use of robust self-clinging climbers with a thickness of branch more than 15 cm might cause damage to the building exterior.
2. Deformations of the supporting structure are caused by an improper calculation of the weight of the green layer.
3. Challenges brought on by the complexity of performing maintenance tasks on walls and drying during the season.

3.4.2. Indirect greening and living wall

These walls do not cause damage to the structure as direct greening due to the presence of an air gap between the wall and the structural system. However, the issues are related to the plant's growth, vitality, condition of the support system, and disposal of excess water from the container [11]

4. METHODOLOGY

The public of Greater Chennai Corporation was given access to 11 closed-ended multiple-choice online questionnaires to gather quantitative data on their perceptions of VG. Photographs were included along with the questionnaires for a better understanding and accuracy of the results. The survey result was obtained from 100 respondents from Chennai

5. SURVEY QUESTIONS

5.1. Part 1: Socio Demography

1. What gender do you belong to?
2. What is your age?
3. Are you a resident of Chennai?

5.2. Part 2: Awareness and desire to adopt

1. Where did you see the Vertical garden in Chennai?
2. What type of Vertical garden did you observe the most in Chennai? (supported by images)
3. Are you interested to have a vertical garden in your house?
4. What type of vertical garden do you prefer for your house?
5. What type of plants is your choice of preference for the vertical garden?
6. Do you think bringing in more vertical gardens in Chennai will improve the quality of life?

5.3. Part 3: Benefits of Vertical Garden

- What do you think is the purpose of a vertical garden?

5.4 Part4: Barrier to its Widespread Adoption

- Which of the following do you think is the barrier to adopting vertical gardens?

6. DESCRIPTIVE STATISTICS AND ANALYSIS

6.1. Socio Demography

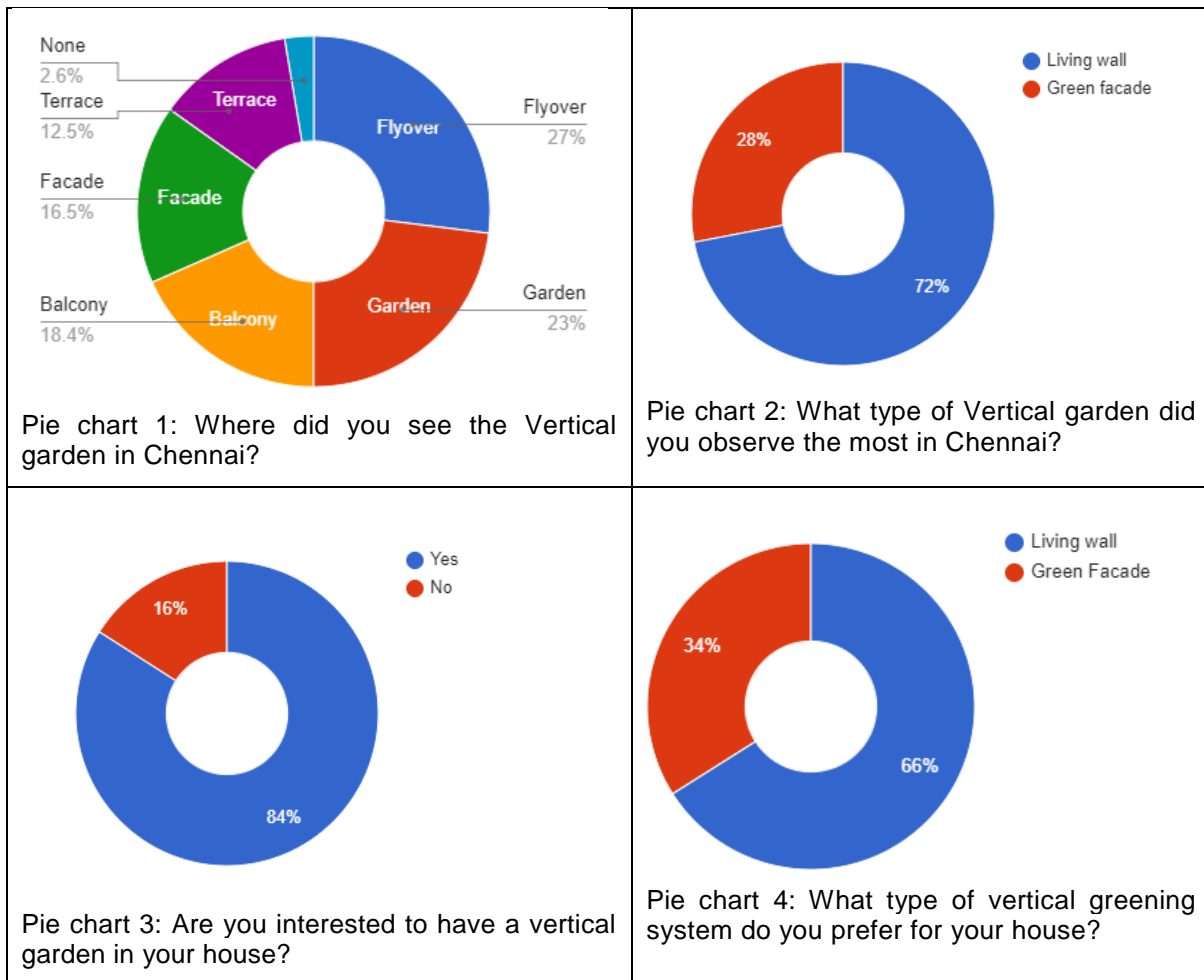
The survey was conducted for the residents of Chennai. The age group of the respondents involved in the survey is as follows, 50% in the age group 21-30, 33% in the age group 31-40, 8 % in 41-50,5% in 51-60, and 4% in 10-20. The gender ratio of males and females was 54:46.

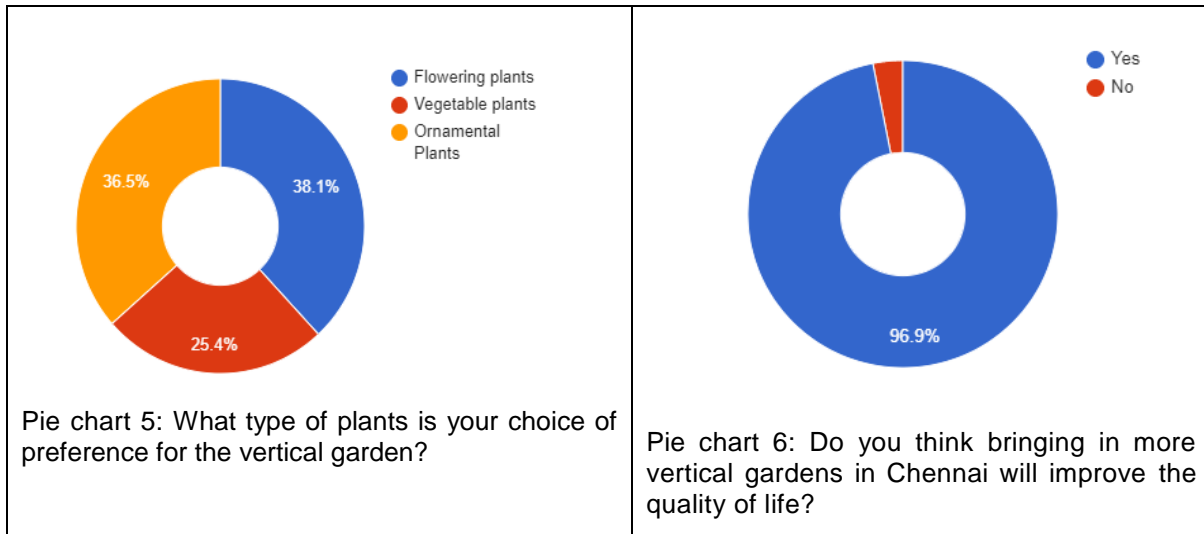
6.2. Awareness and desire to adopt

Out of 100 respondents, 27%, which is the highest on the scale, have seen VG under flyovers installed by Great Chennai corporation followed by outdoor gardens, balconies, façades, and terraces of public and private places with 23%, 18.4%, 16.5%, 12.5% respectively. (Pie chart 1) However, 2.6% have reported that they have not seen a vertical garden anywhere in Chennai indicating that the concept of VG has to be further promoted

among the public of Chennai. 72% of respondents have seen living walls more often than the green wall (Pie chart 2). This implies that consideration of green facades is required, as it is known for their low maintenance and simple structural system than living walls. 84% of respondents are interested to have VG in their house (Pie chart 3). This makes it even clearer that VG is still in the conceptual stages, creating more awareness can help widespread adoption of VG in Chennai. 66% of respondents are interested to have a living wall in their house due to its variety of species (Pie chart 4). The survey results are majorly from 50% of the age group 21-30 who recommend flowering plants as their choice of preference for VG as it will make the vertical garden more attractive (pie chart 5). 96.9% of respondents agreed that integrating VGS will improve the quality of life. (Pie chart 6)

6 Pie chart: Awareness and Desire to Adopt Chart

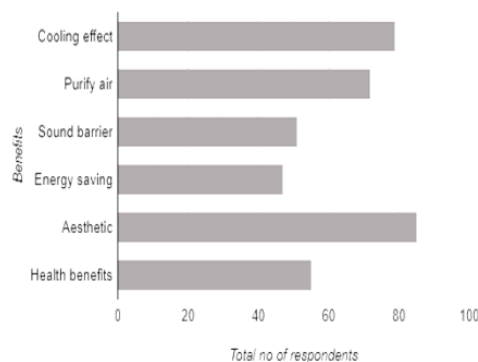




6.3. Benefits

This survey included the following benefits such as cooling benefit, absorption of sound, purification of air, Energy savings, and Aesthetic and health benefits to understand the purpose of VG in the minds of the public. The survey analysis made it clear that the VG is most recognized for its aesthetic value and least recognized for its energy-saving benefits. The respondent's perception of benefits is as follows, cooling effect (79 respondents), purification of air (72 respondents), sound barrier (51 respondents), energy savings (47 respondents), aesthetic (85 respondents), and health benefits (55). (Bar graph 1)

Bar graph 1: Perception of public on benefits of VG

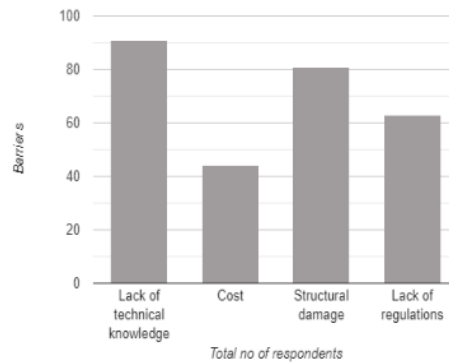


6.4. Barrier to its Widespread Adoption

To understand the barrier to widespread adoption in Chennai the possible reasons were given to the public to choose and the results obtained are as follow, Lack of technical knowledge on maintenance and irrigation aspects (91 respondents), cost (44 respondents), structural damage (81 respondents), and lack of regulations and Subsidies

(63 respondents). Lack of technical knowledge and fear of structural damages are the foremost reasons followed by lack of strict regulation and investment (Bar graph 2)

Bar graph 2: Perception of public on barriers to its adoption



7. DISCUSSION

From the survey, the following issues are identified as barriers to its widespread adoption.

1. In Chennai, especially beneath bridges, it is typical to see just one form of vertical garden. When the regular inspection is impossible and there are financial limits, low-maintenance green facades that employ straightforward structures and climbing plants may be an option.
2. Even while the public has expressed interest in incorporating vertical gardens into their homes, a lack of technical knowledge and fear of structural damage is the biggest obstacle to its installation, which involves choosing the appropriate species, structural system, maintenance, and watering requirement. Structural damage can be avoided by providing a minimum gap between the wall and the vertical garden as seen in indirect greening and living wall.
3. The public is more interested in adding flowering plants to the vertical garden to make it more attractive.
4. The aesthetic benefits of vertical gardens are well recognized than their positive effects on the environment, the economy, and society. The environmental advantages of vertical gardens must be widely publicized to improve the integration of VG in the resident's houses.
5. There is a need to research efficient plant species to give maximum benefits in low-cost, easy maintenance structural systems to promote vertical greening for a hot and humid climate like Chennai.

8. CONCLUSION

The key to creating beautiful vertical gardens is having a clear understanding of the maintenance of plants and the support system used. The VG should be thoughtfully

developed considering the owner's maintenance requirements to avoid the failure of the system. Considering native, drought, and pest species can help in the easy maintenance of VG. Architects, Engineers, and individuals should take initiative to implement vertical gardens in their projects and take necessary measures to keep them healthy. Measures like strict rules and subsidies, seminars, and community participation can help in restoring the lost greenery through VG. More research has to focus on simple maintenance and irrigation techniques for VG in different climatic regions and ways to create awareness among the public to make the installation of VG easy.

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