

## REVIEW OF EXISTING SOLUTIONS FOR INTEGRATING VERTICAL GREENS FOR BUILDINGS IN INDIA TO EXPLORE THE FEASIBILITY OF URBAN FOREST

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### **Abstract**

In this paper the importance of the chosen topic is commonly the proper fact to develop or improve the quality of air and thermal comfort, both outside and inside of buildings. Apart from this factor, plants also can automatically filter and absorb toxic chemicals, air and suppress specks of dust. On the other hand, it also can be said that the proportion of vertical garden can higher productivity in any kind of small area, utilization of low level of water, etc.

Now the major role and problem is facing by the world that is result by the number of concrete building. That is reducing the total requirement of the open spaces and the portion of the building. In the model if the urbanization has implemented the green area of the town, and it is provide a suitable way and sustainable platform for environment. The vertical gardening is the system that is covers the entire building and its facades of the walls. It is using the different type of the spaces. It not only increase the urban system the greenery also develop the function such as different part of the environment which is sound, the positive part and the human model of psychology, the production system of energy, and the quality index of air. There are various methods that are present in the current scenario which may be applicable to the research of green building systematics. The BREEAM method is one of the most widely used evaluation systems. LEED system from the US also can be used in this method of evaluation. This system could be applicable for the utilization and the application of the study of vertical gardening in India as urban forests it represent some of some of the effective nature-based solutions. They are a crucial instrument for addressing social-environmental issues including climate change, dust risk, water pollution, and the safety of people and their food. Although the European Commission very recently introduced this idea, it is swiftly gaining traction worldwide in accordance to the United Nations' Sustainable Development Goals (SDG).

Urban forest is very closely tied to the idea of "green infrastructure" which is a key component that supports resilient planning and environmentally friendly growth.

**Keywords:** The "urban forest", "air quality", "vertical wall", "vertical garden" "nature integration"..

### **Introduction**

Long skyscrapers are very much energy consuming. Also there are many harmful impacts upon ecology and sustainability. There are different types of developing countries that are facing this problem. In a country like India. Now there is no type of skyscraper above the level of 300m in India. These things must be changed in the upcoming years. As the Indian economy is getting

advanced and developed. It will be third-largest economic country in the year 2030 [11][17]. The policy and the architecture are determined by the market practice which is better prepared and not repeating their mistakes again. The high-rise building is not built for the environment, which was built in the earlier stage that was developed by the nation. This is affecting the local environment and the local co-existing birds and even requires an expensive system that maintains the proper part of the thermal comforts. In this, the vertical garden is the only part that is covered by the building facades and the wall which is used by the different parts of plant species. The importance of green building commonly involves various beneficiary facts about eliminating or reducing the operating costs in terms of safety, health and comfort for residents.

### **Aim**

This paper's goal is to clarify the present level of knowledge on the benefits and uses of urban forests in India.

With regard to the use of vegetation frameworks, green infrastructure includes all advances and best practices to provide ecological benefits and higher levels of human sustenance. The aim of this paper is to determine the role and factors of the garden which is vertically designed. The landscapes and the elements are related to the heat effect on the island and the comfort of the thermal indoors. It identifies the importance which is related to the high-rise building and the town planning process for contributing to their sustainable future. It also describes the importance of the vertical garden which is adding value to the various parts of the Indian policy. Identify the different factors of the vertical garden which increase in the urban areas and the function. This function is heart isolation, the air quality and its improvement, the heat island process and the reduction of sounds, productivity, and energy, different types of positive contributions to the human model for psychology.

### **Objectives**

- To determine the different types of challenges for the vertical garden to develop.
- To discuss the factor for implementing the vertical design of the green facades.
- To identify the different parts of building design practice in the system of the Indian context.
- To implement strategies those are very efficient for the execution and installation process.
- Activities for implementing urban forests can improve people's lives, reduce social isolation, and raise environmental consciousness. Urban forests may also provide things like lumber or food in addition to offering economic benefits like rising property values and an increase in tourist attractions, companies, and investment. Urban green spaces help to build healthy, sustainable communities when they are properly managed and maintained.

### **Discussion**

#### **Vertical garden and its origin**

The vertical garden is the technique for cultivating plants in the hanging plan or the panel. This is a very hydroponic type of technology. Vertical gardening is the type that is an urban model of gardening that is very especially suited to a small area. It is used to decorate the rooftops and the walls in a variety of ways [3]. It is a very different part of the approach that is meeting gardening

to allow the main growth of the plants that are situated vertically. This is very little area for the horizontal area that is outdooring the gardening model due to the insecticide factor of the urbanizations. The green wall is not the only condition for the environment that is stunningly very gorgeous, but it also helps to brighten up the atmospheric condition. The green wall is the lower part for both outdoor and indoor temperatures [14]. It is absorbing the hot gasses in the air. That is resulting in healthier part of indoor air quality. So it creates a more effective type and attractive environment. The factor is maintaining the constant values and the maintenance for difficulties, the lack of knowledge, and the high-cost preparation in the vertical gardens. It is used for the aesthetic concept and purpose to spread the application.

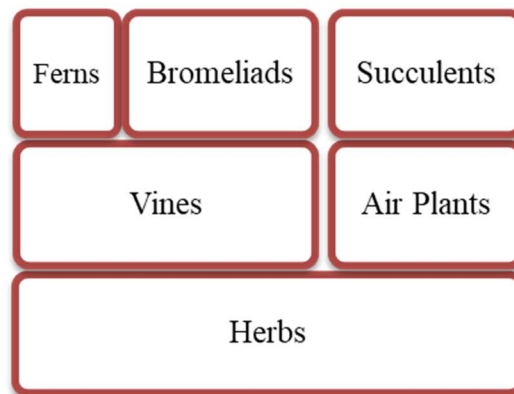


Fig 1: Plant types vertical garden  
(Source: Self-made)

### The classification of the green wall and vegetated system

Wall system is determined by the two different types which are green facades and living facades of walls. The green face is also of two types, the climbing system, and the trailing model. The climbing system is determined by the modular part of the trellis panel and the grid rope system. The other part of the living walls is also determined by the three main factors which are the modular part for the living walls, the vegetated mat for the walls, and the landscape part of the walls.

### Benefits

- The green wall is important for achieving different types of sustainable goals. The sustainable initiatives and the introduction system of the green walls are used as a recycling framework and the material for designing this module [2]. It identifies the green water and the recycling porches that are issued in rainwater harvesting in the system of irrigation, it is reused for the used water. So use different types of energy sources like the solar system and run them into an automatic system.
- The urban part of agriculture is the urban gas model which has gained momentum in the activity for affecting the rural part of the area which covers the agricultural land. It is the proliferation process of the urbanization of land, which is related to the population rate. This rate is also mentioned in the climbing and making of the new food production system.

- It improved the aesthetic part. This part determines the variation from visual interest and the main role for the future that is imparted by the green wall and it does not make the character. It also increases the value of the building.
- The indoor part of air quality is improved by this model. This is regarded as the effective part of the scavenger that is related to the particle pollutant and the gaseous pollutant in the urban environment.
- It improves the economic condition. Because it helps to decrease the impact effect on the weather [4]. The green wall decreases climate cognition and the stress on the building facades that is in the building's structural service and the usefulness of building life.
- This will help us improve health and wellness. The plant is very energetic so it demonstrates the consideration values for health. The green wall offers a calming effect that improves the rate of the patient's recovery and makes the people more susceptible to the illness.

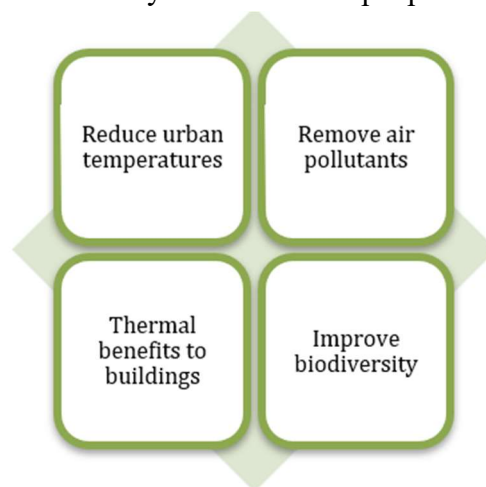


Fig 2: Benefit of green wall or garden  
(Source: Self-made)

### **The plant and the purpose for a sustainable portion of the vertical garden**

The suitable condition for the vertical garden is based on the condition of the climate changes in the area. The plant and the design concept are compact in growth. This is more likely to create a thick cover and dense. It is a very short process that is for growing the plants which is fibrous to the structural system in the long run and long life [13]. Depending on the region of the plant it should be able to tolerate the fuel consumption for full shade or the full sun condition. The most effective part for the user is the plants and the vertical concept of the gardens. The aim and the advanced level for productivity deal with the level that determines the urban and the suburban level for agriculture which is related to the production site in agriculture. This is the most effective purpose and the spaces that are a bigger part of the meditation. The different parts of the design solution are available.

### **The hydrothermal activity of the green wall**

This is important because that is a regular process for watering and it is make sure that the values and the process develop the plants in the time of the summer. The vertical part of the garden is to

take up less room consumption, tunes the traditional part of the vegetable which is herb gardens and uses the significant purpose of less water. The vertical purpose of farming is to produce more of a hobby that has less space than conventional farming. It is making the key concept for some food production [1].

The different types of branches, the grapevines, and the twigs are used as a temporary part of the material that is subdued to support the garden. The stalk portion of the tall plants is like sunflowers and the portion of the corn is also modified by the excellent facts and the natural trellis-type material. The natural part of the vertical concept of the garden which is material for free is huge in the bonus. The vertical portion of the garden system is determined by the garden walls. The garden wall comprises the main part of the contrary plant and it is the modular part of the green position which is across the wall part of the faces. The green facades and the freestanding part of the vertical gardening module or system.

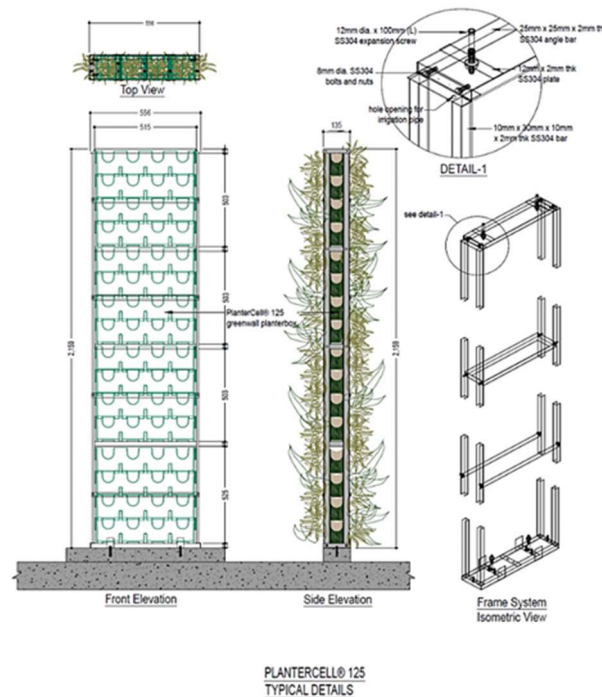


Fig 3: Green wall system

(Source: <https://www.actforumexpo.com>)

### Modern vertical gardening strategy and application

The main part of vertical gardening is to improve air quality. This is very effective for the urban population. It is offering the most beautiful system in the green approaches for health. It is very effective for the photosynthesis process of the plant and it is very effective for purifying the air, the air quality, and its index [9]. This strategy is a development process that is convenient to the private building and the public building that is converted. That is very effective for the garden values and the implementation. It mobilizes resources and public points. Technical resources are always available in the Indian market [10]. But the main portable is due to the different parts of the lacking demand and the special set which is a very effective requirement for the high-cost

activity in their quality. If the public building and the orientation are approved by the system then the budget is reduced.

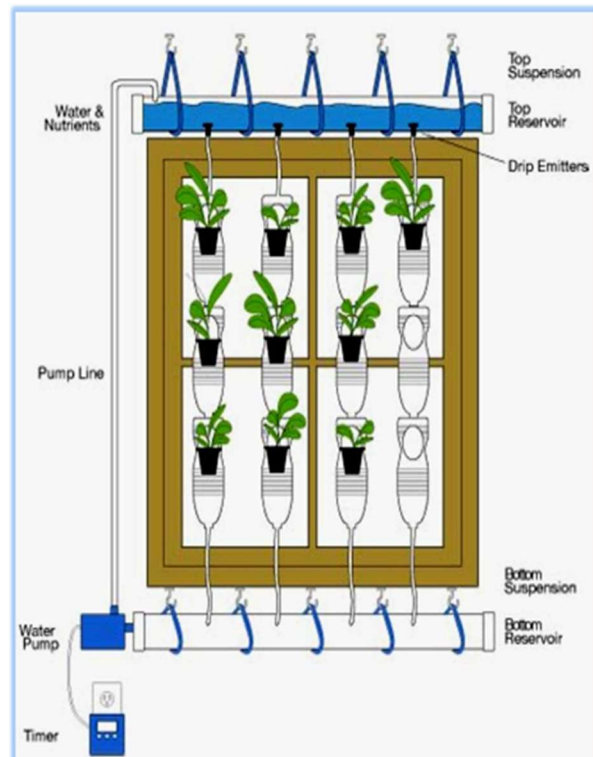


Fig 4: Vertical garden technology  
(Source: <https://www.semanticscholar.org>)

### Challenges faced by vertical gardening

#### The humidity and the temperature

The first concept of the climate condition is to manage the different parts of the challenges. The Vertical part must be overcome to figure out the cooling process and manage the temperature and the concept for the humidity which is growing. The lighting contribution is the greatest source that is heated the following part by the motors and used to operate the fans and the automation process and the pumps [7]. Dehumidification is the part that is a constant requirement for moisture from the air. The heating system in the model of the VF is generated inside values of the spaces by the lights.

#### Module for air circulation

The second part of the challenge is to figure out the delivery model for conditioning the air which is related to the vertical part of the firm. It created a uniform part of the growing system in the environment. The rocks and the space tightly deal with the vertical part and the horizontal part. It is very effective to create the form of the model and the condition in every situation [6]. In the direction of the horizontal, the light and the plant is developed obstruct by the flow of the air from the point of A to the point of B. It is resulting in the temperature and humanity and air conduction speed which is directly different from one end to the other part of the rack end condition.

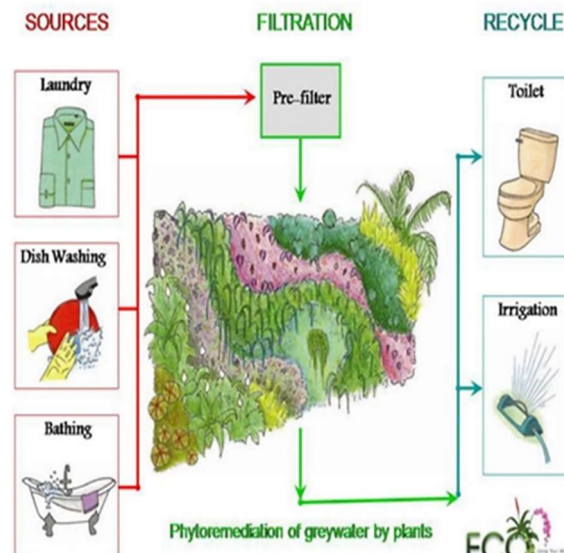


Fig 5: Vertical garden filtration process (Source: <https://www.intechopen.com>)

### HVAC location

The space values and the consideration is limited to moving the condition of the air. Which is throughout the racking model in the system. It depends on the concept and the design which is equipped by the included system in the air condition, the fans of the circulation porches, the chillers, the boilers, and the pipes and the pumps [5].

### Comparative analysis of the vertical garden

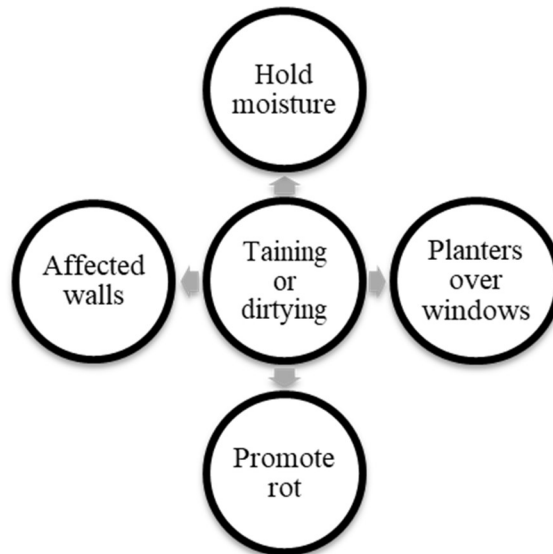
Building	Design concept	Construction system	Irrigation	Different type of plant species
The Newtown suited in the Singapore	This is the residential building that is based on the passive part of the climate changes principle and the control system of the design aspects.	It is protect with the horizontal part of the mesh around the building and it is supported the next part of the exterior staircase.	This system is the auto generation model for the system and the timing for the sensor that is related to the water resistance and the membrane for the structure wall.	Yellow type of the Irish Boston is installed, this planed is matures with in the time of three months.

<p>Trio apartment in the Sydney</p>	<p>The plant thrives in the full fill the exposure of the sunlight that is selected for the top model and it is required more process in hydration which is less amount of sunlight is planted at the bottom portion.</p>	<p>The green wall is designed as per the structural support that is throughout the steel and the recycled in the plastic frame which is support the fabric pocket in the species and planted into it.</p>	<p>Uses the drip irrigation model and the water is collected from the rain water harvesting line in 6 times in a day.</p>	<p>Acacia and the pea is used the top portion of the garden. The bottom part of the garden is plant with the delicate plant like goodenia and the viola.</p>
<p>The PNC bank in the Pittsburg.</p>	<p>The south face for the living wall is retrofitted the G02 wall which is sense to the soil moisture and the temperate for salinity.</p>	<p>602 panels of dirt were installed on a 2,380 square foot wall. The wall is a local undertaking because all of the materials were obtained locally in Pittsburgh.</p>	<p>GO 2 living wall requirements call for uniform pressure throughout and closed-loop supplies.</p>	<p>There are eight different local species that can adapt to the changing climate.</p>
<p>The consortia of the Santiago building in the Chile.</p>	<p>The shape of a boat. The vertical garden system used three green solutions to reduce heat buildup on the north and west facades: horizontal</p>	<p>It is support the structure for the aluminum and horizontal slats for the supports in the grid of the stainless for the steel cables. It is serve the</p>	<p>The drip irrigation is the automation process for the control, the interval part of the morning is develop the 2 minute for the afternoon I</p>	<p>The bougainvillea, the different part of the white bagsia roses and the decision which is based on the</p>



	trellises, a vegetated façade, and creepers.	climbing values for the medium values for the plant and the offset which is façade by the length of the 4m.	the 3 times for duration of 2 min.	selection of the maintenance factor and economy.
The pam parez art in Miami	The vertical part of the gardening which is from the every side around the column that is composed the steel tubes and envelop the felt layers and the arguments with hundreds of small type of pockets.	The array of the column is composed the steel tubes which is enveloped the felt layer it is augmented with the hundred for the small part of the pockets	Watering is provided by the large portion of the rain water and collecting the flat roof portion of the buildings.	The climate is tropical portion in climate which is adequate amount of the rainfall and the rain harvesting system.
The French embassy in New Delhi.	It is ether green wall which is modular panel, with the own soil and the nutrients by the size of medium	It is composed with the PVC layer for the stiff ness and help the waterproofing system	The drip irrigation system is the regular part of the interval which is thin polyamide and transport the water.	Climber and the creepers.

The Vertical garden in Bangalore	It is inspired by the vertical garden which is situated in the metro pillar in the Mexico city. It is implemented by the 222 pillars in Bangalore city	The modular part of the green wall is growing the plants and using the all type of requirement through the water, it is without the support of soil.	Hydroponics with the automation with the smart part of the sensor. It is being filled with the pillar to regulate by the amount of the water	800 plants which is ornamental planets
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**Fig 7: Disadvantages of the vertical gardens**  
 (Source: Self-made)

**Findings**

When differencing each type of vertical garden, it can be concluded that the indirect green facades and the green walls are cheaper. In terms of simple implementation and upkeep, particularly since the irrigation provision is included with the plant modules. Provisions for personnel could be made to approach the plants for maintenance in an indirect green façade when a trellis is employed as a growing framework. The development of a direct green façade would be simpler because fewer structural components would be needed, but because it grows directly on walls, wall upkeep would be crucial. In terms of installation and upkeep, living walls are relatively expensive, but they have proven to reduce construction costs by improving energy efficiency, hence the high cost is justified.



Fig 8: Vertical garden application in Delhi

(Source: <https://so.city/delhi/article/delhi-metro-has-transformed-8-dull-pillars-along-blue-line-into-green-vertical-gardens-wow>)

### **Formulation of guidelines**

In this paper the cost-effectiveness of the plant species employed and the installation of features like catwalks between the trellises for accessibility, indirect green facades can be used, which lowers labor costs for upkeep. For indirect green facades, drip irrigation is advised since it evenly distributes water at regular intervals while conserving a significant amount of water. Drip irrigation or hydroponics could be utilized for irrigation on green walls made of planter boxes because vertical gardens require significantly less water than other types of gardening. Although expensive to maintain and construct, living walls can be employed because they will increase a building's energy efficiency the most. To reduce labor costs, a hydroponic system or an autonomous drip irrigation system can be used instead. The expense of maintaining the living wall could be reduced a little by using recycled water or rainwater for irrigation.

### **Conclusion**

The Vertical garden is a wall that faces different types of challenges. In terms of the constitution method, it is appropriate when the constitution's porches are sustainable. It is also followed by the process of plant selection, maintenance, and constitution procedure. But it is very effective to be careful of every aspect of the implementation of a garden. Maintaining the different parts of the vertical garden is a suitable choice. The maintenance process and the method are to develop the irrigation method and the selecting approaches for the plants. Used different types of local plants and species. It is the implementation of the vertical adaption and the grading system that is very

feasible in the constitution of the warming situation and the humid climate in the condition of the Indian context. With increase in population and also increase in the total rate of pollution. So it is very necessary to determine the structure of the urban forest which is very helpful for environmental decade. It is a very vital decision for urban areas to control pollution and modify the air quality system. It is important to be concerned about the maximum benefit of a vertical garden.

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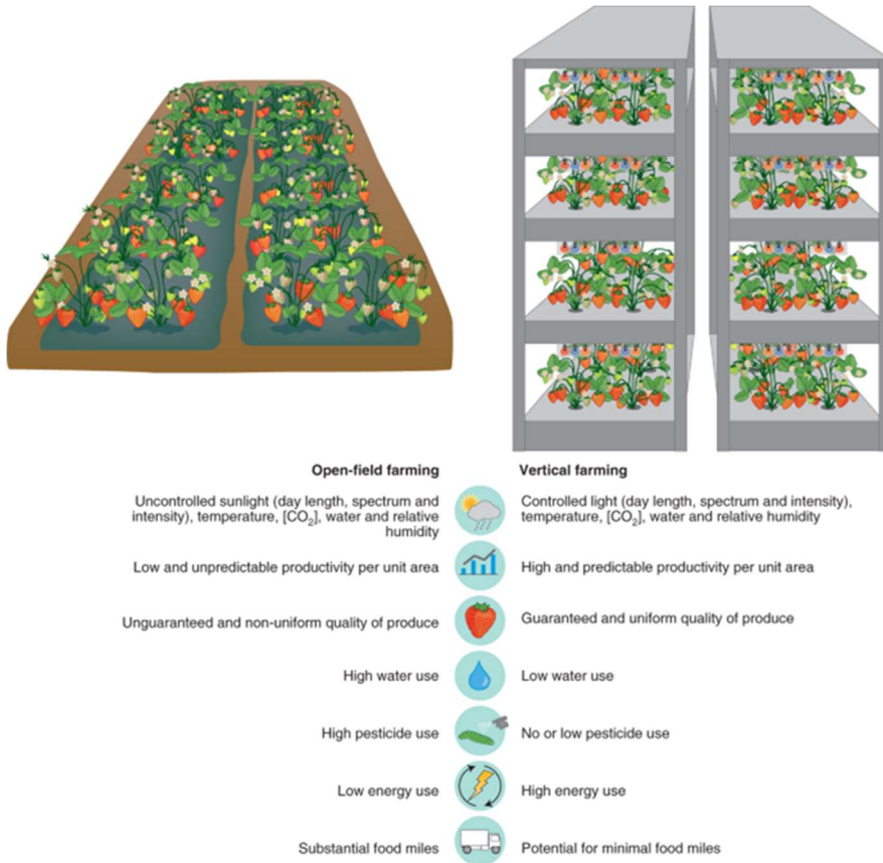
## Appendices

### Appendix 1: Vertical gardening impact



(Source: <https://www.assetzproperty.com>)

Appendix 2: Vertical farming system



(Source: <https://www.nature.com>)