



On Green Roofs: The Production of Vegetables

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ABSTRACT: Growing vegetables on green roofs has gained popularity in recent years as a method of increasing agricultural sustainability in urban settings. (As urban agriculture has recently been revitalised, rooftop gardens are becoming increasingly significant. Vegetable crops may be grown on green roofs, which opens up possibilities for incorporating agriculture into urban areas. However, due to a number of obstacles that must be solved before widespread implementation, rooftop vegetable producing operations are now quite limited. Although intense green roof systems are regarded to be most ideal for vegetable production, vast systems likely have the highest potential for sustained productivity because most buildings have weight load constraints. As a result, it is believed that shallow-rooted vegetables, such as significant salad greens harvests, are best suited for wide systems due to their ability to produce a lot of food with minimal inputs. Urban populations may benefit from the food production that green roofs provide, and they also provide a special opportunity to grow food productively in areas that are generally underused. As human populations become increasingly urbanised and urban customers become keener to purchase local foods for their families, the use of alternative agricultural production methods, such as green roof technology, will become more important. Although growing food upon roofs is an essential component of making cities more liveable and sustainable, green roofs are not the only way to ensure cities have access to food security. They ought to be seen more as an addition to existing urban food production sources.

Keywords: Green roofs on a large scale; rooftop gardens; sustainable agriculture; urban food security.

INTRODUCTION

A garden on the roof is called a roof garden. This means that trees, shrubs, bushes, and grasses are planted on each roof. The phrase "environment or nature in the sky" can also be used to describe roof gardening. Similar to this, a garden where vegetables are permitted to grow instead of other attractive plants is known as a roof-top vegetable garden. (Green roofs, also known as roof gardens, living roofs and eco-roofs, are building roofs covered with a growing substrate and plants (Ackerman *et al.*, 2014). Concerns about inhabitants' health and wellbeing are a prominent source of worry in metropolitan environments. Aside from having a negative impact on air and water quality, industry, vehicles, and impermeable concrete and asphalt surfaces all contribute to climate change, which is causing an increase in atmospheric temperature (Borysiak *et al.*, 2017). There is a spiritual detachment from agricultural roots and the natural world as a result of intense rivalry for land. Green space disappears. It is challenging to live comfortably in urban areas during the summer due to the high night time temperatures brought on by the heat island effect. Rooftop gardening is anticipated to lower temperatures and the amount of heat energy absorbed from solar radiation. In addition, growing vegetables on a roof saves

money by eliminating the need to buy them (Debangshi and Mondal 2021).



Fig. 1.

ROOFTOP GARDEN TYPES

Rooftop gardens for vegetable production are classified into three types:

Direct: Green roofs that produce crops directly into (shallow) beds in a soil-based growth medium that may be placed on top of a waterproof membrane or other layers such as a root barrier, drainage layer, and watering system.

Rooftop container gardens: Use a soil-based growth medium to produce vegetables, herbs, and flowers in pots, buckets, containers, bottles, or raised beds. This medium might be dirt, compost, or woodchips. Rooftop containers vary in complexity from small pots to complicated systems. It is feasible to employ as much locally accessible and repurposed material as possible.

Rooftop hydroponic systems: These systems use water-based fertiliser solutions to produce plants without soil. They require continual fertiliser inputs. To assist enhance yields and lengthen growing seasons, there are open-air exposed hydroponic systems as well as hydroponic systems grown under cover (glass or plastic) (Gajbe, 2020).



Fig. 2.

Benefits of Roof top Garden:

- lowering GHG emissions and energy consumption by decreasing the Urban Heat Island Effect
- Reducing rainwater run-off
- Reducing airpollution
- Reducing food poverty
- Improving living conditions
- Creating habitat for birds, butterflies, and bees
- Providing outside space for you to enjoy



Fig. 3.

Table 1: Different roof systems are compared in their many technical aspects.

Option	Shallow beds	Container gardens	Hydroponic
Weight	Heavier system that may need structural supports. It is determined by the depth of the beds and the growth medium employed.	Lighter system that, depending on the kind and quantity of containers used, may be erected on an existing roof with enough structural support. capacity and on roofs with slopes up to 15 degrees	High variability
Installation	The roofing must be shielded from direct contact with roots and the growing system.	Containers can be relocated after installation.	Growing containers and structural supports, as well as liquid fertilisers, are often expensive.
Cost	Low	Low	Generally high
Repair and Maintenance	Roof problems need the removal of layers and the disturbance of plants.	Easily movable	Upkeep is required. A greater level of technical expertise
Alteration and Additions	Changes are tough, and a fresh installation takes a long time.	Changes and additions are simple to make.	Changes are tough, and a fresh installation takes a long time.
Plants	The depth of the beds limits root development.	The container capacity limits root growth. Containers, on the other hand, may allow for the planting of even little trees.	Water Planting Vegetables

(Van Niekerk *et al.*, 2011)

Technical aspects of rooftop garden. Rooftop growth frequently occurs in shallow beds or containers due to weight restrictions. If the weight capacity of the roof is highly constrained, then very shallow beds should be created or some lightweight material should be added to the soil. Grown with fresh organic matter of many different types if there is insufficient compost available. They are fertilised and have at least a thin layer of compost or dirt on top of them. Shallow beds are ideal for growing almost any vegetable. As the beds or containers are formed, they function similarly to ordinary gardens with the exception (Ghosh, 2021).

Growing Medium. The development of light weight solutions for rooftop applications should receive significant priority. An ideal rooftop bed or container would have a depth of 9 to 12 inches if weight weren't an issue. The choice of the growing medium's composition is influenced by weight considerations as well as the amount of room and nutrients that various plants require to flourish. It is consequently more economical to choose a lighter medium in order to have a deeper soil depth and, as a consequence, more effective plant development and health (Sanyé-Mengual *et al.*, 2015). Growing materials include vermiculite, sand, wood chips, grass clippings that have been accumulated for many weeks, home compost, corncobs, rice hulls, shredded coconut husks, and sugar cane bagasse. Coffee pulp, and so on, as well as perlite, can be used to build up the medium. The growth medium should be rich in organic materials and allow the roots to breathe freely (Huang *et al.*, 2021).



Fig. 4.

Selection criteria of vegetables for roof top gardening

- Crops that are resistant to wind and other harsh climatic conditions are perfect for rooftop gardening.
- Plants with thin, sharp stems should be avoided.
- Because of their slow development, root vegetables such as carrots, radishes, and turnips are ideal.
- A strong root also serves to anchor the plants into the earth, making them wind resistant.
- Low-growing greens such as lettuce and spinach, as well as some species of climbing beans that can survive persistent exposure to wind, are also ideal for rooftop gardening.
- For the best results, start vegetables grown on rooftops in flats or similar containers covered with screens or netting to prevent soil from drying out.

- Add lots of water and high-quality organic ingredients, such as compost, to the growth medium; and apply a spread when transplanting plants, apply a thin layer of mulch around them to help maintain moisture. To avoid sun and heat shock, transplant beginnings into larger pots on cloudy or somewhat gloomy days (Hui, 2011).

CONCLUSIONS

As the population of Indian cities grows, so does the need for and expenditure on food. However, as agricultural land is converted to residential, commercial, or industrial usage, the resource is becoming scarce. As a result, it lowers the opportunity to cultivate more and diverse agricultural food items. Food contamination, such as the use of toxic chemical and inorganic fertiliser and pesticides to improve output, is spreading at an alarming rate. In this situation, starting a vegetable garden on the roof might be a plausible and probable answer to these concerns.) Rooftop vegetable growing can assist to fulfil food demand by providing fresh and hygienic vegetables, lowering family spending for purchasing veggies, and creating a healthy environment by improving air quality.

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