

Smart strategies and interventions for rooftop gardens

Roof gardens have been used extensively all over the world to mitigate adverse effects of urbanization and their benefits are well documented. Architects and landscape designers have applied green-roof technology worldwide, and policymakers and the public are becoming more aware of green-roof benefits. Although green roofs are initially more expensive to construct than conventional roofs, they can be more economical over the life span of the roof because of the energy saved and the longevity of roof membranes.

INDIA, with a population estimated at 1.42 billion, recently surpassed China to become the most populous nation on the globe. With the rapid urbanization accompanying this population explosion, challenges about environmental security have surged. Almost 40% of the population now resides in urban areas, a proportion projected to increase to 60% by 2050. Urbanization brings with it many challenges, and environmental degradation is one of the most pressing concerns. In cities, the rapid construction of buildings, especially high-rises and skyscrapers, has resulted in a reduction of green spaces. As cities expand upward rather than outward, concrete structures dominate the landscape. This over-reliance on reinforced concrete in construction contributes to the Urban Heat Island (UHI) effect, which raises temperature in densely populated areas. One of the major consequences of the UHI effect is an increase in energy consumption. As temperatures rise, residents rely more heavily on air conditioning and cooling systems, which leads to higher energy use and, in turn, greater carbon emissions. The cycle of energy consumption and heat production continues to worsen the environmental impact of urbanization. However, rooftop gardens or 'green roofs,' offer a potential solution to this problem. By covering rooftops with vegetation, cities can mitigate the UHI effect, reduce temperatures, and lower the demand for energy.

In addition to regulating temperatures, rooftop gardens provide an array of other environmental benefits. Plants naturally trap dust and dirt particles from the air, improving air quality in polluted urban environments. Vegetation also absorbs carbon dioxide during photosynthesis, releasing oxygen, which is crucial for maintaining breathable air in cities. In areas where green spaces are scarce, rooftop gardens can play a vital role in reducing air pollution and enhancing the overall health of city dwellers. Besides, rooftop gardens can help alleviate the problem of flooding and water run off by

absorbing rainwater and slowing its flow into the sewer systems. By capturing and retaining stormwater, green roofs reduce the risk of urban flooding, especially during heavy rainfall or monsoon seasons.

Countries like Germany, Singapore, and Canada have been at the forefront of green roof technology, using it not only to improve the aesthetics of buildings but also to promote sustainability and environmental health. While green roofs can initially be more expensive to construct than traditional roofs, they offer long-term financial benefits. Green roofs significantly extend the lifespan of roof membranes by protecting them from ultraviolet radiation and extreme temperature fluctuations. This means that buildings with green roofs require fewer repairs and less maintenance over time. Moreover, the energy savings associated with reduced cooling costs can offset the initial construction expenses, making green roofs an economically viable option in the long run.

In India, where urbanization is accelerating at a rapid pace, rooftop gardens have the potential to revolutionize urban living. Cities like Mumbai, Chennai, Delhi, and Bengaluru are experiencing growing environmental



Intensive roof garden on a building

pressures, and green roofs can be a part of the solution. In densely populated urban centres, the integration of rooftop gardens can improve air quality, manage stormwater, reduce temperature, and provide much-needed green space for residents. Furthermore, rooftop gardening presents an opportunity for economic development and self-reliance. In many cities, urban agriculture is becoming increasingly popular, with individuals and communities growing their own fruits, vegetables, and herbs on rooftops. This not only provides fresh, local produce to urban populations but also helps reduce the carbon footprint associated with transporting food from rural areas to cities. Rooftop gardens also have the potential to positively impact mental health. In crowded urban environments, access to green spaces has been shown to reduce stress, improve mood, and foster a sense of community. Rooftop gardens provide a refuge from the hustle and bustle of city life, offering residents a peaceful and restorative space. The act of gardening itself can have therapeutic effects, promoting mindfulness and physical activity.

As policymakers and urban planners become more aware of the benefits of green roofs, regulations and incentives are being developed to promote their adoption. In cities like Tokyo, there are mandates requiring a percentage of new buildings to include green roofs. In other countries, governments offer tax breaks or financial incentives for developers who incorporate eco-friendly designs, including rooftop gardens. India, too, could benefit from similar policies to encourage the widespread adoption of green roofs.

Concept of roof garden

Creation of vegetated space integrated structurally on top of a building or a structure is referred as roof garden or rooftop garden. Rooftop garden could be lightly developed with shallow growing medium i.e. extensive type or well developed with wide range of planting and heavy load i.e. intensive type. Rooftop gardens or roof gardens are also known as sky gardens, podium gardens, eco-roofs, green roofs or living roofs.

Suitable sites for roof garden

Single-story office buildings, sky scrapers, educational institutes, shopping malls and buildings with a wide roof area are all potential sites for green roofs. Further, the rooftops of the passages, extended balconies can also be utilised for gardening.



Hardscapes on roof garden

Types of green roofs

Fundamentally there are two types of roof gardens, viz. intensive roof garden and extensive roof garden. A third intermediate i.e. semi-intensive roof garden has also evolved.

Characteristic	Extensive roof garden	Intensive roof garden
Depth of growing medium	10-20 cm	General: 20-100 cm For trees: 4-5 ft
Load (Kg/m ²)	72-169	250-950
Plant diversity	Low	High
Plants	Moss-sedum and grasses, succulents	Lawn, perennial shrubs and trees
Utility	Ecological protection layer	Park like garden
Cost	Low	High
Maintenance	Low	High

Extensive roof gardens

Extensive green roofs are lightweight in design and developed mainly for aesthetic and environmental/ecological benefits with low load bearing capacity and low maintenance. These are also known as eco roofs. Plants are carefully selected to be dry resistant types and usually a rainwater storage reservoir is incorporated in the system.

Intensive roof gardens

These gardens involve elaborate landscaping with lawn and shrubs, and may include water features as well as different hardscapes like paving, stones and seating. Intensive gardens are also known as sky or podium gardens. These gardens require regular maintenance such as mowing, fertilizing, watering and weeding.

Semi-intensive roof gardens

These green roofs blend elements of both extensive and intensive types. Semi-intensive roof gardens have a medium-depth growing substrate, usually around 4 to 8 inches deep, and can support a wider range of plants than extensive roofs but with less maintenance than intensive ones. These support a more diverse range of plants than extensive roofs, but not as complex as intensive gardens and are moderately accessible for maintenance and recreational use.

Benefits of roof gardens

The beneficial effects of roof garden are wide, that are not just restricted to aesthetics and environment but are well connected to recreational activities, health, happiness and economics too. These benefits are immediate or short term as well as long term and sustainable.

Short term benefits

Reduction of the urban heat island effect: Roof gardens help cool urban areas by absorbing sunlight and reducing the heat trapped by concrete and asphalt surfaces. The use of roof gardens can lower the surface temperature by as much as 10°C and air temperature by about 4°C in tropical conditions. These reductions in temperature are mainly due to the shading of the heat



Intensive roof garden (Podium garden)

absorbing roof surfaces as well as the evapo-transpirational cooling effects of the plants in the roof gardens.

Improved air quality: Vegetation on rooftops captures dust, dirt, and pollutants from the air, acting as a natural air filter. Plants also release oxygen through photosynthesis, improving the overall air quality, especially in densely populated urban areas.

Energy efficiency: Roof gardens provide natural insulation for buildings, keeping them cooler in summer and warmer in winter. This reduces the need for air conditioning, leading to lower energy consumption and less reliance on fossil fuels.

Stormwater management: Green roofs absorb and retain rainwater, reducing runoff and the pressure on urban drainage systems. This helps prevent flooding and mitigates the risk of stormwater overflows, particularly during heavy rainfall.

Increased biodiversity: Rooftop gardens can create mini-ecosystems that attract birds, insects, and other wildlife. In cities where natural habitats are limited, roof gardens offer a refuge for biodiversity, supporting pollinators like bees and butterflies.

Aesthetic and recreational value: Green roofs enhance the visual appeal of urban spaces and provide residents with green areas for relaxation, recreation, and community interaction. These spaces offer a break from the concrete jungle and improve quality of life in cities.

Improved mental health: Access to green spaces is linked to reduced stress and improved mental well-being. Rooftop gardens offer a tranquil environment for city dwellers, promoting relaxation and mental health in fast-paced urban settings.

Economic benefits: By increasing the lifespan of roof membranes, green roofs reduce maintenance and replacement costs. Additionally, they offer opportunities for urban horticulture, allowing residents and businesses to grow food and herbs, contributing to local economy.

Property face value: Skyrise greenery can enhance the value of the real estate development it occupies. Rooftop gardens can provide outdoor amenity space and increase the aesthetic appeal of a building, which directly increase the face value and marketability of that property.

Long term benefits

Climate change mitigation: As cities grow and temperature rise due to climate change, roof gardens will play an increasingly important role in reducing urban heat and cooling buildings. By absorbing CO₂ and releasing

oxygen, they can also contribute to carbon sequestration efforts, helping to mitigate global warming.

Urban sustainability and resilience: In the future, cities will need to be more self-sufficient and resilient to environmental changes. Roof gardens offer a sustainable solution by providing food production, enhancing energy efficiency, and creating greener urban environments.

Flood prevention and water conservation: As climate change leads to more extreme weather events, the role of green roofs in managing stormwater and reducing flood risks will become even more critical. In the future, cities may rely on roof gardens as a natural solution to mitigate the impact of heavy rainfall and flash floods.

Support for food security: With increasing urban population and potential disruptions to global food supply chains, rooftop gardens can help ensure food security by promoting urban agriculture. Growing fruits, vegetables, and herbs locally on rooftops reduces dependence on rural agriculture and long-distance food transportation.

Adaptation to future energy needs: As energy resources become scarcer, green roofs will be essential in reducing energy consumption. Future cities will likely focus more on energy-efficient designs, and roof gardens can provide natural cooling and insulation to minimize energy usage.

Pollution reduction and carbon capture: With increasing pollution levels, rooftop gardens will help filter urban air and capture CO₂. Advanced technologies, like carbon-capturing plants or bioengineered green roofs, may emerge to further enhance their role in combating urban pollution.

Expansion of green infrastructure: Future urban planning will likely integrate more green infrastructure, and roof gardens will be a central feature. These spaces can be connected to other green areas, forming networks of greenery that promote biodiversity and ecological health across cities.

Resilience to health crisis: As cities face public health challenges, including pandemics, green spaces will become more important for mental and physical well-being. Rooftop gardens will offer safe, outdoor environments for residents to engage with nature, which is crucial for emotional and physical health.

Technological advancements: In the future, technological innovations such as smart irrigation systems, drought-resistant plants, and sustainable growing mediums will make rooftop gardens even more efficient and scalable. Automated systems could monitor plant health and optimize water and energy use.

Contribution to green economy: The increasing focus on sustainability and green infrastructure will open up new economic opportunities. Jobs related to the design, installation, and maintenance of rooftop gardens will expand, creating a new sector within the green economy.

Urban cooling during heat waves: As heat waves become more frequent due to climate change, green roofs will be vital in cooling urban environments. They will help protect vulnerable populations, such as the elderly, from extreme heat, making cities more liveable in a warming world.

Future urban farming hubs: With growing interest in

local food production, some cities may transform rooftops into full-scale urban farms, contributing significantly to local food systems. Rooftop gardens could evolve into major sources of organic as well as fresh produce in densely populated urban centres.

Regulatory changes and incentives: In the future, more cities may introduce regulations that mandate green roofs for new construction projects. Governments could also offer subsidies or tax incentives to encourage the adoption of green roofs, making them a standard feature in sustainable urban design.

Integration with renewable energy systems: As solar panels and other renewable energy technologies advance, rooftops could serve a dual purpose, housing both green roofs and solar energy systems. This combination could reduce energy costs while providing environmental benefits, making buildings more energy-efficient.

Cultural and social transformation: As awareness about environmental sustainability grows, green roofs may become symbols of eco-friendly living. Communities will increasingly view rooftop gardens as spaces for social interaction, education, and cultural activities, fostering a greater sense of connection between people and nature in the urban fabric.

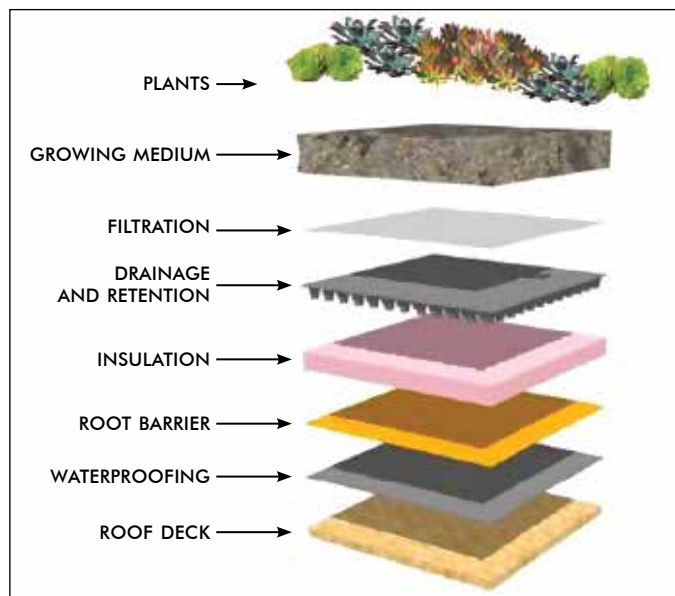
Installation of roof garden

Installation of rooftop garden requires careful planning and execution to ensure that it is both functional and sustainable. The process involves multiple layers of design, structural assessment, materials selection, sunlight and wind exposure as well as garden utility and proper installation techniques. Detailed guide for the installation process for a roof garden is given below.

Pre-Installation considerations

Several key factors need to be assessed to determine the feasibility and requirements of the roof garden project:

Structural assessment: The first and most critical step in installing a roof garden is determining if the building's structure can support the additional weight. This weight



Layers of foundation for roof garden



Intensive roof garden (Podium garden)

includes not just the soil and plants but also water from rain or irrigation and any necessary features like planters or paving.

Load-bearing capacity: Buildings have different load-bearing capacities, and a structural engineer should be consulted to calculate whether the roof can support the extra weight. Extensive roofs are lighter and may be suitable for most structures, while intensive roofs require stronger load-bearing capacity due to their heavier soil and plant layers.

Water proofing: Waterproofing is essential to prevent water damage to the building. A roof garden involves regular watering, either naturally through rain or artificially through irrigation systems, which can cause leaks if the roof is not adequately protected.

Waterproof membrane: A waterproof membrane is installed to prevent water from seeping through the roof into the building below. This layer needs to be durable and resistant to root penetration to protect the structural integrity of the roof.

Drainage system: Effective drainage is crucial in preventing waterlogging and ensuring that excess water is safely diverted off the roof.

Drainage layers: A drainage layer is installed to allow excess water to flow off the roof without saturating the soil. This can include materials like gravel, perforated mats, or specialized drainage boards.

Foundation for installation of roof-top garden

Roof gardens typically consist of several distinct layers, each serving a specific purpose. These layers are crucial to the success of the installation, as they ensure plant health and roof protection.

Growing medium: Selection of growing media is critical for roof top landscaping. Load-bearing capacity of roof, its slope, type of garden, selection of plant species need to be considered for growing media. It should be lightweight, with good aeration and water holding capacity. Soil with other amendments like gravel, sand, leafmold with organic matter can be used but soil based system adds to the roof load. Smart interventions using soilless growing system with cocopeat, peatmoss, vermiculite, perlite, *etc.*, can be adopted with added advantage of light weight along with good drainage and water holding capacity besides maintaining neutral pH and low EC.

Filter membrane: The membrane acts just like a filter. It catches small particles from the excess water that passes



Intensive roof garden at ASPEE College of Horticulture building with seating and accessories



through the growing medium and drains water. Geotextile material is commonly used as filter membrane.

Drainage layer: Drainage layer facilitates excess water drainage from the growing media. Common materials include gravel, drainage mats, or plastic modules designed to retain water while allowing the rest to drain away.

Insulation: It is a polyfoam having moisture resistance that adds protection to the roof structure.

Root barrier: The root barrier protects the roof from excessively long and harmful roots which may damage roof. It is typically made from a durable, impermeable material like high-density polyethylene (HDPE) or synthetic fabrics.

Water proof membrane: Water proofing with a membrane is essential as it protects the roof from water penetration. This layer protects the roof structure from water damage. A high-quality waterproof membrane, often made of PVC, EPDM rubber, or modified bitumen, is installed to create a watertight seal.

Planting in the rooftop garden

The choice of plants is crucial for ensuring the sustainability and success of the roof garden.

Selection of plants for roof gardening

Selection of plant species is as per the extensive to intensive type of green roof. Shallow rooted perennial plants used in extensive with less load, while deep rooted grasses, shrubs, trees used in intensive roof garden.

Plants for intensive roof gardens

Shrubs like *Hamelia patens*, *Hibiscus rosa-chinensis*, *Calliandra* spp., *Adenium obesum* (Desert Rose), *Brunfelsia americana* (Lady of the Night), *Rose* spp., *Cordyline terminalis*, *Duranta repens* (Golden Dewdrop), *Galphimia glauca* (Rain of Gold), *Ixora* species, *Jasminum nitidum*, *Jasminum sambac*, *Ervatamia divaricata*, *Lantana camara*, *Murraya* spp., *Phyllanthus nivosus* (Snow bush), *Mussaenda*, *Dieffenbachia*, *Aglaonema*, *Aralia*, *Poinsettia*, *Plumbago*, *Begonia*, *Tecoma*, *Pentas* etc.

Palms like *Rhapis excelsa*, *Licuala grandis*,

Chrysalidocarpus, etc. can be grown.

Herbaceous perennials like *Vinca rosea*, *Geranium*, *Aloe* spp., *Agave americana*, *Bryophyllum*, *chrysanthemum*, etc.

Succulents like *Agave Americana* (Century Plant), *Ananas comosus* 'Variegata' (Variegated Pineapple), etc.

Annuals in beds or troughs like *Petunia*, *Sweet William*, *Matthiola incana*, annual *chrysanthemum*, *Rudbeckia*, *Allium* spp., *Achillea*, *portulaca*, etc.

Climbers like *Vernonia*, *Ipomoea quamoclit*, *Thunbergia alata*, *Combretum comosum*, *Allamanda* spp., *Echites*, *Clematis*, *Quisqualis indica* etc. on poles or a pergola or gazebo add a different charm.

Trees like *Eugenia oleina*, *Gustavia angusta*, *Melaleuca bracteata*, *Pisonia alba*, *Cordia sebestena*, *Ficus benjamina*, *Brownea* spp., *Plumeria* spp., *Erythrina crista-galli*, *Buddha Belly Bamboo*, also known as *Bambusa ventricosa* etc. may also be grown provided sufficient depth of growing media and load capacity is available.

Plants for extensive roof gardens

Due to the shallowness and the extreme desert-like microclimate on many roofs, plants must be low and hardy, typically alpine, dry land or indigenous.

Sedum, *Sempervivum* and moss are good choices. *Sedum* species used include *Sedum acre*, *S. rupestre* and *S. album*. *Delosperma* could be tried in a sunny frost-free area. Ferns such as *Polypodium vulgare* and *Asplenium trichomanes* are suitable.

Euphorbia could be used in dry shady conditions. Ground covers like *Epipremnum aureum* (money plant), *Ficus pumila* (creeping fig), *Rhoeo spathacea* (dwarf variety), *Tradescantia pallida* 'Purpurea' (Purple Heart), *Wedelia trilobata* (Creeping Daisy) etc. can be used. Use of hanging baskets with *portulaca*, *petunia*, tangled heart plant, *dianthus*, *geranium*, *verbena*, etc., for sunny location and *begonia*, golden philodendron, *zebrina*, *ivy*, *setcreasea*, *pothos* etc., under shade add charm to the roof garden.

Planting method

Plants can be installed in several ways depending on the design.

- **Pre-grown mats:** These are rolls of pre-grown vegetation (typically *sedum* or grasses) that can

be rolled out onto the soil layer, providing instant greenery.

- **Plug plants:** Small, young plants (plugs) are planted individually into the soil, allowing them to grow and fill in the garden over time.
- **Seed planting:** Seeds can be directly sown into the soil for a cost-effective solution, though this requires more time and maintenance.

Planting patterns

For roof gardens designed for aesthetic purposes, carefully planning the planting pattern will create a visually appealing landscape. Plants should be grouped based on their water and sunlight needs to ensure healthy growth.

Irrigation system

An irrigation system may be installed, considering slope of roof, microclimate, intensity of vegetation, type of green roof installed and plant species. Drip irrigation systems are popular as they conserve water by delivering it directly to plant roots. Smart irrigation systems that adjust watering schedules based on weather conditions can also be implemented for more efficient water use.

Additional features (Hardscapes and Garden accessories)

Hardscapes improve functional role as well as aesthetics in landscaping on roof gardens. Seating arrangement includes chairs, benches and platforms, swings, walkways or path, lanterns, lights, statues, bird bath, pot galleries, novel stands like poles and pillars for training climbers etc. can be smartly incorporated. Artificial lawn can also be laid down on roof floor in extensive gardens. Special features like Gazebo in different shapes like rectangle, circular or hexagonal and platforms with seating incorporating bamboo or natural stone blend nicely with garden adding to its aesthetic appeal and functional role. Incorporation of proper lights further add bright charm to the roof top garden. Different types of lights viz., LED floor spot lights, flood lights, bollards and wall lamps provide an aesthetically pleasing view with a safe and well-lit environment. Solar lights should be smartly incorporated in the roof garden.



Post-Installation maintenance

After the roof garden is installed, ongoing maintenance is essential to ensure plant health and structural integrity.

Regular watering: While extensive green roofs may not require frequent watering due to drought-resistant plants, intensive roofs with more complex vegetation will need regular irrigation, especially during dry periods.

Weeding and pruning: Weeding is essential to prevent invasive plants from overtaking the garden. Pruning should be done regularly to maintain the aesthetic appeal of the garden and encourage healthy plant growth.

Fertilization: Green roofs may require fertilization to replenish nutrients in the soil. Organic or slow-release fertilizers are recommended to minimize environmental impact.

Drainage system checks: The drainage system should be inspected regularly to ensure that it is functioning properly. Blockages or pooling water can lead to root rot and damage to the roof structure.

Monitoring and inspection

Once the roof garden is established, regular inspections should be conducted to assess the health of the plants and the integrity of the underlying roof structure. Monitoring soil moisture, plant health, and water drainage are crucial for maintaining the long-term functionality of the roof garden. From designing the garden layout and selecting appropriate plants to ensuring proper waterproofing and drainage, every step is critical to the garden's success. With the right approach, a roof garden can provide substantial environmental, aesthetic, and economic benefits, transforming unused urban rooftops into thriving green spaces.

Smart strategies for rooftop gardens

Rooftop gardens are becoming a popular way to add greenery in urban areas, but they require thoughtful planning and smart interventions to thrive in the often harsh conditions of high-rise environments. These strategies blend technology, sustainable design, and



Planters and statues in extensive roof gardens



Extensive roof garden with planters and hardscapes

innovative practices to make the most of small spaces, improve plant health, and create eco-friendly urban oasis. Some of the best smart interventions that can elevate your rooftop garden are described below.

Automated irrigation systems: Watering a rooftop garden can be tricky, especially since these spaces are more exposed to wind and heat than ground-level gardens. Automated irrigation systems, like drip irrigation or smart sprinklers, are game-changers. They can be connected to weather apps to adjust watering schedules based on real-time data, ensuring your plants are hydrated without wasting water. Some even come with sensors that detect soil moisture, preventing overwatering or underwatering.

Lightweight growing medium and planters: Rooftop gardens have weight restrictions, making it essential to choose lightweight soil mixes and containers. Smart, lightweight growing mediums are designed to be less dense while still providing enough nutrients and structure for healthy plant growth. For planters, materials like fiberglass, high-density plastic, or even eco-friendly alternatives like recycled containers help keep the garden manageable without compromising durability.

Smart plant sensors: With smart plant sensors, keeping an eye on your rooftop garden becomes much easier. These devices monitor soil health, light exposure, and temperature in real-time, sending data directly to your phone.

Wind and sun barriers: High-rise buildings often face extreme wind and sunlight exposure. Smart design solutions like windbreaks or shade structures can help

protect your garden from these elements. Vertical trellises, pergolas, and retractable shades are all stylish yet functional ways to provide protection. Additionally, strategically placing taller plants or hardy shrubs to act as natural windbreaks can enhance the garden's resilience.

Composting and waste management: A sustainable rooftop garden should also manage its organic waste smartly. Small-scale composting systems or worm farms can turn plant clippings and kitchen scraps into nutrient-rich compost to feed the plants. This not only reduces waste but also minimizes the need for synthetic fertilizers, making your rooftop garden more eco-friendly.

Vertical gardens and green walls: To maximize space, vertical gardens or green walls are a perfect smart intervention. These systems allow you to grow more plants in a smaller footprint, using pockets, panels, or trellises. You can use vertical gardens for ornamental plants, herbs, or even small fruits and vegetables. Some green wall systems come with built-in irrigation and smart controls to ensure that each plant gets the right amount of water.

Solar-powered features: Solar power is a smart, sustainable solution for rooftop gardens. Install solar-powered lights for an atmospheric evening garden, or use solar energy to run irrigation pumps, fans, or other small garden gadgets. Solar panels can also help shade plants from excessive heat, while contributing to the garden's eco-friendly design.

Biodiversity corridors: If space permits, creating biodiversity corridors can attract pollinators like bees and butterflies, enhancing your garden's ecosystem. Smart interventions like planting native wildflowers or installing small beehives can help increase biodiversity. These elements not only make the space beautiful but also promote environmental health.

Rainwater harvesting systems: Smart rooftop gardens often include rainwater harvesting systems to make use of natural rainfall. Simple collection barrels or more sophisticated systems can gather rainwater for use during dry spells. These systems reduce the need for municipal water and provide plants with untreated, naturally soft water that they often prefer.

By integrating these smart interventions, rooftop gardens can be transformed into a high-performing green space that requires less maintenance while offering greater rewards. Whether growing a lush retreat, a productive veggie patch, or a biodiversity-friendly ecosystem, technology and smart design can help overcome the challenges of urban gardening and create a thriving rooftop heaven.

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