

Cultivation of High-Value Vegetables under Solar Panels: A Pathway to Sustainable Income and Food Security

The intersection of renewable energy and agriculture presents a promising opportunity to address both sustainable income generation and food security challenges. One such strategy is the cultivation of high-value vegetables under solar panels, known as agrivoltaics. Agrivoltaics involves the co-location of solar photovoltaic (PV) panels with agricultural crops, utilizing the same land for both energy generation and food production. By harnessing the synergy between renewable energy and agriculture, farmers can optimize land-use efficiency, increase farm profitability, and contribute to local food security.

IN light of the challenges posed by climate change, diminishing natural resources, and global food insecurity, innovative solutions at the nexus of renewable energy and agriculture are increasingly being sought. Agrivoltaics is one such solution gaining traction. This approach holds promise not only for bolstering sustainable income for farmers but also for enhancing food security in local communities. The convergence of renewable energy infrastructure and agricultural land offers a unique opportunity to maximize resource utilization and productivity while minimizing environmental impact.

Agrivoltaics leverages this convergence by co-locating solar PV arrays with crops, effectively using the same land for both energy and food production. This integrated approach represents a paradigm shift in farming practices, where the synergy between solar energy and agriculture is harnessed to achieve multiple socio-economic and environmental goals.

The cultivation of high-value vegetables under solar panels offers several compelling advantages. Firstly, it enables farmers to diversify their income streams by tapping into the lucrative market for specialty crops such as tomatoes, onions, cucumbers, and leafy greens. These vegetables command premium prices in local and regional markets, providing farmers with a reliable source of sustainable income.

Secondly, agrivoltaics extends the growing season by providing shade and moderating temperature extremes, thereby enabling year-round cultivation and increased crop yields. This improved productivity not only leads to higher financial returns but also supports food security by ensuring a consistent supply of fresh, nutritious produce to meet local demand.

Furthermore, the resource-efficient nature of agrivoltaics underscores its role in promoting environmental sustainability. Solar panels reduce water evaporation from the soil, thereby minimizing irrigation needs and conserving water. Additionally, the filtered sunlight enhances crop quality and reduces reliance on synthetic inputs, fostering soil health and biodiversity.

The following are the benefits of the agrivoltaic system to the farming community:

Optimized land use

Solar panels mounted on frames provide shade for the crops grown underneath, creating a microclimate that can be beneficial for certain vegetables. By utilizing the same land for both solar energy generation and crop cultivation, farmers can maximize land productivity and generate dual income streams from solar energy and vegetable sales.

Diversified income

Growing high-value vegetables such as tomatoes, onions, cauliflower, broccoli, cucumbers, and leafy greens under solar panels can significantly increase farm income compared to traditional crops. These vegetables often have higher market prices and demand, allowing farmers to capture greater value per acre and achieve better financial returns.

Extended growing season

The shade provided by solar panels helps moderate temperature extremes, reducing heat stress on crops during hot summer months and extending the growing season. This allows farmers to cultivate vegetables year-round or during periods when traditional outdoor farming may be challenging due to weather conditions.



Solar farm demonstration unit with cultivation of vegetables crops

Higher water use efficiency

Solar panels reduce water evaporation from the soil by providing shade, thereby decreasing the water requirements of crops grown underneath. This is particularly beneficial in arid or semi-arid regions where water scarcity is a concern. Additionally, drip irrigation systems can be integrated with solar infrastructure to further enhance water-use efficiency.

Enhanced crop quality

The filtered sunlight that reaches crops under solar panels can improve the quality of certain vegetables, such as leafy greens, by reducing sunburn and preventing excessive heat stress. This results in higher-quality produce with better taste, texture, and nutritional value, thereby increasing marketability and consumer demand.

Environmental benefits

Agrivoltaics promotes sustainable land-use practices by combining renewable energy generation with agricultural production. Solar panels help reduce greenhouse gas emissions by generating clean electricity, while vegetable cultivation contributes to carbon sequestration in the soil and enhances biodiversity. This integrated approach supports environmental sustainability and resilience in food production systems.

Local food security

By cultivating high-value vegetables locally, agrivoltaics can contribute to food security by reducing

reliance on imported produce and increasing access to fresh, nutritious food in local communities. Farmers can sell their produce directly to consumers through farmers' markets, community-supported agriculture (CSA) programs, or local restaurants, thereby strengthening local food systems and supporting regional economies.

CONCLUSION

Cultivating high-value vegetables like onions, cucumbers, cauliflowers, tomatoes, and broccoli under solar panels offers a dual solution to the challenges of sustainable income and food security. By optimizing land use and resource efficiency, this innovative approach addresses land constraints and contributes to climate change mitigation through the use of renewable energy. The practice minimizes environmental impact by reducing water usage, pesticide reliance, and soil erosion. Economically, it diversifies income streams for farmers, improves livelihoods, and stimulates rural development. Overall, integrating agriculture with solar energy promotes resilience in food production, ensuring communities have access to nutritious food while advancing sustainability objectives. Embracing this strategy represents a pragmatic step toward a more resilient, prosperous, and sustainable future.

For further information, please write to:

¹Farm manager, ²Horticulture, ³*Agronomy and, ⁴Head Krishi Vigyan Kendra, New Delhi-110073 *Corresponding author's Email: samarpalagro@gmail.com



INDIAN
Horticulture

July-August 2025

UPCOMING SPECIAL ISSUE:

Commemorating **Golden Jubilee** of
ICAR-Indian Institute of Spices Research
Kozhikode, Kerala