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PROTECTED CULTIVATION TECHNOLOGIES FOR ENTREPRENEURSHIP DEVELOPMENT

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Protected cultivation technology refers to the practice of growing plants under controlled environmental conditions within structures such as greenhouses, polytunnels, or shade houses (Hasan et al., 2022). In recent years, there has been a notable shift in agricultural practices towards protected cultivation technologies, driven by the need for sustainable food production, climate resilience, and economic viability. Protected cultivation involves the cultivation of crops within controlled environments such as greenhouses, shade nets or vertical farming systems, shielding them from adverse environmental conditions while optimizing growth factors. This paradigm shift has not only revolutionized traditional farming methods but has also created a fertile ground for entrepreneurship development in the agricultural sector. Protected cultivation offers a multitude of advantages over conventional open-field farming, including enhanced crop quality, increased yields, reduced water usage, and minimized dependency on chemical inputs (Ameta et al., 2019). These benefits have attracted entrepreneurs seeking innovative opportunities to capitalize on the growing demand for fresh, high-quality produce year-round. By harnessing advanced technologies, such as hydroponics, aeroponics, precision agriculture, and climate control systems, entrepreneurs can establish thriving agribusiness ventures that cater to diverse market needs.

Moreover, protected cultivation facilitates market diversification and value addition, enabling entrepreneurs to cultivate specialty crops, produce value-added products, and target niche markets. This diversification not only improves profitability but also strengthens food security by reducing reliance on weather-dependent crops and external supply chains. In this

context, this article explores the role of protected cultivation technologies in fostering entrepreneurship development within the agricultural sector. It delves into the various technological innovations, best practices, and business models that enable aspiring entrepreneurs to establish successful ventures in protected cultivation. Additionally, it examines the socio-economic and environmental implications of protected cultivation entrepreneurship, highlighting its potential to drive rural development, create employment opportunities, and promote sustainable agricultural practices. Through a comprehensive analysis of the opportunities, challenges, and success factors associated with protected cultivation entrepreneurship, this article aims to provide insights and guidance for individuals, organizations, and policymakers interested in harnessing the transformative potential of protected cultivation for agricultural development and economic growth.

Understanding Protected Cultivation Technologies

Protected cultivation techniques involve growing crops within structures that shield them from adverse environmental conditions, such as extreme weather, pests, and diseases. The aim is to create an optimal microclimate for plant growth, leading to increased yield, quality, and resource efficiency. This method allows for extended growing seasons, crop diversification, and better management practices, ultimately enhancing agricultural productivity, profitability, and sustainability. There are different types of protected cultivation technologies used in agriculture to create controlled environments for optimal plant growth. These protected cultivation technologies provide farmers with options to create controlled environments tailored to the specific needs of crops, leading to increased productivity, crop quality, and resource efficiency. The most common types are;

1. Greenhouses

- Greenhouses are structures made of glass, plastic, or other transparent materials.
- They trap sunlight and heat, creating a warm environment suitable for growing crops.
- Greenhouses provide protection from extreme weather conditions, pests, and diseases.
- They allow for precise control of temperature, humidity, and ventilation.
- Various types of greenhouses include traditional glass greenhouses, plastic film greenhouses, and multi-span greenhouses.

2. Polyhouses

- Polyhouses, also known as polytunnels or high tunnels, are structures covered with polyethylene plastic.
- They are similar to greenhouses but are typically less expensive and easier to construct.
- Polyhouses provide protection from weather elements, pests, and diseases while allowing sunlight to penetrate.
- They are commonly used for season extension and crop production in regions with variable climates.
- Polyhouses offer flexibility in design and can be easily moved or expanded as needed.

3. Shade Houses

- Shade houses are structures covered with shade cloth or netting materials.
- They provide partial shade to crops, reducing sunlight intensity and heat stress.
- Shade houses are used in regions with high temperatures or strong sunlight to protect crops from sunburn and heat damage.
- They allow for better regulation of temperature and light intensity, promoting optimal plant growth.
- Shade houses are commonly used for growing shade-tolerant crops or as a nursery for young plants.



Fig. 1: Insect proof net house/Net house

(Image Courtesy: Centre for Protected Cultivation Technology, ICAR-Indian Agricultural Research Institute, New Delhi)

4. Hydroponics

- Hydroponics integrated with protected cultivation technology offers a sustainable and efficient approach to agriculture by providing optimized nutrient delivery, water conservation, enhanced plant growth, year-round production capabilities, space efficiency, and reduced environmental impact.
- By growing plants without soil in a controlled environment, this method ensures efficient nutrient uptake, minimizes water usage, and protects crops from adverse weather conditions and pests.
- The precise control over growing conditions allows for increased yields, extended growing seasons, and reduced environmental footprint compared to traditional soil-based farming methods, making it an attractive solution for addressing food security and environmental challenges.

5. Vertical farming systems

- Vertical farming systems utilize vertical space to grow crops in stacked layers or towers.
- They often employ hydroponic or aeroponic growing methods, where plants are grown without soil in nutrient-rich water solutions.
- LED grow lights are used to provide artificial lighting for plant growth.
- Vertical farming systems are highly space-efficient and can be implemented in urban areas with limited land availability.
- They offer precise control over environmental factors such as temperature, humidity, and light intensity.



Fig. 2 Hydroponic vertical farming

(Image Courtesy: Centre for Protected Cultivation Technology, ICAR-Indian Agricultural Research Institute, New Delhi)

Opportunities for Entrepreneurship Within the Realm of Protected Cultivation

- Protected cultivation technologies create opportunities for entrepreneurs to engage in year-round production, regardless of weather conditions, enabling them to grow high-value crops even in unfavourable climates.
- Entrepreneurs can specialize in niche markets by cultivating exotic or specialty crops that command premium prices in local or international markets.
- Vertical farming and hydroponic systems within protected structures present opportunities for entrepreneurs to produce crops in urban areas, reducing transportation costs and carbon footprint.
- Collaborative farming models where multiple small-scale farmers share the infrastructure and operational costs of a protected cultivation facility, thereby reducing individual financial burdens.
- Farm-to-table or direct-to-consumer models where entrepreneurs establish relationships with local restaurants, farmers' markets, or subscription-based services to sell fresh, locally-grown produce directly to consumers, ensuring higher profit margins.
- Agri-tourism ventures where entrepreneurs combine protected cultivation with on-farm experiences such as tours, workshops, or farm stays to attract visitors and diversify revenue streams

Technical Know-How and Skill Development

Technical know-how and skill development are crucial aspects for entrepreneurs venturing into protected cultivation.

a. Training and capacity building programs for entrepreneurs

- Training programs are designed to educate entrepreneurs on the principles and practices of protected cultivation.
- These programs cover topics such as greenhouse construction, climate control, irrigation techniques, pest and disease management, crop selection, and post-harvest handling.
- Capacity building programs focus on enhancing entrepreneurs' knowledge, skills, and competencies to effectively manage and operate protected cultivation facilities.

- Training may be conducted by agricultural extension services, universities, research institutions, or private organizations specialized in greenhouse technology.

b. Hands-on workshops and demonstrations on greenhouse management

- Hands-on workshops provide entrepreneurs with practical experience in greenhouse management and operation.
- Participants learn by actively engaging in activities such as greenhouse construction, installation of equipment, crop planting, irrigation system setup, and pest monitoring.
- Demonstrations allow entrepreneurs to observe best practices in action and gain insights from experienced professionals.

c. Access to Technical Support and Expertise

- Entrepreneurs require on-going technical support and expertise to address challenges and optimize the performance of their protected cultivation operations.
- Technical support may include troubleshooting guidance, advice on crop management practices, and assistance with equipment maintenance and repair.
- Access to experts in agronomy, horticulture, engineering, and other relevant fields is essential for addressing complex issues and implementing innovative solutions.
- Technical support can be provided through online platforms, helplines, on-site consultations, or partnership agreements with experienced professionals or service providers.

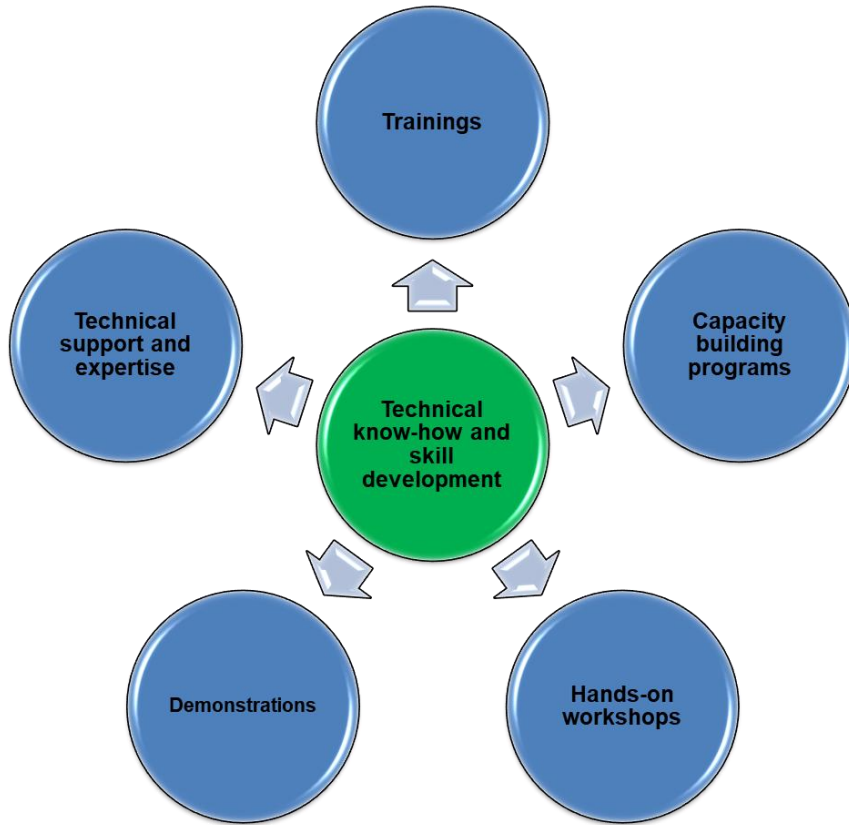


Fig. 3: Technical know-how and skill development for entrepreneurship in protected cultivation technology

Conclusion

Protected cultivation technologies have several benefits, including the ability to cultivate crops outside of peak seasons, protection from harsh weather conditions, defence against insects and pests, enhanced quality and yield, significant automation potential, honourable workmanship, and a subsequent rise in youth interest in agriculture. These technologies save time, and the government has subsidized some of them. The incorporation of protected cultivation technology is therefore a viable avenue for contemporary agriculture entrepreneurship. Urban farming may be made both feasible and sustainable by entrepreneurs by utilizing techniques like as hydroponics and vertical farming, which optimize resource consumption and space utilization. These cutting-edge methods not only solve the problems with conventional farming but also create new opportunities for food production in urban settings, strengthening food systems' resilience and enhancing the general sustainability of our cities.

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