

Protected Cultivation: A Climate Smart Agriculture and Emerging Agribusiness Enterprise

Niyati Thakur and Anshuman Klate*

¹Dr. Yashwant Singh Parmar University of Horticulture & Forestry, Nauni, Solan (HP) – 173230

*Corresponding Author: anshumanklate85@gmail.com

Agriculture encompasses a variety of types, each characterized by specific properties and practices. Subsistence farming revolves around producing enough food to sustain the farmer's family or local community. It often relies on traditional and labor-intensive methods. Mixed farming involves cultivating both crops and livestock, with each complementing the other for maximum output and income. Plantation farming focuses on large-scale cultivation of a single cash crop like tea, coffee, or palm oil, requiring significant capital investment. Livestock farming, or pastoral farming, entails raising animals for meat, milk, and other products, with different subtypes such as sheep farming, cattle farming, and poultry farming. Nomadic farming is practiced by mobile communities who move to find fresh pasture and water for their livestock. These various forms of agriculture cater to specific needs and are influenced by factors such as climate, geography, cultural traditions, and economic considerations. The cultivation of crops faces numerous challenges, particularly adverse environmental conditions. In order to mitigate these challenges, protected farming practices have been established.

Protected cultivation Technology

Protected cultivation technology encompasses a range of tools and techniques used to create controlled environments for plant growth. Key components include greenhouse structures made of transparent materials, climate control systems for temperature and ventilation regulation,



and artificial lighting systems for adequate illumination. Efficient irrigation systems, such as drip irrigation or hydroponics, deliver water and nutrients directly to plant roots. Alternative growing media or substrates, like coco coir, water, air, etc. replace traditional soil. Environmental monitoring and control systems utilize sensors to measure and adjust parameters such as temperature, humidity, and nutrient levels. Automation and robotics assist with tasks like planting, harvesting, and pest management. Integrated pest management strategies are implemented to control pests and diseases effectively. Together, these technologies optimize growing conditions, improve resource efficiency, and enhance crop quality and yield in protected cultivation. Protected farming aims to create an environment that shields crops from unfavorable conditions such as heavy snowfall in winter or extremely high temperatures in summer. It relies on the use of facilities and technologies to provide a controlled and optimized growing

environment. In developing countries, low-tech methods of protected cultivation are commonly employed. These methods, as noted by Nordey *et al.* (2017), make use of simpler and more affordable technologies to create a favorable environment for crop growth. By implementing protected farming techniques, farmers can overcome environmental limitations and enhance their crop production.

Protected cultivation plays a significant role in modern agriculture and offers several important benefits:

1. **Extending Growing Seasons:** Protected cultivation allows farmers to extend the growing seasons by providing a controlled environment. This means they can grow crops beyond their natural seasons, ensuring a continuous supply of fresh produce throughout the year. It reduces dependency on specific climates and opens up opportunities for year-round cultivation.
2. **Protection from Adverse Weather Conditions:** By providing a sheltered environment, protected cultivation safeguards crops from extreme weather conditions such as frost, hailstorms, heavy rains, or high winds. This protection minimizes crop losses and ensures more stable and predictable yields.
3. **Pest and Disease Management:** The enclosed structure of protected cultivation helps prevent pests, insects, and diseases from reaching the crops. It reduces the need for chemical pesticides and allows farmers to implement integrated pest management practices, minimizing environmental impact and improving food safety.
4. **Optimal Resource Utilization:** Protected cultivation optimizes the use of resources like water, fertilizers, and energy. The controlled environment allows for efficient irrigation systems, reducing water wastage. It also facilitates precise nutrient management, reducing fertilizer use and minimizing runoff. Additionally, technologies such as LED lighting and climate control systems help optimize energy consumption.
5. **Enhanced Crop Quality and Yield:** The controlled environment in protected cultivation provides ideal growing conditions, allowing farmers to achieve higher crop quality and increased yields. Factors such as temperature, humidity, light, and nutrient levels can be finely tuned to maximize plant growth and productivity.
6. **Crop Diversity and Specialty Crops:** Protected cultivation enables the cultivation of a wide range of crops, including non-native or specialty crops that may not thrive in local climates. This promotes crop diversity, expands market opportunities, and provides consumers with access to a broader selection of fresh produce.
7. **Sustainable Farming Practices:** Protected cultivation supports sustainable farming practices by reducing reliance on chemical inputs, conserving water resources, and minimizing soil erosion. It also enables the adoption of soilless growing systems, which can reduce land requirements and enable cultivation in urban areas.
8. **Economic Benefits:** Protected cultivation can be economically advantageous as it allows farmers to grow high-value crops, meet off-season demand, and obtain premium prices in the market. It can also create employment

opportunities, particularly in greenhouse construction, maintenance, and management.

Protected Cultivation Technology as Climate Smart Agriculture

Climate change is a phenomenon characterized by long-term variations in climatic elements or the distribution of weather over extended periods. In the context of this article, the primary focus is on three key issues related to agriculture, climate change and agripreneurship. Such interventions include investments in research and development for climate-resilient agricultural practices, the promotion of sustainable farming methods, provision of climate information and advisory services to farmers, access to financial tools like credit and insurance, and capacity-building programs for climate-smart agriculture. Protected cultivation plays a crucial role in climate-resilient agriculture, offering several key benefits:

1. **Mitigating Climate Risks:** Protected cultivation provides a controlled environment that reduces the vulnerability of crops to adverse weather conditions associated with climate change. It helps mitigate risks such as extreme temperatures, droughts, heavy rainfall, or storms, which can have detrimental effects on crop growth and productivity. By creating a sheltered environment, protected cultivation safeguards plants and ensures more reliable and stable yields, even in challenging climatic conditions.
2. **Extended Growing Seasons:** Climate change can disrupt traditional growing seasons, but protected cultivation allows farmers to extend

their production periods. By providing a controlled climate, farmers can grow crops outside their normal seasons and compensate for climate-related limitations. This flexibility helps maintain a consistent supply of fresh produce and reduces the reliance on specific weather patterns.

3. **Water Management:** Water scarcity is a significant concern in many regions affected by climate change. Protected cultivation systems, such as drip irrigation or hydroponics, allow for efficient water management. Precise control over irrigation and reduced water evaporation within protected structures help optimize water usage and minimize waste. This water-saving aspect contributes to improved sustainability and resilience in agriculture.
4. **Enhanced Crop Adaptation:** Protected cultivation enables farmers to adapt to changing climatic conditions by growing crops that are better suited to the altered environment. Farmers can select climate-resilient crop varieties, which are bred or genetically modified to withstand challenging conditions such as heat, drought, or disease. By providing a controlled environment, protected cultivation facilitates the successful cultivation of these adapted crops, reducing the vulnerability of the agricultural system to climate change.
5. **Reduced Pest and Disease Pressure:** Climate change can lead to shifts in pest and disease patterns, increasing the risk of crop damage. Protected cultivation provides a physical barrier against pests and diseases, reducing the reliance on chemical pesticides. Integrated pest management practices can be implemented more effectively within protected structures,

including biological control methods and the use of beneficial insects. This approach contributes to a more sustainable and resilient agricultural system.

6. **Carbon Sequestration:** Protected cultivation systems, such as greenhouses, have the potential to sequester carbon dioxide (CO₂). By capturing and retaining CO₂ within enclosed structures, protected cultivation can help mitigate greenhouse gas emissions and contribute to climate change mitigation efforts.
7. **Adaptation and Innovation:** Protected cultivation encourages innovation and adaptation in agricultural practices. Farmers and researchers continually explore and develop new technologies, such as improved greenhouse designs, energy-efficient climate control systems, and advanced monitoring and automation tools. These innovations enhance the resilience of agriculture in the face of climate change by improving resource efficiency, reducing environmental impact, and increasing productivity.

Protected Cultivation Technology as Emerging Agri-Enterprise

Protected cultivation can indeed be seen as a form of entrepreneurship in the agricultural sector. It provides opportunities for individuals to establish and operate businesses that specialize in controlled environment agriculture. As an entrepreneurial venture, protected cultivation involves the application of innovative technologies, management practices, and market strategies to maximize productivity and profitability within a protected growing environment. Entrepreneurs in protected cultivation are responsible for creating and managing the infrastructure necessary for controlled

environment agriculture, such as greenhouses, shade houses, or indoor vertical farms. They invest in technologies like climate control systems, artificial lighting, irrigation systems, and automation to optimize growing conditions and resource utilization. Moreover, entrepreneurs in protected cultivation need to make strategic decisions regarding crop selection, market analysis, and product differentiation. They may choose to focus on high-value crops, specialty varieties, or niche markets to maximize their returns. They must also adapt to changing consumer preferences and market demands, ensuring that their cultivated products meet the quality, consistency, and sustainability expectations of their target customers. Furthermore, entrepreneurship in protected cultivation involves risk management and financial planning. Entrepreneurs need to assess and mitigate potential risks such as crop diseases, pests, and extreme weather events that could impact their production. They also need to secure financing, manage operational costs, and establish effective marketing and distribution channels to reach customers and generate revenue. Successful entrepreneurs in protected cultivation can contribute to the growth of the agricultural sector by increasing local food production, reducing dependency on external sources, creating employment opportunities, and promoting sustainable farming practices. They play a vital role in meeting the growing demand for fresh, high-quality produce year-round, regardless of external climatic conditions.

Conclusion

Protected cultivation serves as both a climate-resilient technology and an emerging agricultural enterprise. It provides a controlled environment that protects crops from the adverse impacts of climate

change, making it a resilient approach to agriculture. By extending growing seasons, adapting to changing climates, and optimizing resource efficiency, protected cultivation helps farmers mitigate climate-related risks and ensure consistent crop production. It also opens up new market opportunities by meeting consumer demand for fresh produce year-round and allowing farmers to differentiate their products. Technological advancements in climate control, automation, and data analytics further enhance the efficiency and productivity of protected cultivation, contributing to the growth of the emerging agri enterprise sector. By embracing protected cultivation, farmers can adapt to climate change, create viable businesses, and foster sustainability in agriculture.

References

- Andati P, Majiwa E, Ngigi M, Mbeche R, Josiah Ateka J. 2022. Determinants of adoption of climate smart agricultural technologies among potato farmers in Kenya: Does entrepreneurial orientation play a role? *Sustainable Technology and Entrepreneurship* 1 (2): 100017
- Bazzana D, Foltz J, Zhang Y. 2022. Impact of climate smart agriculture on food security: An agent-based analysis. *Food Policy* 111: 102304.
- FAO. 2022. Climate-Smart Agriculture. <https://www.fao.org/climate-smart-agriculture/en/> Accessed on 20.08.2022.
- Nerlich A and Dannehl D. 2021. Soilless Cultivation: Dynamically Changing Chemical Properties and Physical Conditions of Organic Substrates Influence the Plant Phenotype of Lettuce. *Front. Plant Sci.* 11:601455.
- Nimbrayan PK, Chauhan RS, Mehta VP, Bhatia JK .2018. A review on economic aspect of protected cultivation in India. *Research Trends in Horticulture Sciences* 43-59.
- Nordey T, Basset-Mens C, De Bon H, Martin T, Déletré E, Simon S, Parrot L, Despretz H, Huat J, Biard Y, Dubois T, Malézieux E. 2017. Protected cultivation of vegetable crops in sub-Saharan Africa: limits and prospects for smallholders. *A review. Agron. Sustain. Dev.* 37: 53.
- Pooja, Shilpa, Thakur N and Sharma A. 2022. Role of protected cultivation of flowers in improving the socio-economic status of farmers in Seraj Valley of Himachal Pradesh. *Agricos* 3(09): 94-96.
- Thakur N, Sharma R, Shilpa, Sharma A and Klate A. 2023. Protected Flower Cultivation is a boon: An economical analysis in the Sirmour District of Himachal Pradesh. *PLANTA Book Series* 6:1056-1064.
