



Information about the Kentucky State University Cooperative Extension Program



Farmers Need To Adopt Controlled Environment Agriculture ?

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Introduction

Did you know that Kentucky has over 119,132 farmers and 69,425 farms, 97% of which are family-owned, with 51.2% of the land used as cropland ? (NASS-USDA, 2022) Traditional farmers have been relying on the rhythm of the soil, sun and seasons, where fertile soil had fed generations, the sun had nurtured their crops, and the seasons had dictated their way of farming. They lived by this cycle, planting and harvesting at nature's mercy until rapid population growth, urbanization and climate change challenges shifted the agricultural landscape. Despite these challenges, the demand for food continues to rise and this situation requires new farming practices that ensure sustainability.

What is Controlled Environment Agriculture ?

Controlled Environment Agriculture (CEA) is potentially sustainable alternative to soil-based agriculture. It refers to advanced agricultural techniques that optimize growing conditions by controlling environmental variables such as temperature, humidity, light, CO₂ levels, and nutrient delivery. It is used for producing nutritious fruits and vegetable crops in greenhouses, vertical farms, or other controlled setups using less water and ensuring a consistent, year-round supply of fresh produce.

Tips for Adopting CEA

- ❖ **Start Small:** Begin with modular/home based systems and gradually scale up based on available resources and demand.
- ❖ **Leverage Renewable Energy:** Use solar panels or other renewable sources to reduce operational costs.
- ❖ **Seek Financial Support:** Explore grants, subsidies, or partnerships to offset initial startup costs.
- ❖ **Focus on High-Value Crops:** Grow crops with consistent demand to ensure profitability.
- ❖ **Train Staff Effectively:** Emphasize training in system maintenance and using data-driven approaches for decision-making.

How CEA Addresses Food Insecurity?

- ❖ **Increased Access to Nutritious Food:** CEA allows local production of fresh produce in urban areas with limited land, improving access to nutrient-rich foods.
- ❖ **Resilience to Climate Change:** By protecting crops from extreme weather conditions such as drought or floods, CEA ensures a consistent output of fresh food, even during climate disruptions.
- ❖ **Scalability for Urban Areas:** CEA supports urban farming initiatives like gardening, reducing reliance on food imports and enabling cities to become more self-sufficient.
- ❖ **Employment and Economic Opportunities:** The rise of CEA fosters new job opportunities in high-tech farming, agriculture innovation, and sustainable food production.

Challenges and Solutions to CEA

One of the key challenges of adopting CEA is the need for proper training and skilled labor. To overcome this, farmers can participate in workshops or online courses that cover the fundamentals of CEA systems and provide hands-on experience. Since CEA systems require skilled operators and technicians to manage the technology and maintain optimal growing conditions, investing in comprehensive training programs is essential for the successful implementation and long-term sustainability of CEA operations. This ensures that farmers have the knowledge and expertise needed to operate these advanced systems effectively.



High Tunnel

Popular Controlled Environment Agriculture Techniques/ Systems

According to the U.S. Department of Agriculture's National Agricultural Statistics Service, Kentucky's agricultural production has grown by 40 percent since 2017, with the average farm size increasing by 4.7 percent (NASS-USDA, 2022). This growth reflects the adoption of innovative farming methods, including popular Controlled Environment Agriculture (CEA) systems such as greenhouses, vertical farming, and indoor growing setups, which are transforming how food is produced in the state. Indoor growing systems further enhance year-round cultivation by providing artificial lighting, precise temperature control, and irrigation systems that provide plants' specific needs, regardless of external weather conditions. These CEA methods are highly adaptable and sustainable for the future.

- ❖ **Greenhouses**, the cornerstone of CEA, create controlled environments where temperature, humidity, and light can be adjusted to optimal levels for plant growth.
- ❖ **Vertical farming**, utilizing hydroponic or aeroponic systems, maximizes space by growing crops in stacked layers and is particularly ideal for urban areas with limited land.
- ❖ **Hydroponics** is growing plants in nutrient-rich water/Soilless farming.
- ❖ **Aeroponics** is growing plants in air/mist environments with nutrient sprays.
- ❖ **Aquaponics** combining fish farming with hydroponics enable efficient and soilless production.

Components of a CEA System

- ❖ **Climate Control Systems:** Regulate temperature, humidity, and air circulation to create the ideal crop growth environment.
- ❖ **Lighting Systems:** Artificial lighting (LEDs) or a mix of natural and supplemental light to support photosynthesis (process by which plants make their own food).
- ❖ **Irrigation and Nutrient Delivery Systems:** Include hydroponics, aeroponics, or aquaponics for precise water and nutrient management.
- ❖ **Monitoring and Automation:** Sensors and IoT devices monitor plant health, environmental conditions, and resource usage in real time.
- ❖ **Structural Components:** Enclosed or semi-enclosed spaces like greenhouses, tunnels, or vertical farming racks.



Greenhouse



Indoor Growing System



Vertical Farm



Aquaponics



Aeroponics



Hydroponics

Sources

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