

Sources:

[Challenges in greenhouse crop production by smallholder farmers in Kisii County](#)

[Challenges facing smallholder farmers](#)

[Challenges and solutions for smallholder farmers in african agribusiness](#)

[The Kenyan farmers deploying AI to increase productivity](#)

## **Proposal for an IoT-Based Greenhouse Automation System for Small-Scale Farmers**

### **Background Information**

Smallholder farming plays a crucial role in global food production, contributing approximately 70% of the world's food supply while utilizing less than 25% of all agricultural land. However, smallholder farmers, particularly in Kenya, face significant challenges that hinder productivity and sustainability. Pests, diseases, high operational costs, lack of technical knowledge, and climate variability continue to affect yields and economic viability.

Greenhouse farming has emerged as a solution to mitigate some of these challenges by providing controlled environments for crop production. Despite its success in large-scale horticulture, smallholder adoption has been slow, with failure rates between 30% and 70% due to inadequate knowledge, high setup costs, water scarcity, and poor market access

### **Problem statement**

Smallholder greenhouse farming in Kenya faces several challenges that lead to inefficiencies and economic losses:

#### **1. Environmental Monitoring Issues**

- Difficulty maintaining optimal temperature and humidity levels
- Limited ability to monitor soil moisture consistently
- Challenges in tracking greenhouse conditions remotely

#### **2. Crop Health Challenges**

- Early disease detection difficulties
- Limited expertise in pest identification
- Delayed response to crop stress

#### **3. Resource Management Problems**

- Inefficient water usage patterns
- Suboptimal fertilizer application
- Limited technical support (1:1093 extension officer-to-farmer ratio)

### **Objectives**

The proposed IoT-based greenhouse automation system aims to:

- Automate greenhouse monitoring and control processes to improve productivity.
- Reduce operational costs by optimizing water and input usage.

- Provide real-time data and alerts to farmers for proactive decision-making.
- Enhance knowledge-sharing through a digital platform integrated with agricultural extension services.
- Improve market access by linking farmers directly to buyers and cooperatives.
- Develop an AI-powered image recognition system that allows farmers to upload crop images via for instant disease diagnosis and tailored treatment recommendations.
- Link farmers with nearby agrovets for personalized crop treatment solutions based on real-time disease diagnostics.

### **Proposed Solution: IoT-Based Greenhouse Automation**

This project will deploy an IoT-based system consisting of:

- 1. Environmental Monitoring Sensors:**
  - Temperature, humidity, and soil moisture sensors to provide real-time data.
  - Automated irrigation systems based on soil moisture levels to optimize water use.
- 2. Pest and Disease Detection:**
  - AI-powered image recognition system that allows farmers to upload crop images via for instant disease diagnosis and tailored treatment recommendations.
- 3. Automated Ventilation and Climate Control:**
  - Automated windows and fans controlled by real-time temperature and humidity data.
- 4. Mobile and Web-Based Dashboard:**
  - Farmers can monitor greenhouse conditions remotely via a smartphone app.
  - Alerts and recommendations based on AI-powered analysis of data trends.
  - Agrovets can see requests from farmers who need crop treatment solutions on the web dashboards.

### **Expected Outcomes.**

- Increased greenhouse productivity due to optimized environmental control.
- Reduction in crop losses from pests and diseases through early detection.
- Lower water and input costs through automation and precise monitoring.
- Enhanced access to technical knowledge through digital learning tools.
- Improved income for smallholder farmers through better market connections.

### **Conclusion**

This IoT-based greenhouse automation system has the potential to revolutionize small-scale farming in Kenya by improving productivity, reducing costs, and increasing food security. By

leveraging technology, we can empower smallholder farmers to overcome existing challenges and create a more sustainable agricultural future.

#### 1. **Success Stories**

- Improved crop yields through better climate control
- Reduced water consumption
- Extended growing seasons
- Increased market access