GARDEN HOUSE YOUTH

Stakeholder Engagement and Policy Presentation

IoT Technologies for Climate Adaptation in Smallholder Agriculture During Zambia's 2024 Energy Crisis

Project:
Applied Research on the Role of Internet of Things (IoT) Technologies in Strengthening Climate Adaptation Among Smallholder Farmers

Implemented by:
Garden House Youth Society

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1. Introduction

Zambia's 2024 drought triggered one of the most severe energy crises in the country's history. Reduced water levels in hydropower reservoirs led to widespread electricity shortages and extended load shedding.

These disruptions affected multiple sectors of the economy, including agriculture. Smallholder farmers who rely on irrigation systems, water pumping, and agro-processing activities were particularly affected.

This research explored how **Internet of Things (IoT) technologies** can help farmers manage water and energy resources more efficiently during climate and energy crises.

2. Objectives of the Research

The research aimed to:

- Evaluate how IoT monitoring systems improve irrigation management.
- Assess the role of digital technologies in improving energy efficiency in solar-powered irrigation systems.
- Examine the economic benefits of IoT technologies for smallholder farmers.
- Provide policy recommendations for scaling digital climate adaptation technologies.

3. Study Areas

The research was conducted in selected smallholder farming communities in **Southern and Western Zambia**, where farmers rely on solar-powered irrigation systems.

These regions experienced significant impacts from the **2024 drought and energy crisis**.

4. Research Methodology

The study used a **mixed-method research approach**, including:

- Deployment of IoT monitoring sensors in solar-powered irrigation systems
- Household surveys with **150 smallholder farmers**
- Key informant interviews with agricultural extension officers and community leaders
- Field observations of irrigation and energy use practices

This approach enabled both **technical performance analysis and socioeconomic assessment**.

5. Key Findings

5.1 Improved Irrigation Efficiency

IoT monitoring systems allowed farmers to monitor soil moisture levels and schedule irrigation more effectively.

Results showed:

- **25–30% reduction in water usage**
- Improved irrigation timing
- Reduced water wastage

5.2 Energy Efficiency Improvements

The research found that optimized irrigation schedules reduced unnecessary pump operation.

Participating farms experienced:

- **20–25% reduction in energy consumption** for irrigation
- Reduced operational costs
- Improved efficiency of solar-powered irrigation systems

5.3 Agricultural Productivity

Despite reduced water and energy use, farmers maintained or improved crop productivity.

Benefits included:

- Improved crop health
- Stable crop yields
- Better irrigation management

5.4 Economic Benefits

Farmers reported several economic advantages:

- Reduced irrigation costs
- Lower energy expenses
- More stable farm incomes during the energy crisis

This demonstrates the **economic value of digital climate adaptation technologies**.

6. Farmer Perceptions

Most participating farmers expressed positive perceptions of the technology.

Farmers appreciated:

- Real-time soil moisture information
- Improved irrigation planning
- Reduced uncertainty in water management

However, challenges included:

- Limited digital literacy
- Technology costs
- Connectivity limitations

7. Climate Adaptation Implications

The research shows that digital technologies can play a critical role in climate adaptation.

IoT technologies help farmers:

- Respond to drought conditions
- Manage water resources efficiently
- Maintain agricultural productivity during energy disruptions

These technologies therefore support **climate-resilient agricultural systems**.

8. Policy Implications

The research highlights the importance of integrating **digital agriculture technologies** into national climate adaptation strategies.

Key policy considerations include:

- Supporting digital agriculture innovation
- Expanding rural digital infrastructure
- Promoting climate-smart irrigation technologies
- Strengthening agricultural extension support

9. Policy Recommendations

Promote Digital Climate Adaptation Technologies

Government programs should support adoption of IoT technologies within climate-smart agriculture initiatives.

Expand Rural Digital Infrastructure

Improving internet connectivity will support the use of digital monitoring systems in agriculture.

Improve Farmer Training and Digital Literacy

Agricultural extension programs should include training on digital technologies and climate-smart irrigation.

Support Access to Affordable Technology

Subsidy programs and financing mechanisms can help smallholder farmers adopt digital technologies.

10. Stakeholder Roles

Effective scaling of digital climate adaptation technologies requires collaboration among:

Government Institutions

- Ministry of Agriculture
- Ministry of Green Economy and Environment
- Ministry of Finance and National Planning

Development Partners

- African Development Bank
- Global Center on Adaptation
- Climate finance institutions

Technology Developers

- Digital agriculture innovators
- IoT technology providers

Farmers and Cooperatives

- Adoption and implementation of technologies

11. Long-Term Impact

Scaling IoT technologies in agriculture could lead to:

- Improved climate resilience in farming systems
- More efficient water and energy use
- Higher agricultural productivity
- Stronger rural economic resilience

12. Conclusion

Zambia's 2024 energy crisis highlighted the vulnerability of agricultural systems to climate shocks.

This research demonstrates that **IoT technologies can significantly improve irrigation efficiency, energy management, and climate resilience among smallholder farmers**.

With appropriate policy support and investment, digital agriculture innovations can play a transformative role in strengthening climate adaptation across Zambia and Africa.