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KGID 2025 Green Growth: The Path to Sustainable Jobs

Smart Farming for Agricultural Development in the Caribbean

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KGGTF Grant Activities

Development Objective:
To enhance access to market and climate-resilience approach for targeted beneficiaries

Key Outcome:
To assess the feasibility of adopting smart farming technologies

Component 1. Identifying enablers and challenges	**Component 2.** Engaging public and private stakeholders	**Component 3.** Developing potential global collaborations	**Component 4.** Mainstreaming smart farming technologies
Completed *Output 1.* (1) In-country consultations;	*Output 2.* International workshop	*Output 3.* Bilateral/Multilateral discussions	*Output 4.* Policy dialogues (Validation)
(2) A final report			

Completed: Outputs 1–3

**The initiative is linked to the following projects: (1) Second Rural Economic Development Initiative (REDI II) and (2) Emergency Agricultural Livelihoods and Climate Resilience Project (EALCRP)*

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Timeline

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Mar 24 — TF approval

Aug 24 — In-country consultations in Jamaica & Dominica

Oct 24 — Workshop in Korea

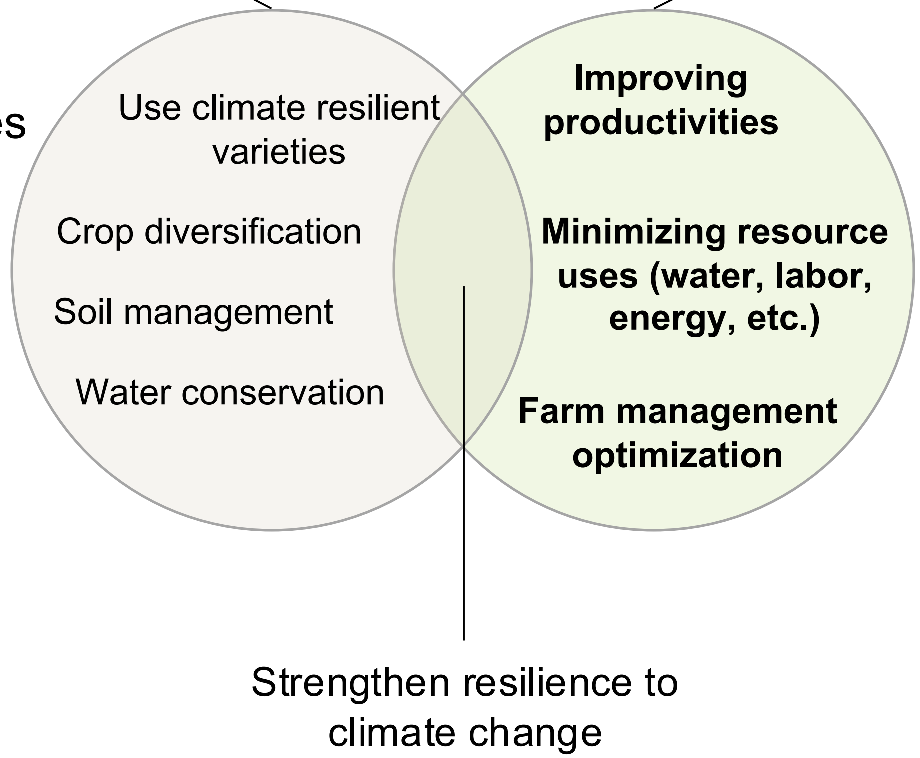
Oct 25 – Dec 25 — Drafting a report "Strategies to adopting smart farming technologies in the Caribbean"

Apr 26 — Validations in Jamica and Dominica

Smart Farming (vs Climate Smart Agriculture)

Climate Smart Agriculture

- **Definition:** An approach for transforming agricultural systems to support food security under the new realities of climate change.
- **Focus Areas:** Sustainability, reduction of greenhouse gas emissions, and increased resilience to climate change.
- **Benefits:** Ensures long-term agricultural productivity and food security in the face of climate change



Smart Farming

- **Definition:** An approach to farm management using modern technology and IoT (Internet of Things) to increase the quantity and quality of agricultural products.
- **Focus Areas:** Efficiency, technology use (sensors, drones, AI, GPS, data analytics), precision agriculture (Controlled-Environment Agriculture).
- **Benefits:** Increases farm productivity, reduces reliance on manual labor, optimizes agricultural practices.

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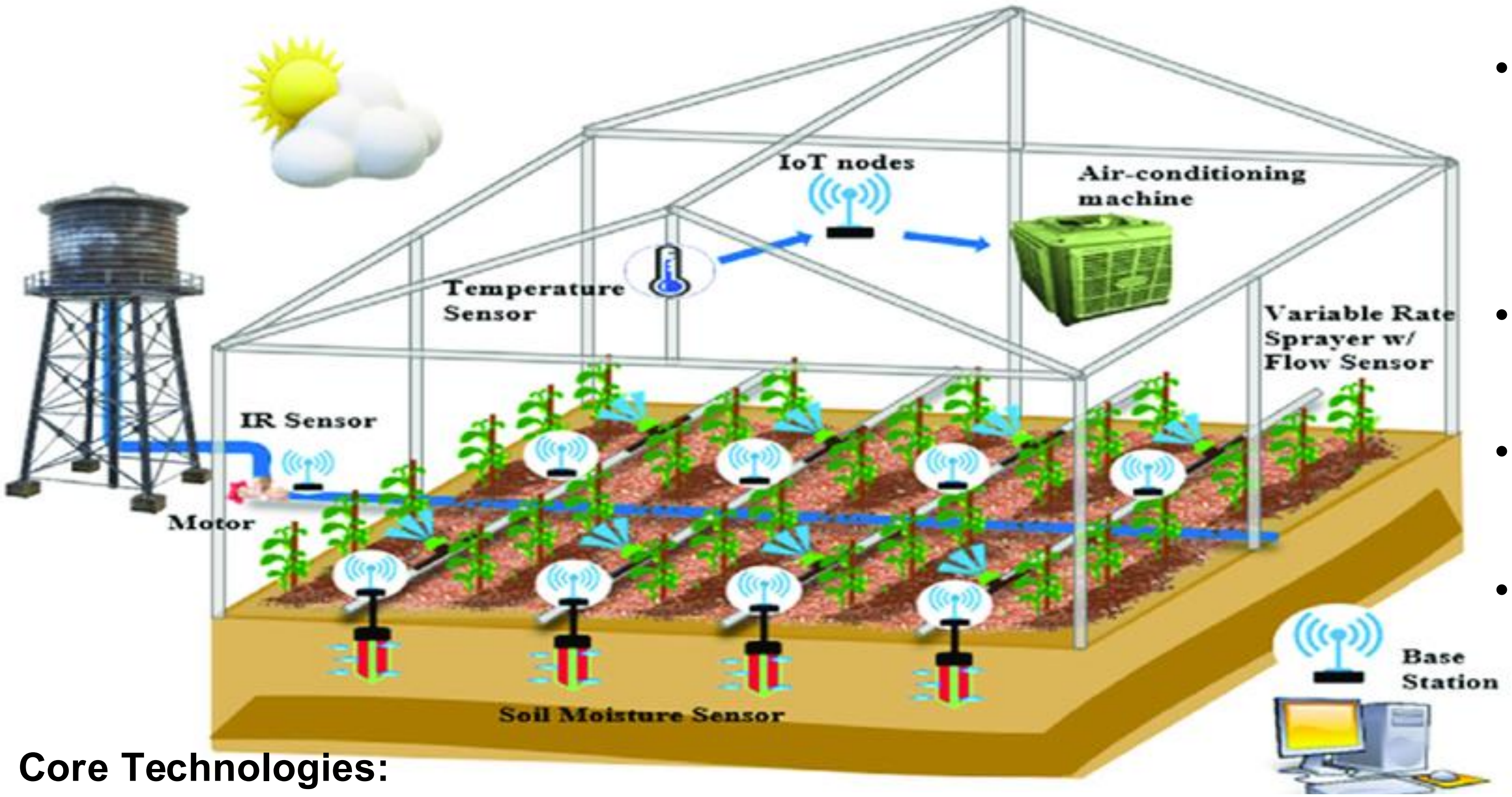
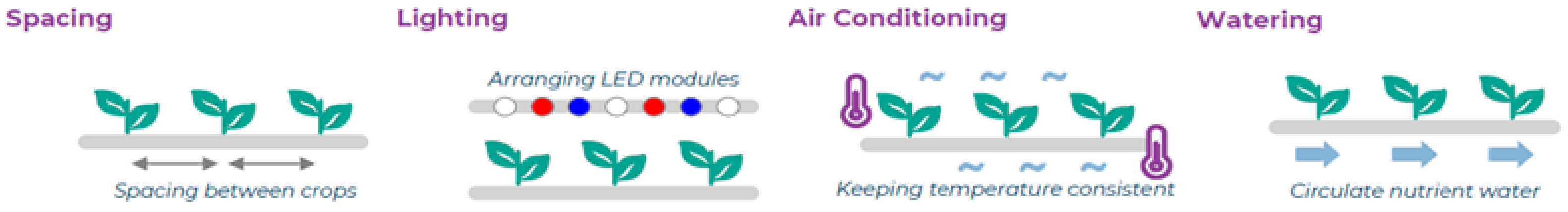
Smart Farming – Conceptual Model



- **Data collection**: IoT sensors collect temperature, humidity, soil conditions, and potential disease risks information.
- **Data Processing:** Collected data is processed at the Base Station.
- **Data Analyzing:** Data is analyzed to generate insights (and forecasts).
- **Action (response):** Results are shared with farmers for decision-making, or automated machines take direct action (e.g., irrigation, air-conditioning, spraying).

Core Technologies:



Various Types of Smart Farm

Indoor Smart Farm

- Large scale salad production
- For large farms and enterprises

Greenhouse Type Smart Farm

- Low budget facilities within greenhouses
- For small farms and local businesses

Container Farm

- Fully automated, off-the-shelf solutions
- For small-scale, specific purposes

Interior Farm

- Customized facilities for "planterior"
- For commercial and retail spaces

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Smart Farming in South Korea

- High reliance on food imports due to limited arable land and no possibility of land-based importation (peninsula geography and closed North Korean border).
- Volatile domestic food prices driven by unstable precipitation and periodic typhoons.
- Smart farming adoption: 14% of total facility horticulture area (7,716 ha of 55,000 ha); overall adoption rate of 6.8% among farms.
- Focus on high-value horticulture crops such as strawberries, tomatoes, paprika (bell peppers), and lettuce.
- Four Smart Farm Innovation Valleys established, providing rental greenhouses, startup training, export support, and seed funds (largest valley: 429,754 m² in Sangju).
- Youth Smart Farm Incubation Program launched to attract new entrants in their 20s and 30s into agriculture.

Smart Farming in South Korea (Farm 8)

- A total of 5 major farms with net growing areas of 25,500 m²
- Energy sources: solar, thermal, waste-heat reuse
- Productivity ↑ up to 60x (vs open field): 3,000 t/yr leafy greens: Edible portion: 95% (vs 67% in open-fields); 8X Space efficiencies; 2X farming densities; Half growing periods; year-round production; 1.5X for high quality crop value (e.g., strawberry (up to 16 brix)
- High-value crops: cilantro, mushrooms, wasabi, medical hemp, cosmetics crops
- Buyers: Global food chains (KFC, Starbucks, Burger King), Local large supermarkets, Schools (school feeding)

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Transitional models in the Caribbean

Hydroponic system with simple automated system
(smart drip controller for water and fertilizer)

Simple sensors: solar radiation, fain, temperature, etc.

Appropriate Smart Farms

- Basic-level technologies (sensors, hydroponic system, automated system) can be integrated into existing farms.
- Provide a low-cost, easy-to-use entry point into digital agriculture.
- Suitable for small farmers, enabling them to access accurate farming information that improves yields, reduces risks, and builds confidence to scale up.

Pros and Cons of Smart Farming

Pros

Sensors detect variables such as temperature, CO_2 levels, light, humidity, diseases, and maturity

Control external environment

Automated system

Smart farming software calculates and suggests the optimum amount of input and energy to use

Less resources (labor, input)

High yields

In optimal scenarios, it increases land productivity by 300 times

Resilience to climate change

Risk management

Uniform quality/ quality control

Able to customize nutrients in products

Lower costs of production

Lower impact on environment

Less chemical, less wastes

Cons

Smart Farming can present ***challenges***, including high installation and energy costs (electricity), difficulty with technology dissemination, and a need for extensive technical assistance to support farmer adoption.

Findings 1. Benefits of Smart Farming in the Caribbean

Improved productivity and efficiency through precision irrigation, automation, and data-driven crop management.

Enhances resilience to natural disasters (e.g., hurricanes and droughts) through stable and controlled environments that ensure consistent production.

Can increase nutrition security by providing a variety of horticultural products rich in vitamins and other nutrients.

Can help meet the growing demand from the tourism industry for specific products such as strawberries, tomatoes, herbs, and bell peppers.

Reduced production costs by optimizing the use of inputs such as water, fertilizers, and energy.

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Findings 2. Smart Farming – Enabling Conditions

Strong Market Linkage

- Focus on high-value perishable crops with consistent demand such as strawberries, herbs, lettuce, tomato, etc.
- Target high-end buyers including tourism sector (hotels, resorts, restaurants) and modern retail channels (large supermarket chains).
- Promote contract farming and long-term supply agreements, ensuring stable supply and uniform quality on a regular basis, which reduces market risks and builds trust with buyers.

Enabling Resources

- Stable and affordable energy sources are critical; renewable solutions such as solar or use of deep-sea water-cooling systems can lower costs and improve resilience.
- Reliable water access and irrigation infrastructure must complement energy supply.
- Strong linkages with the upstream supply chain (equipment, facilities, technical services, spare parts, and inputs) are necessary for sustained operations.

Resilient Facility Design

- Considering the high frequency of hurricanes and extreme weather in the Caribbean, facilities must be designed for resilience. Reinforced glass greenhouses, climate-controlled buildings, and container-based farming units provide higher durability than traditional plastic greenhouses.
- Modular-based facility design allows for flexible scaling and easier integration of global standard technologies, enabling upgrades in automation, climate control, and digital monitoring systems.

Achieving Economies of Scale

- Economic feasibility depends on scaling up production to reach critical mass.
- Gradual expansion from pilot farms to cluster-based production hubs can increase competitiveness and attract private investment.

Economic Feasibility – Example

Hypothesis

- Container-based farming facility
- Size of the container: 500 sqm
- Location: 200m above sea level in Jamaica
- Crop: Iceberg Lettuce

Revenue: USD 886,464/y

- Market price: USD 15/kg
- Productivity: 59,098kg/y

Costs

- Installation of facility: USD 1.2M (lifespan: 10 years)
- Maintenance: USD 7,251/y (USD 0.04/m2)
- Seeds: 2,851/y
- Labor: USD 26,400/y (3 part time)
- Electricity: USD 214,704/y (LED, HVAC, pumps, etc.)
- Water: USD 14,930/y

Net Present Value*: USD 2.7M per installation

Discount rate: 10% (IRR: 107%); Break-even period: 2 years

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Thank you