CRAFT Technical Assistance Facility

Impact Assessment:
WayCool Foods: Deploying IoT-based pest & disease prediction and irrigation management technology to improve crop productivity

Location: India
Project Period: September 2023 – December 2024

The Lightsmith Group

Nordic Development Fund

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Executive Summary

Between September 2023 and December 2024, Lightsmith's CRAFT Technical Assistance Facility worked in partnership with WayCool Foods and CensaNext to deploy a pilot program of climate-smart technologies to help smallholder farmers prevent crop losses, optimize resource use, and build resilience against climate-induced pests and diseases.

The "Deploying IoT-based Pest & Disease Prediction and Irrigation Management Technology to Improve Crop Productivity" piloted technology to enhance climate resilience of smallholder farmers in India by deploying 133 IoT weather stations across 12 crops to provide real-time weather data, irrigation recommendations, and pest and disease predictions, while simultaneously capturing 2.7 million images detecting 867 pests and diseases across 115 crops with 84% accuracy. 55 crop-specific algorithms were developed for AI-powered detection. The project demonstrated the potential for greater impact - farmers using the technology reduced water consumption (some by over 50%), decreased pest infestation severity, improved farming practices, and increased production and income by making data-driven decisions on irrigation timing, pesticide application, and preventive crop management.

The technology and algorithms developed could be further developed and deployed to address critical gaps in weather data and pest and disease predictions affecting millions of smallholder farmers globally, with significant scalability potential through adoption by agribusinesses with farmer networks, integration into government programs such as India's Ministry of Agriculture, which is reaching 38 million farmers, and replication across Sub-Saharan Africa where similar climate challenges exist.

Project Partners

Lightsmith partnered with WayCool Foods to implement the “Deploying IoT-based pest & disease prediction and irrigation management technology to improve crop productivity” project alongside CensaNext and Unisem.

The Lightsmith Group (“Lightsmith”) is a sustainable private equity firm that invests in companies that address critical society needs. Lightsmith partners with growth-stage companies to deploy impactful projects and help them scale their solutions globally.

WayCool Foods & Products Pvt Ltd. (“WayCool”) is in the Agriculture Supply Chain Industry. Waycool Foods is the only full-stack tech-led supply chain player in India, focusing on food cultivation, processing and distribution, while leveraging innovative technology to scale and operate a complex supply chain from fork to farm. The company has merged the physical and digital worlds for a “phy-gital” business model connecting farmers, processors, distributors and the retailers, while boosting profitability for every stakeholder. Waycool Foods products include fresh fruits and vegetables, staples, nuts and spices, dairy, and value-added products.

CensaNext (“Censa”), a WayCool technology subsidiary, provides digital, IoT, and Enterprise Resource Planning solutions tailored to the food and agri industry to improve efficiency, transparency, and sustainability. Their flagship platform, Censa Cloud, offers six modular product suites that support the entire seed-to-sale supply chain through integrated SaaS and customized solutions.

Unisem Electronics (“Unisem”) helps clients design, build, and launch innovative products in the global Electronic System Design & Manufacturing market. The company designed and manufactured the GWX 100 Weather Station used by the farmers in this project.

This project was funded in part by a grant from the United States Department of State and in part by a grant from the Nordic Development Fund.

Climate Change and Agriculture in India

National Context

- India ranks 7th globally among countries most affected by climate change (Global Climate Risk Index 2021)
- Agriculture provides livelihoods for approximately 58% of the population and contributes about 18% of GDP

Smallholder Farmer Vulnerability

- Over 85% of India's farming population are smallholder farmers who rely on rainfed agriculture, have poor access to irrigation, lack adequate credit or insurance, and are excluded from formal market systems, making them particularly vulnerable to climate shocks

Increasing Pest & Disease Impacts

- Warmer temperatures driven by climate change enable pests to survive in new regions and attack crops year-round, while erratic weather creates ideal conditions for disease outbreaks
- As a result, farmers lose 30% of crops, worth over $10 billion annually, to pests and diseases, with climate change accelerating both pest spread and severity

Climate-Smart Solutions

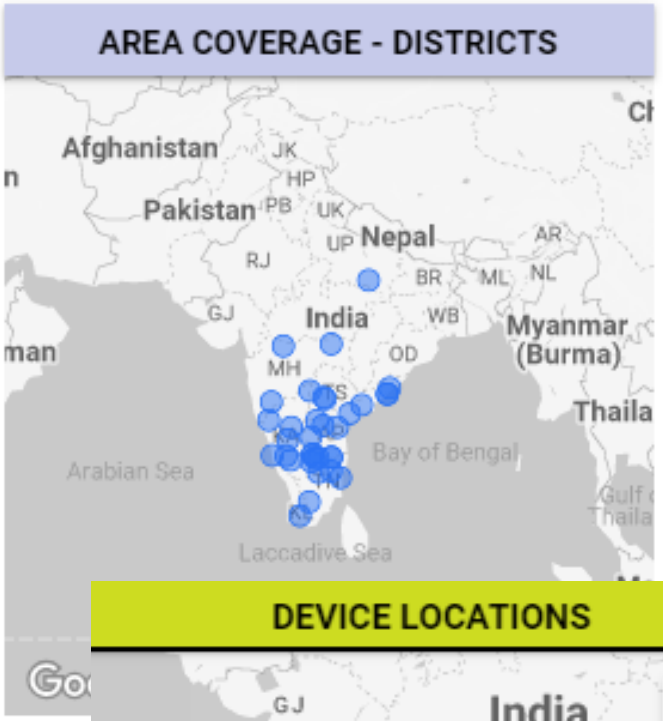
- IoT-enabled technologies offer a path forward, allowing farmers to enhance productivity, reduce costs, and mitigate climate risks through real-time monitoring and data-driven decisions

Project Objectives

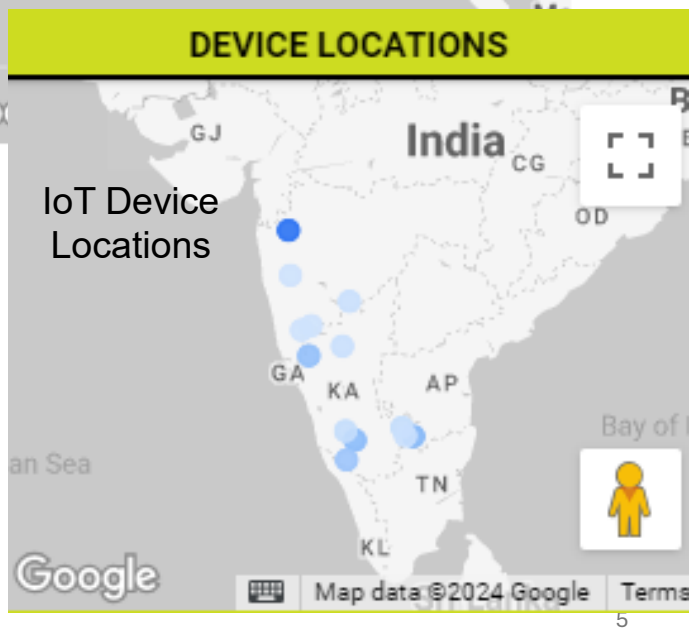
Objective: Develop and deploy climate-smart agricultural technologies to help smallholder farmers prevent crop loss, optimize resource use, and build resilience against climate-induced pests and diseases

Stakeholders:

- Smallholder farmers (primary beneficiaries)
- CensaNext (technology platform; technology validation and development; and implementation)
- Unisem Electronics (IoT device production - GWX 100 Weather Station)
- WayCool (farmer network access and ground support)
- Field team (interns, project associates, and installation engineers)
- Agricultural universities and institutes (intern recruitment and expertise)



Area coverage of pest & disease modeling



IoT Device Locations

Enhancing farmer resilience in India

Need 1: Smallholder farmers lack access to accurate, localized weather data and struggle to predict when pests and diseases will affect their crops, leading to preventable crop losses up to 30%	**Objective 1**: Deployed 133 IoT weather stations across 12 crop types to provide real-time micro-climatic data and AI-powered predictions that alert farmers to pest and disease risks before they cause damage
Need 2: It is difficult for farmers to quickly and accurately identify the specific pests and diseases affecting their crops, resulting in delayed treatment, incorrect pesticide application, and reduced yields	**Objective 2**: Build an AI-powered image recognition system covering 867 pests and diseases across 115 crops, enabling farmers to quickly diagnose problems through their mobile phones
Need 3: Current irrigation practices rely on estimation rather than data, leading to water wastage, increased costs, and poor crop growth, particularly critical during erratic monsoon patterns and drought conditions	**Objective 3**: Provide crop-specific irrigation recommendations based on real-time farm conditions, such as soil moisture and weather data, informing farmers exactly when to irrigate and how much water to use for optimal resource efficiency

Project Activities: IoT Deployment & Weather-Based Predictions

Device Production & Quality Control

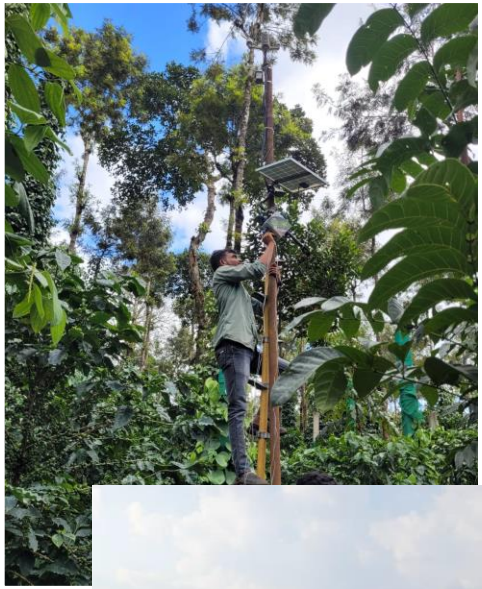
- Unisem manufactured the GWX-100 weather stations with micro-climatic data capture capabilities
- CensaNext conducted quality control reviews of all IoT devices before deployment
- CensaNext developed and improved a second-generation weather sensors (GWX-100 V1.6) to address technical challenges

Farmer Outreach & Installation

- Generated leads through WayCool departments, business partners, agricultural institutions, and local connections
- Conducted on-site visits to explain device benefits
- Installed 133 devices across 12 crop types in multiple regions with engineer-led training on operation and maintenance
- Provided remote troubleshooting support & follow-up visits as needed

Data Collection & Model Development

- Conducted on-field truthing (OFT) activities to collect irrigation data, spraying responses, fertilizer application, crop yield parameters, and produce quality metrics
- Gathered farmer feedback on service usability and benefits throughout crop cycles
- Conducted third party impact survey to understand impact and farmer feedback.



Project Activities: AI image-based Detection System

Team Recruitment & Deployment

- Hired 34 image collection interns and 16 image validation interns from agricultural universities and institutes
- Mapped interns to specific project areas and assigned crop coverage

Image Capture & Model Building

- Captured 2.7 million images covering 867 pests and diseases across 115 crops with 84% accuracy
- Validated images for accuracy and quality
- Developed 55 crop-specific algorithms for AI-powered detection and made available through mobile app to pilot farmers
- Deployed and tested models, with ongoing bug fixes and refinements

Project Impact

- Lightsmith partnered with research partner, 60 Decibels, to conduct an independent farmer survey in Fall 2025 through phone interviews to assess the technology's impact on water management, pest control, farm productivity, and income. Findings are included as follows:

Farmers engaged with both the IoT weather sensors and the pest and disease prediction tool in WayCool's Outgrow app. The real-time data enabled them to:

Optimize irrigation timing and water use, with some farmers reducing water consumption by over 50% while maintaining or improving crop health	**Make informed pest management decisions**, knowing precisely when to apply pesticides or fungicides based on weather conditions and disease predictions	**Take preventive action** rather than reacting to visible crop damage, reducing the severity of pest infestations

Project Impact (continued)

Key outcomes included:

- Reduced water waste while preventing water stress in crops
- Lower pest and disease severity through timely interventions based on predictions
- Improved crop quality and yields, with farmers reporting better leaf growth and healthier root systems
- Some increased farmer income for those who consistently used the technology and received reliable data
- Enhanced climate preparedness, with farmers feeling more equipped to handle future climate shocks
- Issues related to connectivity and continuation of services post-pilot limited the depth of impact for some farmers in the pilot.

"The weather sensor showed what the weather is like, whether it is good or if it is going to rain, and how much sunlight there is. Because of this, I know when to apply pesticides or fungicides and when not to. It also told me how to manage water. With this, the leaves grow better, and I can know whether the roots are getting enough water or not."

42 years old, Maharashtra

"Because of the sensor, I knew when to irrigate my field, how much water to use, and for how long. This helped reduce the yellowness in the plants."

40 years old, Maharashtra

Farmer Engagement

+ *Profiles of farmers* using mini-weather stations with IOT based pest & disease prediction and irrigation management to improve crop productivity*

**Farmer names have been omitted for confidentiality purposes*

Farmer 1

- 1-acre tomato farm
- Irrigation decreased from 3 hours/day to 1.5 hours every other day
- Applies fewer chemicals, knows when to spray ahead for blight using app
- Costs decreased by 30%; mostly from reduction in crop losses
- Size of produce has increased

Farmer 2

- 1-acre tomato & 10-acre mango farm
- Added both crops to mobile app
- Irrigation decreased from 30,000 liters/day to 15,000 liters/day
- More accurate data through app after requesting repositioning of IoT device
- Reduced irrigation costs and increased response to pest and disease outbreaks through the detection feature

Farmer 3

- 2-acre capsicum (bell pepper) farm & 18-acre pomegranate farm
- 2 devices, one on each farm
- Inputs reduced greatly
- Targeted and scheduled application of pesticides instead of random
- 75% decrease in irrigation from 2 hrs/day to .5 hr every other day
- Automatic overhead irrigation: sprinklers activated when sensor records specific temperature

Lessons Learned and Recommendations

Issues	Lessons Learned	Recommendations
Device Reliability (IoT deployment)	Device malfunctions were the top farmer complaint. Farmers reported their sensors had stopped working, limiting impact depth and farmer trust	Prioritize rigorous field testing before deployment and establish local technical support networks for timely on-site assistance and ongoing farmer assistance. Ensure unit economics of device allows for continued technical support. Need to understand the minimum number of devices required to cover operational costs
Farmer Support and Engagement (IoT deployment)	Poor customer support intensified device issues. Peer influence was the strongest adoption motivator, particularly in remote locations.	Build local support networks with trained engineers and use farmer champions for peer-to-peer technology demonstration and ongoing engagement.
Timing & Planning (IoT deployment)	Late device installations resulted in incomplete crop cycle data, limiting impact validation and positive impacts for farmers.	Begin farmer outreach 2-3 months before planting seasons to ensure devices capture complete crop cycles from beginning to harvest.

Lessons Learned and Recommendations (continued)

Issues	Lessons Learned	Recommendations
Data Collection Quality (AI model development)	Challenging terrain, adverse weather, limited phone storage, and variable camera quality impacted image capture. Differentiating similar diseases required expert agronomist input.	Provide image collectors with adequate equipment (phones with sufficient storage and camera quality) and involve agricultural experts early in model validation and disease classification.
Model Accuracy & Validation (AI model development)	Initial approach of merging similar disease classes reduced model accuracy. Creating distinct classes for each "crop x disease" combination improved results but required more images per class.	Set clear image thresholds per disease class and maintain distinct classifications even when symptoms appear similar across crops.
Crop and Geographic Focus (Across project activities)	The initial objective to cover 20 crops proved overly ambitious due to the limited rains during the 2023 monsoon and farmer access challenges. However, the AI model successfully covered 115 crops by leveraging agricultural university networks for image collection.	For IoT deployment, prioritize regions with strong local partnerships and longer-season crops to capture complete cycle data and maximize impact demonstration. For AI development, leverage academic networks to access diverse crop varieties efficiently.

Replicability and Scalability

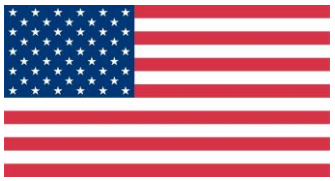
- This project demonstrates the potential of combining IoT sensors with AI-powered mobile applications to build climate resilience among smallholder farmers. The technology addresses critical gaps in access to localized, real-time weather data and actionable pest and disease predictions, challenges that affect millions of smallholder farmers across India and similar contexts globally.
- Pathways to scale:

Within India	Across Sub-Saharan Africa	Globally
• The AI-powered pest and disease detection model could complement the University of Chicago's 2025 partnership with India's Ministry of Agriculture, which delivered tailored weather forecasts to 38 million farmers reached via SMS by integrating pest and disease predictions for comprehensive decision-making support	• Governments establishing IoT weather stations could integrate AI-powered pest and disease detection • Successful models such as Kilimo Salama in Kenya demonstrate how bundling IoT weather data with complementary services (crop insurance, market information) drives adoption and impact	

CRAFT Technical Assistance Facility

+ CRAFT TA is a grant facility designed to accelerate application of climate resilience and adaptation technologies in developing countries, particularly in Low Income Countries (LICs) and Small Island Developing States (SIDS). It is a deployment-oriented strategy focused overcoming up-front barriers to application of adaptation & climate resilience solutions in LICs, SIDS, other ODA countries

+ This project was funded in part by a grant from the United States Department of State and in part by a grant from the Nordic Development Fund. The opinions, findings and conclusions stated herein are those of the authors and do not necessarily reflect those of the United States Department of State.



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