Final Year Project Showcase Batch 2021
Year 2025

Department: Software Engineering **Programme:** Software Engineering	
1	**Project Title** AgriSense: Smart Solutions for Precision Farming, Sustainability and Resource Efficiency
2	**Project Idea** AgriSense is an IoT- and AI-based precision agriculture system designed to optimize crop yield, conserve resources, and promote sustainable farming in urban and peri-urban areas. It uses real-time environmental sensing through ESP32 microcontrollers and 7-in-1 NPK sensors, transmitting data via LoRaWAN. The mobile application provides actionable recommendations, disease detection, and expert/community support, making it a comprehensive smart farming tool.
3	**Process** The system includes: • **Hardware:** ESP32 microcontroller with LoRaWAN and NPK 7-in-1 sensors • **Data Handling:** Azure Cloud + PostgreSQL + Firebase (for notifications) • **AI Models:** Crop Recommendation, Action Recommendation, CNN-based Disease Detection • **Mobile App:** Real-time dashboard, AI chatbot, community feature, expert video calls • **Deployment:** Field-tested on one real-world device • **Data Sync:** Periodic (hourly to monthly) with fallback retry mechanism • **Showcased At:** IBA HackFest'25 Sharktank (1st place), Climatech Intl Conference'25 and Sindh HEC Research Showcase'25
4	**Outcome** AgriSense helps urban and peri-urban farmers increase productivity and reduce water and fertilizer waste. It enables timely crop recommendations, automated disease diagnostics, and expert consultation—all from a mobile device. The prototype is field-validated and ready for scaling with industrial partnerships.
5	**Evidence (Theoretical Basis)** AgriSense is grounded in the convergence of **IoT**, **AI**, and **wireless sensor networks**—emerging technologies increasingly adopted in smart agriculture. The system's design leverages established theoretical frameworks: • **Precision Agriculture Principles**, which advocate for site-specific farming to increase yield and reduce waste • **Machine Learning Algorithms**, such as classification models for crop recommendation and CNNs for disease detection, trained on real-world agricultural datasets • **Wireless Sensor Networks (WSNs)**, where ESP32 with LoRaWAN ensures long-range, low-power communication • **Sustainable Development Theory**, aligning with SDG-11 to promote resilient agricultural systems in urban settings

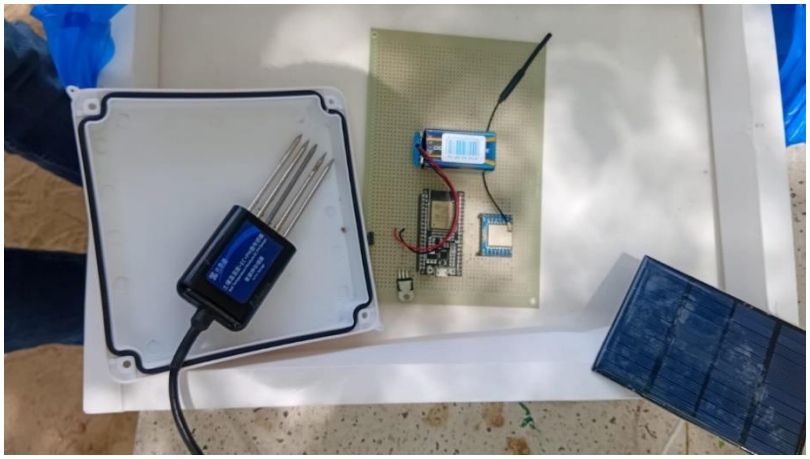
	By combining these elements, AgriSense enables farmers to make evidence-based decisions. Real-time data from soil and environmental sensors is analyzed by AI models, generating actionable insights that directly impact crop productivity, resource efficiency, and sustainable practices.
6	**Impact on Sustainability of Urban Regions or SDG-11 "Sustainable Cities and Communities"** AgriSense supports SDG-11 by making urban agriculture smarter and more efficient. It reduces resource usage (water, fertilizers), improves crop health monitoring, and promotes local food production within or near cities. It also empowers small-scale and community farmers with AI-powered insights, contributing to resilient and inclusive cities.
7	**Competitive Advantage or Unique Selling Proposition** AgriSense stands out through its fusion of **low-cost IoT**, **AI-powered intelligence**, and **user-centric design**, tailored specifically for underserved farming communities. Unlike traditional farming methods or costly enterprise-level solutions, AgriSense offers a **comprehensive, scalable, and field-tested precision agriculture platform**. Its unique strengths lie in **achieving key Sustainable Development Goals (SDGs)**, reducing environmental impact, optimizing processes, and unlocking access to **new and neglected market segments**—making it a strong candidate for both **industrial investment** and **large-scale impact** in sustainable urban agriculture.
a	**Attainment of any SDG** AgriSense achieves multiple Sustainable Development Goals (SDGs), including: ✓ **SDG 1 – No Poverty:** Empowers smallholder farmers with affordable smart farming tools that improve productivity and income, helping reduce rural poverty. ✓ **SDG 2 – Zero Hunger:** Increases food security by improving crop yields through AI-based recommendations and disease detection. ✓ **SDG 3 – Good Health and Well-Being:** Minimizes the use of harmful agrochemicals through precision application, enhancing food safety and reducing health risks for farmers. ✓ **SDG 8 – Decent Work and Economic Growth:** Promotes decent work by modernizing agriculture with smart technologies, increasing economic opportunities, and fostering agri-entrepreneurship in rural and urban areas. ✓ **SDG 9 – Industry, Innovation and Infrastructure:** Integrates cutting-edge technologies (AI, IoT, LoRaWAN) into agriculture, advancing innovation and building smart rural infrastructure. ✓ **SDG 12 – Responsible Consumption and Production:** Promotes sustainable resource use (water, fertilizers) by enabling data-driven, need-based application, minimizing waste. ✓ **SDG 13 – Climate Action:** Supports climate-resilient agriculture with efficient resource use, reduced emissions, and real-time adaptation to environmental changes.
b	**Environmental Aspect** AgriSense promotes environmentally sustainable agriculture by enabling **data-driven decisions** that reduce the overuse of fertilizers, pesticides, and water. Its precision recommendations help avoid chemical runoff, preserving soil and water quality. The use of **LoRaWAN**, a low-power long-range wireless communication protocol, minimizes energy consumption and carbon footprint in data transmission. Additionally, by improving

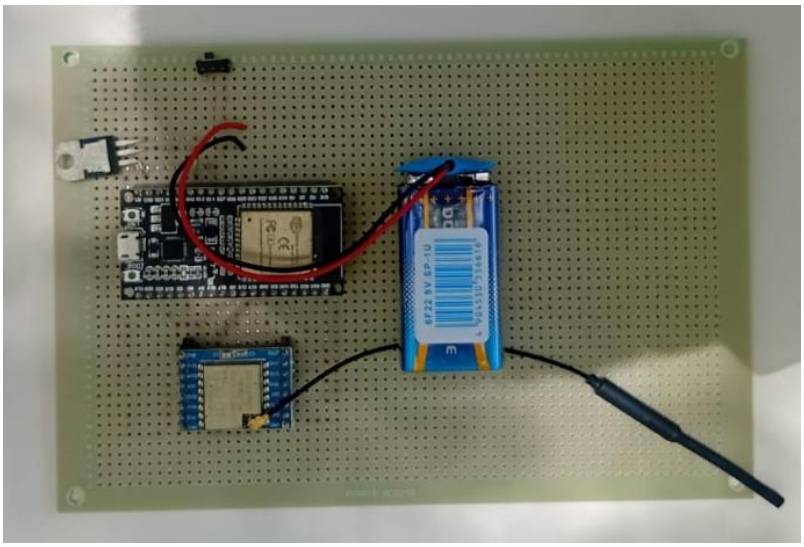
	crop health and reducing losses, AgriSense indirectly reduces the need for land expansion and deforestation. In short, it supports **climate-friendly, resource-efficient, and low-emission agriculture**—a critical need in the face of environmental degradation and climate change.
c	**Cost Reduction of Existing Product** AgriSense significantly reduces the operational costs associated with traditional farming by introducing **automated, intelligent decision-making**. Instead of relying on costly trial-and-error methods or consulting experts manually, farmers receive **AI-generated recommendations** for: • **Optimized fertilizer usage**, reducing chemical expenditure • **Timely irrigation**, minimizing water bills • **Early disease detection**, lowering the need for expensive treatments or replanting The use of **LoRaWAN communication** lowers data transmission costs compared to mobile internet, and the **ESP32 microcontroller** ensures an affordable hardware base. Additionally, all insights are accessible via a mobile app, eliminating the need for costly external equipment or third-party services.
d	**Process Improvement which Leads to Superior Product or Cost Reduction, Efficiency Improvement of the Whole Process** **Current Issue:** Traditional farming methods in urban and peri-urban areas rely heavily on manual decision-making, guesswork, and delayed reactions to environmental changes. Farmers often lack access to real-time information about soil health, weather conditions, and crop disease — leading to **inefficient input use**, **increased operational costs**, **lower yields**, and **wasted resources**. **Suggested Improvement with AgriSense:** AgriSense transforms the entire agricultural process through **real-time sensing** and **AI-powered recommendations**. Key improvements include: • **Precision Irrigation & Fertilization**: Sensors detect exact nutrient and moisture needs, guiding optimal input use. • **Disease Detection**: A CNN-based AI model detects plant diseases early, preventing large-scale crop losses. • **Smart Decision Support**: AI recommends the best crop type and actionable strategies based on environmental conditions. • **Data Logging & Alerts**: Farmers receive timely alerts and historical data trends via a user-friendly mobile app. These improvements result in: • **Reduced costs** (less waste of water, fertilizers, pesticides) • **Higher efficiency** (faster, data-driven decisions) • **Better yields** (early problem detection and optimal crop matching) • **Scalability** (suitable for small to medium farms, with minimal training) AgriSense upgrades farming into a **low-cost, high-impact digital process**, offering significant productivity and sustainability gains.
e	**Expanding of Market Share** **Current Market Problem:** The existing market for precision agriculture solutions is dominated by high-cost, complex systems tailored for large-scale industrial farms. These are

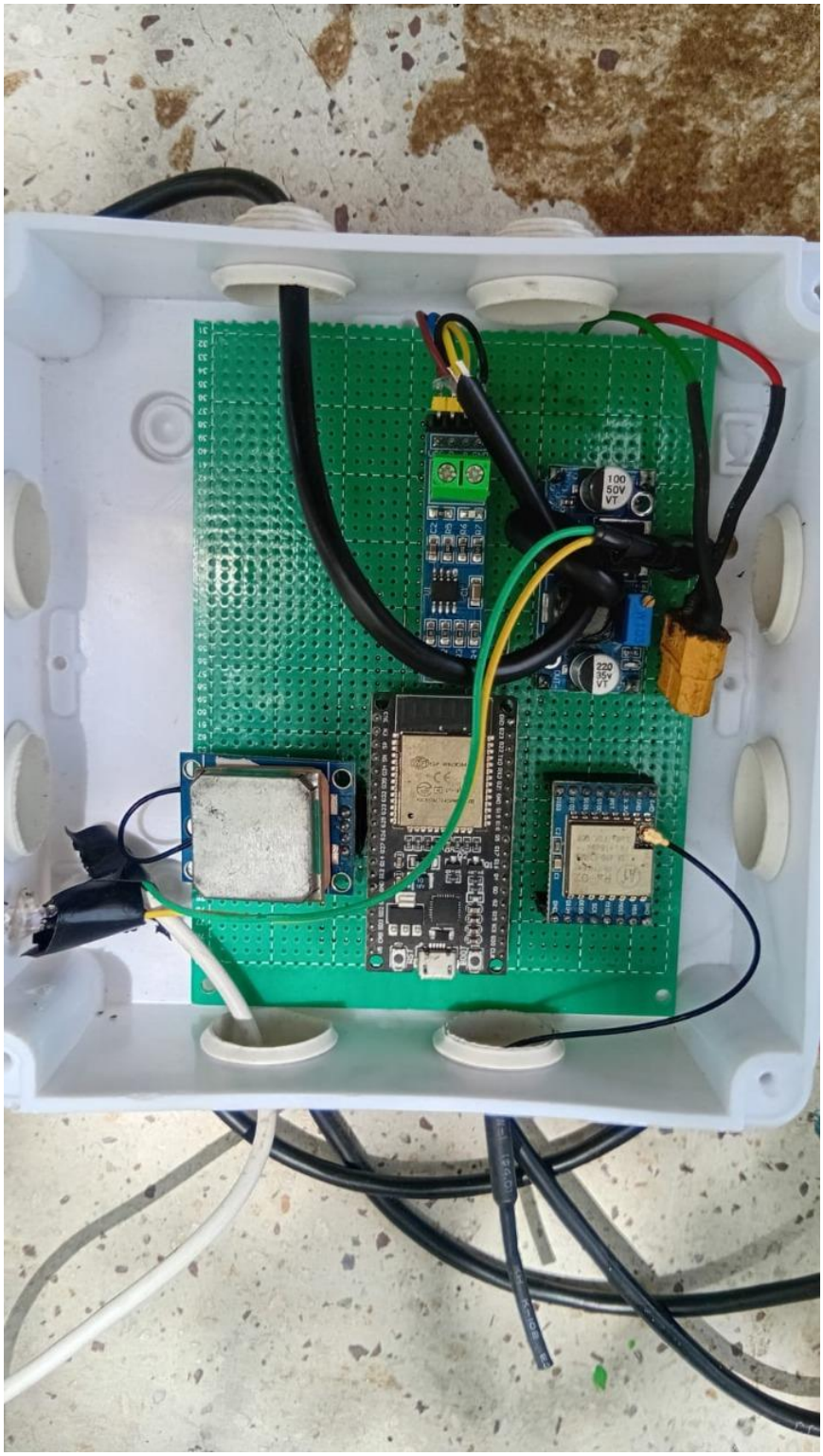
	often **inaccessible to smallholder and peri-urban farmers** due to high pricing, complex setups, or lack of local language and support features. Additionally, many platforms offer fragmented services (e.g., only weather updates or only irrigation tips), leading to poor adoption. **How AgriSense Expands Market Share:** AgriSense breaks these barriers by offering a **low-cost, all-in-one smart farming solution** that is: • **Affordable:** Uses low-cost hardware (ESP32, LoRaWAN) and open-source AI models • **User-Friendly:** Designed for non-technical farmers with a multilingual mobile app • **Scalable:** Suitable for individual users, community farms, and NGOs working in agriculture • **Comprehensive:** Combines sensor-based insights, crop recommendations, disease detection, and expert/community interaction into one platform By targeting the **underserved segment of small to mid-scale farmers** in developing and emerging markets, AgriSense is well-positioned to **capture and grow a new user base**, thereby expanding the overall market for smart agriculture solutions.
f	**Capture New Market** **Unaddressed Segment:** The precision agriculture industry has largely overlooked **smallholder, peri-urban, and low-tech farmers**—particularly in developing countries. These farmers often lack access to expensive smart farming tools, consistent internet, and agricultural advisory services. Additionally, solutions tailored for large commercial farms are often too complex or unaffordable for these users. **How AgriSense Captures This Niche:** AgriSense is purpose-built to serve this **untapped, underserved market** with: • **Offline-capable technology** via LoRaWAN (no dependency on continuous internet access) • **Multilingual mobile application** designed for ease of use, including for those with low digital literacy • **Affordable hardware setup** using ESP32 and open-source AI models • **Complete smart farming solution** in one package (real-time sensor data, crop/disease recommendations, expert interaction) This makes AgriSense ideal for **rural cooperatives, small farming communities, NGOs, and urban rooftop/agri-tech enthusiasts**, capturing a **new market segment** currently unsupported by mainstream agri-tech players.
g	**<u>Strategic Collaboration & Real-World Validation</u>** AgriSense has already gained **industrial interest** and undergone **real-world testing** — a major differentiator from many academic prototypes. • It won **1st place at HackFest X Datathon**, showcasing innovation and business viability. • It was presented at **Climatech Conference**, receiving **interest from Engro**, one of the leading agri-business companies in Pakistan. • A working prototype has been **tested in real farming conditions**, proving practical feasibility and performance. • The system is designed with **scalability** and **cloud integration (Azure)** in mind, allowing easy deployment across regions.

	These elements demonstrate that AgriSense is not just a project but a **market-ready innovation**, with the potential for **commercial adoption, public-private partnerships, and regional deployment** in smart agriculture initiatives.	
8	**Target Market** Urban and peri-urban farmers, agricultural extension departments, agritech startups, NGOs working in food security, and small landowners. It's user-friendly, even for individuals with limited tech experience, and scalable for community farming.	
9	**Team Members** (Names along with email address)	Syed Muhammad Ammar - syedmammar123@gmail.com Muhammad Osama - mo354598@gmail.com Sahil - sahilkumarm226@gmail.com Hassan Shahid - hassanshahid234@gmail.com
10	**Supervisor Name** (along with email address)	Dr. Shehnila Zardari - shehnilaz@cloud.neduet.edu.pk
11	**Video (If any)**	https://drive.google.com/file/d/1ICHYomHB9JwI5YToMZjnoG6PQDyPPb8c/view

Pictures (If any)



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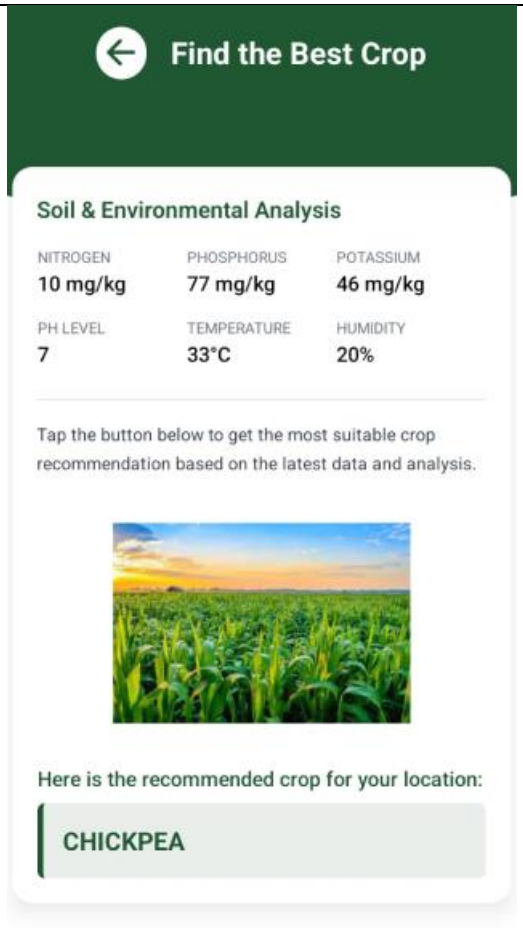
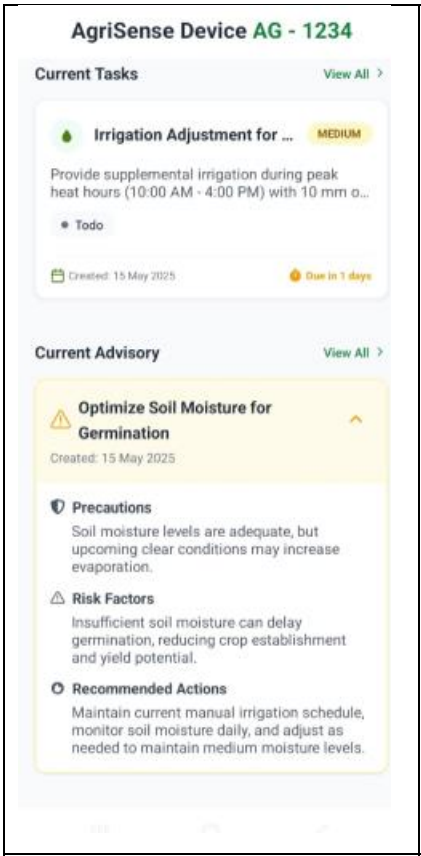
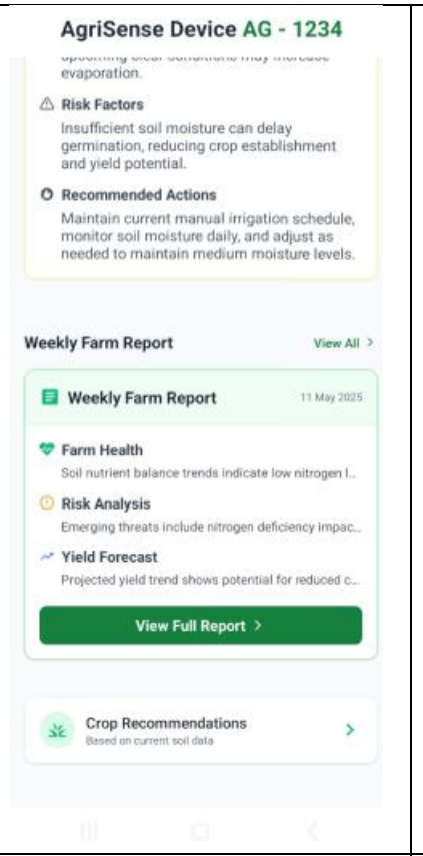
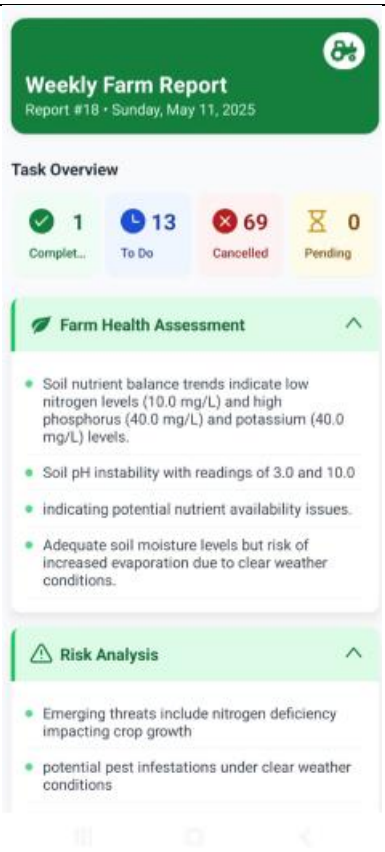
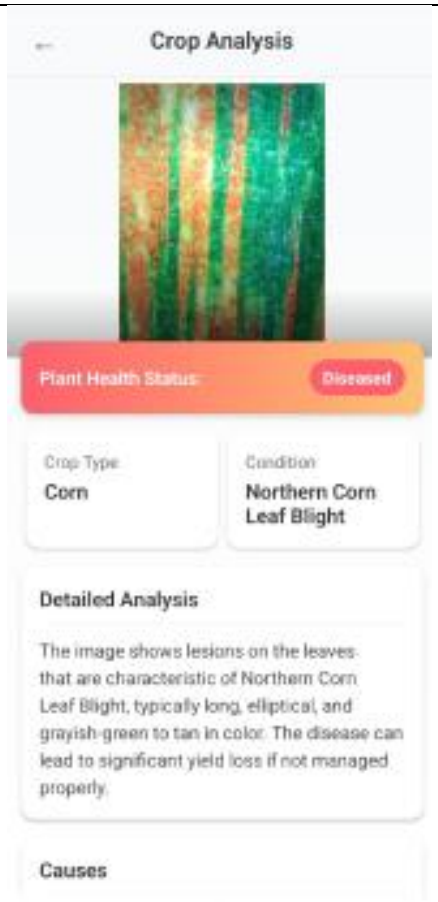
Dashboard with real-time data from farm



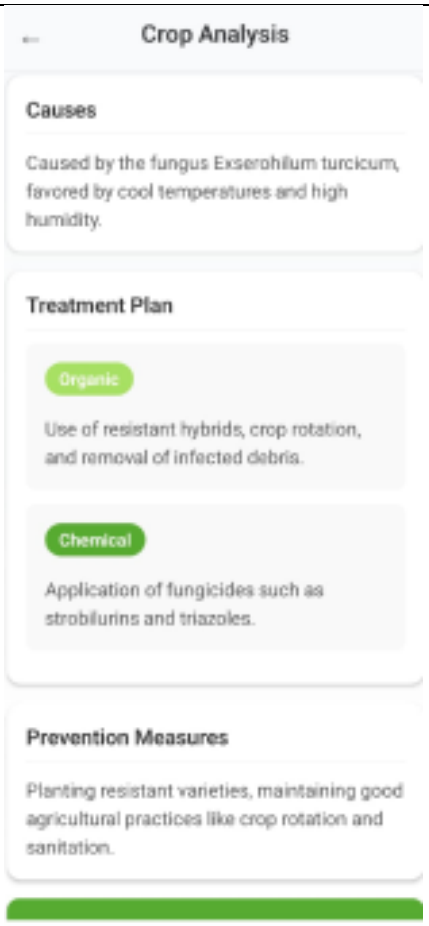
Recommended crop

		
Task/Advisory for Farmer	**Farm Report**	**Farm Health/Risks**

		
Task/Advisory For Non-Device Farms	**Advisory For Non-Device Farms**	**Advisory For Non-Device Farms**



Health Assessment



Health Assessment