Abstract

The future of farming does not depend on more labor or more chemicals, but on intelligence that can think, decide, and act alongside farmers.

This project presents an intelligent, agent-driven agricultural ecosystem designed to transform conventional farming into a sustainable, data-informed, and economically fair practice. The central vision is to empower farmers—particularly small and medium-scale producers—by embedding advanced artificial intelligence directly into everyday agricultural decision-making. Rather than offering isolated advice or static information, the system operates as a collaborative network of AI agents that actively support farmers from crop cultivation to market access.

At the foundation of the system is a voice-based AI agronomist capable of understanding and responding in local Bangla dialects. Farmers can communicate naturally through speech, asking questions about crops, soil conditions, pests, or pricing without requiring literacy or technical expertise. This dialect-first approach addresses one of the most significant barriers in agricultural technology adoption and ensures inclusivity at the grassroots level.

The system integrates computer vision for real-time crop diagnostics. Farmers can upload images of affected crops using a mobile device, enabling the AI to identify diseases, pest infestations, or nutrient deficiencies and recommend appropriate treatments. These recommendations include both organic and chemical options, allowing farmers to balance productivity with environmental responsibility while reducing unnecessary pesticide use.

Precision agriculture and soil health management form another core component. IoT-enabled sensors monitor soil moisture, temperature, and nutrient levels such as nitrogen, phosphorus, and potassium. Based on real-time data, the system generates personalized fertilizer and irrigation recommendations, reducing input waste, lowering costs, and protecting long-term soil fertility. Integrated weather and climate monitoring further enhances resilience by providing early warnings for droughts, heat stress, and extreme rainfall events.

Beyond production, the project addresses unfair pricing and post-harvest losses through a smart digital marketplace. Farmers are directly connected with buyers such as retailers, exporters, and agro-processing units. Autonomous AI agents negotiate prices on behalf of farmers using real-time market trends and demand forecasts, reducing exploitation by intermediaries and ensuring fair compensation.

An intelligent shelf-life prediction mechanism estimates the remaining freshness of harvested produce. When spoilage risk increases, the system can trigger flash sales or redirect produce to nearby processing facilities, creating a circular agricultural economy that minimizes food waste and maximizes farmer income.

The platform employs an agentic decision workflow where specialized AI agents—responsible for agronomy, climate risk, market intelligence, and shelf-life management—collaborate to deliver a single, actionable recommendation. With user consent, the system can autonomously execute actions such as buyer matching or price negotiation, shifting from advisory tools to action-oriented intelligence.

The project aligns strongly with the United Nations Sustainable Development Goals, particularly SDG 2 (Zero Hunger), SDG 8 (Decent Work and Economic Growth), SDG 12 (Responsible Consumption and Production), SDG 13 (Climate Action), and SDG 15 (Life on Land). Trust and transparency are ensured through AI-based trust scoring and escrow-secured payments.

Implementation follows a phased approach, beginning with a pilot deployment in a single agricultural district, followed by marketplace integration and large-scale expansion through

cooperatives and NGOs. Future development includes satellite imagery integration, carbon footprint tracking, AI-driven crop insurance, and climate finance connectivity. Overall, the project envisions a future where agriculture is guided not by uncertainty, but by intelligence that works ethically and sustainably alongside farmers.