

KGAI4Ag: Advancing Knowledge-Guided AI to Develop Agricultural Digital Twins for Singapore's Climate Resilience

Co-led by Illinois Advanced Research Center at Singapore Ltd. (Illinois ARCS) and NUS

Southeast Asia's food systems face growing pressures from climate change. Increasingly erratic rainfall, rising temperatures and shifting growing seasons are threatening staple crops such as rice and key export commodities like oil palm, cacao and coffee, with knock-on effects for food security and trade across the region.

This project builds digital twins for ASEAN agro-ecosystems, which are virtual replicas of real farmland that are continuously updated with data from satellites and ground-level sensors, and can simulate how different conditions or decisions play out before they are implemented. The twins are powered by Knowledge-Guided AI (KGAI): AI models that are designed not just to find patterns in data but to respect and incorporate established scientific understanding of how crops grow and how ecosystems function. This makes them more interpretable and reliable than pure data-driven approaches.

Practical tools developed from the platform will include AI-driven forecasting for food trade flows and decision-support systems that help farmers and policymakers optimise planting strategies, resource use, regional policy design and supply chain logistics in response to changing conditions.

The project aims to position Singapore as a regional hub for AI-driven agricultural innovation, contributing tools and frameworks that can be adapted by other ASEAN countries facing similar food security challenges.