



AI-Enabled Monitoring, Forecasting and Control of Vegetation Pest and Diseases

- Wenjiang Huang, Aerospace Information Research Institute, Chinese Academy of Sciences
- Feng Zhang, CABI East and Southeast Asia
- Yingying Dong, Aerospace Information Research Institute, Chinese Academy of Sciences
- Hongmei Li, CABI East and Southeast Asia
- Linyi Liu, Aerospace Information Research Institute, Chinese Academy of Sciences

A joint collaboration between Aerospace Information Research Institute, Chinese Academy of Sciences (AIR-CAS) and CAB International (CABI) integrates biological expertise, artificial intelligence, and Earth-observation intelligence to deliver an end-to-end pathway for multi-scale monitoring, early warning, and green control of major vegetation pests and diseases. The approach links mechanistic understanding of pest-pathogen dynamics with AI-enabled satellite/UAV spatiotemporal analytics and risk modelling, translating scientific evidence into actionable, decision-ready services.

What the integrated pathway delivers

- Hotspot detection and situation awareness: 10-30 day rolling monitoring of high-risk areas, coupled with 2-10 m fine-scale occurrence mapping to track outbreak evolution and damage dynamics across regions.
- Early warning and dynamic forecasting: up to 30 days ahead early-warning of pest and disease risks, delivering ~10% higher accuracy than traditional meteorological-factor-driven models; supports preparedness and rapid response.
- Invasion-risk alerting and pathway prediction: 30-day-ahead, day-by-day invasion risk forecasts for migratory pests, together with migration corridor prediction to anticipate spread routes and inform surveillance deployment.
- Decision-support and green control linkage: operational briefs, maps and tailored services that connect early warning to targeted intervention and resource allocation, including guidance for reduced-risk, precision actions such as biocontrol deployment and ecological management options.

Operational scale and demonstrated impact

- Sustained open sharing of 180+ monitoring and prediction reports and 2,800+ service products, covering 18 major agro-forestry pests and diseases,

including desert locust, fall armyworm, rust, etc.

- Support to pest and disease management across over 30 million ha, contributing to approximately 30% reduction in pesticide application and around 10% increase in species richness in supported areas, while improving the share of biologically based control solutions and reducing pressure on threatened species.

Partnership strengths

- AIR-CAS contributes Earth-observation innovation and operational production chains for scalable monitoring and forecasting.
- CABI contributes internationally recognized expertise in pest biology and plant protection, including growth and epidemic models, and long-term advances in biocontrol research and product development. Notably, *Metarhizium*-based fungal biopesticides have been advanced from research to large-scale field application, supporting sustainable locust management and reducing reliance on broad-spectrum chemical pesticides.

Adoption, recognition and awards

Outputs have been adopted and used by governmental and international stakeholders, including Food and Agriculture Organization of the United Nations (FAO), Group on Earth Observations (GEO) and Global Biodiversity Information Facility (GBIF), with applications reported across multiple countries (e.g., Pakistan, Yemen, Somalia, Eritrea, Ethiopia, Kenya, Nepal, India, etc.). The work has been recognized through multiple major awards (e.g., National Science and Technology Progress Award, FAO Outstanding Contribution Award, GEO Team Impact Award, GEO Emerging Leader Award, Beijing Science and Technology Progress Award, Li Xiaowen Award for Remote Sensing Applications, etc.), underscoring both scientific excellence and operational value.

