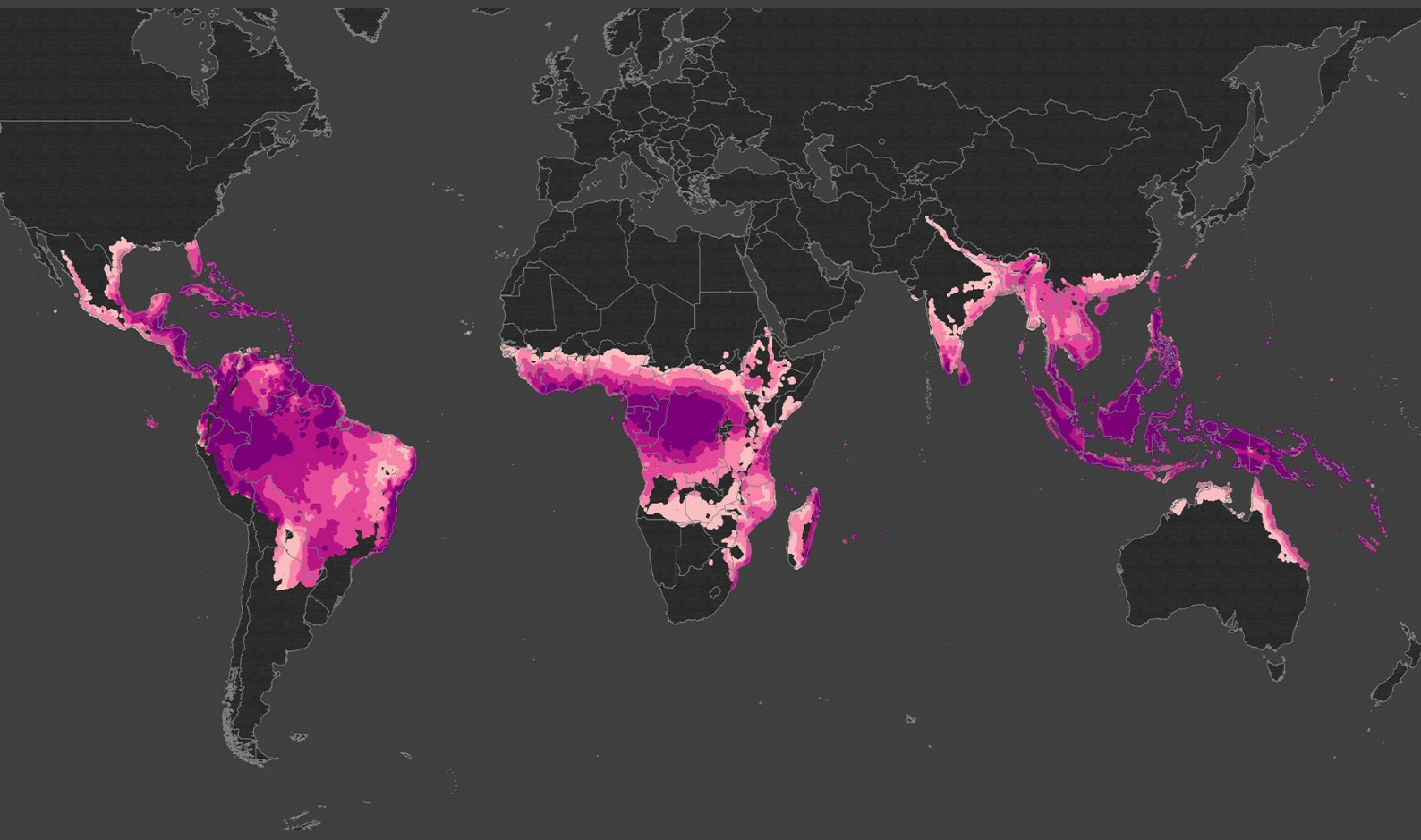
CABI



Data science and modelling

Examples of our work

KNOWLEDGE FOR LIFE

Introduction

Using our expertise in digital development, CABI helps transform smallholder farmers' livelihoods, turning data and science-based knowledge into practical information that addresses their real needs.

Our core strengths in data science and modelling help farmers tackle complex problems related to pests and diseases and other broader problems in agriculture and the environment through the application of data-driven approaches and development of bespoke tools. This work can help farmers and policy makers build stronger agricultural systems and respond to a changing environment.

Our strengths include: alerting farmers about impending pest risks, mapping and monitoring the spread of invasive weeds, predicting the potential establishment of insects, and supporting the uptake of biological control.

The following pages detail some of CABI's current and past data science and modelling activities.

For more information about our work in data science and modelling, visit:
www.cabi.org/data-science-and-modelling

Alerting farmers about impending pest risks

PRISE: a Pest Risk Information SErvice

Location: Ghana, Kenya, Malawi, Zambia

Dates: 01/12/2016-Ongoing

CABI Project Manager: Henry Mibei

CABI Project Team: Charlotte Day, Bryony Taylor, Will Holland, Tim Beale, Alyssa Lowry, Lizzie King, Lizzie Finch, Sean Murphy, Suzy Wood, Joe Beeken, Sarah Thomas, Frances Williams, MaryLucy Oronje, Birgitta Oppong-Mensah, Noah Phiri, Solomon Duah, Duncan Chacha, Harrison Rware, Mary Bundi, Makaiko Khonje

Donors: UK Space Agency; UK Aid; Swiss Agency for Development and Cooperation; European Union; Ministry of Foreign Affairs of the Netherlands; Irish Aid; International Fund for Agricultural Development; Australian Centre for International Agricultural Research; Ministry of Agriculture of the People's Republic of China; Foreign, Commonwealth & Development Office (FCDO); CABI PlantwisePlus; Global Challenges Research Fund

Partners: Assimila Ltd; King's College London; Centre for Environmental Data Analysis; Plant Protection & Regulatory Services Directorate (PPRSD), Ghana; Kenya Agricultural & Livestock Research Organization (KALRO), Kenya; Ministry of Agriculture, Livestock and Fisheries, Kenya; Zambia Agriculture Research Institute (ZARI), Zambia

Pests are estimated to cause typical losses of 40% to crops. A Pest Risk Information Service (PRISE) aims to solve this problem by using data to help farmers manage pests in sub–Saharan Africa.

PRISE works with in-country research organizations to collect data on pest presence to build models which, when combined with Earth Observation data, generate alerts advising farmers on the optimum time to intervene against key pests.

Since 2017, PRISE has delivered pest alerts in Kenya, Ghana, Zambia and Malawi to over two million farmers. In Kenya, PRISE model outputs were integrated into the MoA-INFO SMS service; A study in 2019 showed 59% of farmers who received the service changed their practices based on PRISE recommendations for fall armyworm, resulting in a larger maize harvest.

Since 2021, PRISE has been funded by CABI PlantwisePlus. PRISE has continued to provide farmers with pest alerts and has undertaken further fieldwork in Kenya to understand the impact of PRISE. **A paper** on the PRISE system has been published. We are exploring further expansion opportunities outside of Kenya, Ghana, Malawi and Zambia.

www.cabi.org/PRISE

PRISE: an integrated coffee value chain

Location: Kenya

Dates: 01/01/2024-31/03/2025

CABI Project Manager: Pascale Bodevin

CABI Project Team: Alyssa Lowry, Suzy Wood, Henry Mibei, MaryLucy Oronje, Duncan Chacha, Charlotte Day

Donors: Innovate UK

Partners: Assimila Ltd; Farmer Connect; Trade In Space; University of Leicester

The aim of this collaborative project is to establish an integrated value chain for the coffee industry, using Kenya as a pilot country.

Trade In Space has partnered with the University of Leicester to enhance a deforestation model. CABI is conducting a comprehensive risk assessment review of the Kenyan coffee sector and will address at least one of the identified risks by undertaking ground verification of a pest risk model for coffee berry borer.

By integrating Trade In Space's geolocation-based sustainability and risk verification, Farmer Connect will leverage these data to offer EU Deforestation Regulation compliance with full traceability for farmers and operators. This will allow farmers and farmer associations to receive tailored crop management advice while ensuring regulatory compliance for exporters and importers.

The objectives are to empower farmers with actionable insights, therefore enhancing the value of their holdings, while delivering the necessary legal verification sought by coffee traders, wholesalers, and other stakeholders for existing and forthcoming regulations.

www.cabi.org/PRISE-coffee-value-chain

PRISE: weather-optimized advice for beans

Location: Kenya

Dates: 01/04/2024-31/12/2025

CABI Project Manager: Pascale Bodevin

CABI Project Team: Bryony Taylor, Lizzie Finch, Charlotte Day

Donors: Bill & Melinda Gates Foundation

Partners: TomorrowNow; Regen Organics; Farm Star

This collaborative project will use the PRISE system to support the design, validation and development of weather-optimized bean advisories for selected trial sites across Kenya during the 2024-2026 crop seasons.

TomorrowNow's MVP Global Access Platform will facilitate the integration of existing bean pest and disease models produced by the well-established PRISE models into simple crop plans for dissemination to select trial regions.

The project aims to address five key questions:

1. How to design an optimal trial program to assess the impact and value of pest and disease advisories powered by next-generation weather intelligence
2. What is the potential impact and value of PRISE bean pest and disease advisories for bean farmers served by Farm Star?
3. What is the potential impact and value of better quality weather intelligence data in the context of pest and disease modelling?
4. Can better quality short-term and seasonal forecasts improve the predictability of large pathogen outbreaks?
5. Can the delivery of next-generation weather and pest intelligence through Farm Star increase sales of agricultural input providers?

Predicting the potential establishment of insects and pathogens

Global Burden of Crop Loss

Location: Global

Dates: 13/03/2019-31/12/2027

CABI Project Manager: Rasaki Arasah

CABI Project Team: Anna Szyniszewska, Salar Mahmood, Tim Beale, Gaby Oliver, Joe Beeken, Paul Day, Derek Tapp, Bryony Taylor, Cambria Finegold, Alyssa Lowry

Donors: Foreign, Commonwealth & Development Office (FCDO) (2024-2026); Bill & Melinda Gates Foundation (2019-2020)

Partners: Luma Consulting; Rothamstead Research; University of Exeter; University of Maryland; CIMMYT; Assimila Ltd; Wheat Initiative

Up to 40% of crops are lost to pests and disease, but available data on the scale, scope, spatial patterns, and drivers of loss are limited or missing.

The Global Burden of Crop Loss supports global food security by providing robust estimates on the scale, the economic burden and the factors contributing to crop losses to enable better informed action to protect crops. Improved evidence-driven decision-making and response planning in plant health will reduce and prevent crop losses, build resilience in agricultural systems, and improve food security and livelihoods.

Over the next three years, global and regional estimates of the economic burden of crop loss will be produced for three major global crops (maize, wheat, rice), and attributed to major biotic and abiotic causes. Additionally, pilot work will be undertaken for two tropical food security crops, with outputs tailored for selected regions and attributed to major biotic and abiotic factors. The project will disseminate these estimates as a global public good, via a user-friendly interactive dashboard and a series of open access papers, accompanied by policy engagement activities in selected countries.

www.cabi.org/gbcl

Wheat blast

Location: Bangladesh, Australia, India, Thailand

Dates: 01/09/2023–31/03/2025

CABI Project Manager: Pascale Bodevin

CABI Project Team: Tim Beale, Libertad Sanchez Presa, Bryony Taylor

Donors: Science and Technology Facilities Council (STFC)

Partners: Assimila Ltd; Cervantes Agritech; University of Leicester; RAL Space; Commonwealth Scientific and Industrial Research Organisation (CSIRO); DPI DSW Australia

Wheat blast (*Magnaporthe oryzae triticum, MoT*) is an emerging plant disease, threatening crop production and biosecurity. Using earth observation, precision imaging and climate modelling, this project will develop frameworks for dynamic, disease risk mapping and the remote detection of outbreaks.

A key dataset for future project phases will also be developed, helping to model potential dispersal pathways through South Asia and Australia, guiding monitoring, extension and early detection efforts.

Key research objectives include the use of earth observation data to classify crop types in temporally and spatially complex environments in Bangladesh; linking niche models with crop type models to derive a highly accurate spatial risk model; and identify unique, diagnostic spectral signatures of *MoT* using high resolution remote sensing data. Local data capture and validation will enable collaboration with an existing research programme in *MoT* management, and extension and outreach programmes in Bangladesh.

The project will engage with key stakeholders in two countries where the disease is not present yet but are at risk (India and Thailand) to understand how information is currently communicated.

www.cabi.org/wheat-blast

Earth observation to improve critical datasets for pest risk modelling (EO4Agroclimate)

Location: Australia, Brazil, Kenya, Pakistan, UK

Dates: 01/04/2023-31/03/2025

CABI Project Manager: Pascale Bodevin

CABI Project Team: Tim Beale, Libertad Sanchez Presa, Bryony Taylor

Donors: Science and Technology Facilities Council (STFC)

Partners: Assimila Ltd; Cervantes Agritech

Rising temperatures have led to pests, diseases and weeds establishing in areas of the world that were previously uninhabitable. Furthermore, growth in global trade and new trade pathways increase the risk of accidental movement of pests.

Earth Observation (EO) and climatic data can help by improving predictions about where potential agricultural pests and diseases may be a threat. Information produced by models can help decision makers understand and prepare for future risks.

Leading a consortium of researchers, CABI and partners are using EO data to improve the data layers used in models that predict where pests can establish, including irrigation, areas under protected agriculture and climatic canopy conditions, demonstrating the improvements made to species distribution estimations for key pests and biological control agents.

www.cabi.org/earth-observation-for-pest-risk-modelling

Global biosecurity radar

Location: Timor Leste, Papua New Guinea, Solomon Island, Australia

Dates: 01/07/2023-31/12/2023

CABI Project Manager: Pascale Bodevin

CABI Project Team: Tim Beale, Bryony Taylor, Libertad Sanchez Presa

Donors: UK Space Agency

Partners: Assimila Ltd; Cervantes Agritech

There is a constant threat from transboundary pests and diseases which can drastically cut production in Australia from countries such as Timor Leste, Papua New Guinea and the Solomon Islands.

This project aimed to build relationships with proposal countries to improve their biosecurity surveillance and crop pest management using earth observation (EO) data such as crop layers and pest suitability mapping.

Funding was received from the UK Space Agency to bring together a consortium to write a bid for further funding.

The consortium proposed to undertake the build of a ground-breaking new reconnaissance and risk alerting system combining the power of EO data with ecological niche modelling to provide strategic and tactical decision support information to counter biosecurity risks. As well as supporting Australian and UK biosecurity objectives, a dual benefit included provision of information to resource poor countries on where to focus extension and training to farmers to tackle key pests affecting farmers.

Letters of support were received from multiple stakeholders in the proposal countries.

Supporting the uptake of biological control options

BioSpace: Using space-enabled remote sensing for long term sustainable growth of biopesticide use

Location: China, Laos

Dates: 13/02/2020–31/03/2022

CABI Project Manager: Belinda Luke

CABI Project Team: Elizabeth Finch, Hongmei Li, Feng Zhang

Donors: Science and Technology Facilities Council (STFC)

Partners: Assimila Ltd; Lao People's Democratic Republic, Ministry of Agriculture and Forestry; Aerospace Information Research Institute Chinese Academy of Sciences; National Agro-Tech Extension and Service Center (NATESC)

In China and Laos, locusts affect over two million hectares of agricultural land. The fall armyworm is also prevalent in China and Southeast Asia and is impacting maize in Laos.

Due to a lack of detailed information on where crop risks are greatest and ineffective control measures used by farmers, managing pest damage can be difficult.

The project used Earth observation (EO) and meteorological data to provide information to farmers and agricultural authorities to help them sustainably manage pest risks.

Project outputs included the collection of distribution data for the yellow spined bamboo locust. This was used in a model to predict areas susceptible to invasion allowing early warning for decision makers. Beta testing of the BioSuccess App was carried out and valuable feedback on improvements was gained.

A biopesticide performance model was calibrated by collecting environmental data which was used to validate the EO data.

Model and risk maps were also produced for fall armyworm looking at data from the last 20 years to assess the spread and a socio-economic survey was produced.

www.cabi.org/biospace

Enabling safe and climate smart coffee production in Colombia

Location: Colombia

Dates: 01/05/2019–31/10/2020

CABI Project Manager: Steve Edgington

CABI Project Team: Yelitza Colmenarez, Steve Edgington, Natalia Corniani, Julien Godwin, Pablo Gonzalez Moreno, Lizzie Finch, Alyssa Lowry, Sean Murphy, Rhian Whelan

Donors: Innovate UK

Partners: Cafexport; Climate Edge; Assimila Ltd

The coffee berry borer is the most serious coffee pest in the world, causing crop damage in excess of US$500 million every year. Climate change is exacerbating the problem by enabling the spread of the pest, especially at higher altitudes. To overcome their losses, farmers are tending to intensify their activities and expand growing areas.

CABI and partners produced a prototype alert system that used climatic data and remote sensing technology to give farmers advance warning of coffee berry borer surges. The system enables farmers the time to access and apply controls effectively.

The team also delivered a series of biopesticide messages via SMS to coffee farmers, which provided basic information on biopesticides and safety information for chemical pesticides. All the farmers involved were women, in an effort to overcome gender disparities in coffee farming.

www.cabi.org/coffee-colombia

Integrating advanced Earth Observation and environmental information for sustainable pest and disease management

Location: China

Dates: 01/06/2016–31/05/2019

CABI Project Manager: Belinda Luke

CABI Project Team: Hongmei Li, Feng Zhang, Bryony Taylor

Donors: Science and Technology Facilities Council (STFC); Natural Science Foundation of China (NSFC)

Partners: Assimila Ltd; Rothamsted Research; King's College of London; Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences (RADI, CAS); Institute of Plant Protection, Chinese Academy of Agricultural Sciences (IPP-CAAS); Zhejiang University (ZJU); National Agro-Tech Extension and Service Center (NATESC)

Forecasting and monitoring insect pests and disease outbreaks is vital for protecting China's economically important agricultural sector. This project aimed to give timely advice on the possible location and timing of locust outbreaks and stripe rust in China. Using data from satellites and other environmental information, CABI and partners designed innovative data products and communication tools to help decision makers make informed decisions about pest control activities, helping to sustainably manage wheat yellow rust and migratory locusts.

Results and outputs included reports, maps, a locust development model and biopesticide efficiency model. 2,800 technical staff, extension officers and farmers were also trained on how to understand and use the reports.

Publications included one book, 42 scientific papers, eight patents and five soft copyrights which have been registered as part of the project.

www.cabi.org/integrating-earth-observation

Improving the rational use of pesticides for locusts in China

Location: China

Dates: 01/07/2015–30/04/2016

CABI Project Manager: Bryony Taylor

CABI Project Team: Hongmei Li, Feng Zhang

Donors: Science and Technology Facilities Council (STFC); Natural Science Foundation of China (NSFC)

Partners: Assimila Ltd; Rothamsted Research; Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences (RADI, CAS); National Engineering Research Center for Information Technology in Agriculture (NERCITA); Chinese Academy of Agricultural Sciences (CAAS); National Agro-Tech Extension and Service Center (NATESC); Zhejiang University (ZJU)

This project combined expertise from multidisciplinary teams in the UK and China, in the fields of Earth Observation (EO) and agriculture. It aimed to build a prototype system that provided timely information to Chinese locust control extension workers at NATESC on possible locations and timings of locust outbreaks in China, together with advisory information on the effects of biopesticide, given current and forecasted conditions.

The prototype system combined EO data, historical weather data derived from re-analysis of weather forecasts, weather forecast data and used models from published literature.

Together with partners, we reviewed locusts' biology and the ability of earth observation data to forecast global outbreaks.

China's knowledge gaps were then reviewed. Fieldwork in Tianjin was carried out to assess locust behaviour, location and temperatures. Laboratory work to assess the response of the biopesticide to temperature was undertaken by CABI.

www.cabi.org/chinalocusts

Mapping and monitoring the spread of invasive weeds

Remote sensing use for mapping Parthenium in Pakistan

Location: Pakistan

Dates: 01/03/2018–31/03/2021

CABI Project Manager: Julien Godwin

CABI Project Team: Tim Beale, Elizabeth Finch, Abdul Rehman

Donors: Science and Technology Facilities Council (STFC)

Partners: The University of Manchester

Data from satellites has the ability to improve lives. By monitoring and mapping things like invasive weeds, they can be effectively managed better. This will improve food security, livelihoods, and human and environmental health. In Pakistan, we used remote sensing technologies to monitor and map Parthenium, an invasive plant which is a huge issue for the country.

Through this project, policy makers were made more aware of the issues and now able to use satellite data to support decision-making in agriculture, livestock and human health.

Methods were improved to allow for automated mapping and monitoring of the distribution of Parthenium in rice and wheat fields. Lastly, we strengthened the capacity of Pakistani researchers and technicians to contribute to their ongoing work.

www.cabi.org/remote-sensing-parthenium

CABI's expertise in digital development

Using our expertise in digital development, we turn data and science-based knowledge into actionable, practical information that addresses real needs such as helping to prevent and tackle invasive crop pests. This helps to transform smallholder farmers' livelihoods and helps agricultural and environmental professionals be more effective in their work.

Contact us

To find out more about working with us on data science and modelling, contact **Bryony Taylor** at **enquiries@cabi.org**

www.cabi.org/digdev

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