CGIAR | INITIATIVE ON Plant Health

District Agricultural Officer of Msaranga and Ng'ambo wards, Moshi Rural, Tanzania, explaining about Banana Bunchy Top Disease (BBTD) during a field day conducted in December 2024.

Credit: IITA

CGIAR Research Initiative on **Plant Health**

Annual Technical Report 2024

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The Artificial Intelligence (AI) software ChatGPT was used to support the editing of parts of this report, specifically to improve clarity, grammar, and style. ChatGPT was not used to generate the content of the report. All edits made with AI assistance were reviewed and validated by the authors to ensure accuracy, coherence, and alignment with the original intent.

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Acronyms

ABC	Alliance Bioversity and CIAT
ABI	Accelerated Breeding Initiative
AI	Artificial intelligence
AMV	Alfalfa Mosaic Virus
ASEAN	Association of Southeast Asian Nations
AVISA	Accelerated Varietal Improvement and Seed Delivery of Legumes and Dryland Cereals in Africa
BBTD	Banana bunchy top disease
BBTV	Banana bunchy top virus
BLB	Bacterial Leaf Blight
BMGF	Bill and Melinda Gates Foundation
BYMV	Bean Yellow Mosaic Virus
CABI	Centre for Agriculture and Bioscience International
CGIAR	Consultative Group on International Agricultural Research
CIMMYT	International Maize and Wheat Improvement Center
CIP	International Potato Center
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
CMV	Cucumber Mosaic Virus
CWANA	Central and West Asia and North Africa
DEWAS	Disease Early Warning Advisory System
DR Congo	Democratic Republic of the Congo
EOIO	End of Initiative Outcome
ESA	Eastern and Southern Africa
FAO	Food and Agriculture Organization
FAW	Fall armyworm
FCDO	Foreign, Commonwealth, and Development Office
FHB	Fusarium head blight
FTF	Feed-the-Future
GBI	Genebanks Initiative
GHU	Germplasm Health Unit
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit
HH-DST	Handheld-Decision Support Tool
IARC	International Agricultural Research Center
ICAR	Indian Council of Agricultural Research
ICARDA	International Center for Agricultural Research in the Dry Areas
icipe	International Centre of Insect Physiology and Ecology
ICT	Information & Communication Technology
IER	Institut d'Economie Rurale (Mali)
IITA	International Institute of Tropical Agriculture
ILCYM	Insect life cycle modeling
IMM	Integrated Mycotoxin Management
INIFAP	Instituto Nacional de Investigaciones Forestales Agrícolas y Pecuarias
INRAN	Institut National de la Recherche Agronomique du Niger
IPDM	Integrated Pest and Disease Management
IPM	Integrated Pest Management
IRRI	International Rice Research Institute
KALRO	Kenya Agricultural and Livestock Research Organization
LAC	Latin-America and the Caribbean
LMICs	Low- and middle-income countries
MLN	Maize Lethal Necrosis
NARES	National Agricultural Research and Extension System
NGO	Non-governmental organization
NPPO	National Plant Protection Organization
NPS	National Policies and Strategies Initiative
ODK	Open Data Kit
OECD-DAC	Organization for Economic Co-operation and Development-Development Assistance Committee
P&Ds	Pests and diseases
PFSR	Post-flowering stalk rot
PHI	Plant Health Initiative
PPT	Push-pull technology
PSbMV	Pea Seed-borne Mosaic Virus
R4D	Research for Development
RAFS	Resilient Agrifood Systems
RCT	Randomized controlled trial
RFM	Rethinking Food Markets Initiative
RT-PCR	Reverse Transcriptase-Polymerase Chain Reaction
SEA	Southeast Asia
SNP	Single Nucleotide Polymorphism
TCP	Technical Cooperation Programme
TOC	Theory of Change
TR4	Tropical Race 4 (Fusarium Wilt of Banana)
UK	United Kingdom
USAID	United States Agency for International Development
USDA-ARS	United States Department of Agriculture – Agricultural Research Service
USDA-FAS	United States Department of Agriculture – Foreign Agricultural Service
WCA	West and Central Africa
WFP	World Food Programme
WorldVeg	World Vegetable Center
WP	Work Package
ZARI	Zambia Agricultural Research Institute

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CGIAR Technical Reporting 2024

CGIAR Technical Reporting has been developed in alignment with CGIAR's Technical Reporting Arrangement. This annual report ("Type 1" Report) constitutes part of the broader CGIAR Technical Report. Each CGIAR Research Initiative/Impact Platform/Science Group Project (SGP) submits an annual "Type 1" Report, which provides assurance on progress towards end of Initiative/Impact Platform/SGP outcomes.

As 2024 marks the final year of this CGIAR Portfolio and the 2022-24 business cycle, this Type 1 Report takes a dual approach to its analysis and reporting. Alongside highlighting key achievements for 2024, the report also provides a cumulative overview of the 2022-24 business cycle, where relevant. This perspective captures the evolution of efforts over the three-year period. By presenting both annual and multi-year insights, the report underscores the cumulative impact of CGIAR's work and sets the stage for the transition to the 2025-30 Portfolio.

The 2024 CGIAR Technical Report comprises:

- **Type 1 Initiative, Impact Platform, and SGP Reports:** These annual reports present progress towards end of Initiative/Impact Platform/SGP outcomes and provide quality-assured results accessible via the CGIAR Results Dashboard.
- **Type 3 CGIAR Portfolio Practice Change Report:** This report provides insights into CGIAR's progress in Performance Management and Project Coordination.
- **Portfolio Narrative:** Drawing on the Type 1 and Type 3 reports, as well as data from the CGIAR Results Dashboard, the Portfolio Narrative synthesizes insights to provide an overall view of Portfolio coherence. It highlights synergies, partnerships, country and regional engagement, and collective progress.
- **Type 2 CGIAR Contributions to Impact in Agrifood Systems: evidence and learnings from 2022 to 2024:** This report offers a high-level summary of CGIAR's contributions to its impact targets and Science Group outcomes, aligned with the Sustainable Development Goals (SDGs), for the three-year business cycle.

The Portfolio Narrative informs the 2024 CGIAR Annual Report – a comprehensive summary of the organization's collective achievements, impacts, and strategic outlook.

Elements of the Type 2 report are integrated into the CGIAR Flagship Report, released in April 2025 at CGIAR Science Week. The Flagship Report synthesizes CGIAR research in an accessible format designed specifically to provide policy- and decision-makers at national, regional, and global levels with the evidence they require to formulate, develop, and negotiate evidence-based policies and investments.

The diagram below illustrates these relationships.

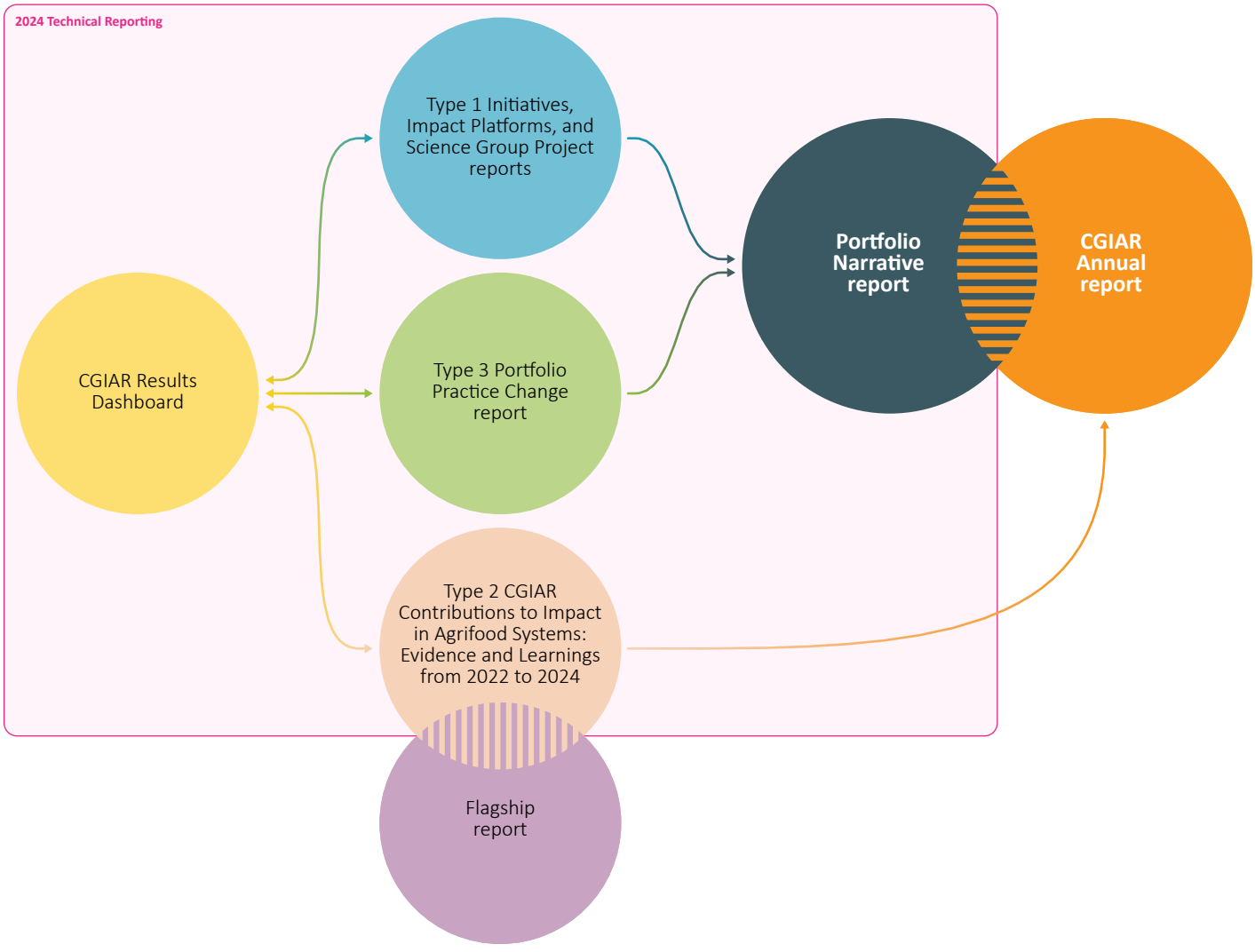


Figure 1. CGIAR's 2024 Technical Reporting components and their integration with other CGIAR reporting products.

Section 1: **Fact sheet, executive summary and budget**

Initiative name	Plant Health and Rapid Response to Protect Food Security and Livelihoods
Initiative short name	Plant Health
Initiative Lead	Prasanna Boddupalli (b.m.prasanna@cgiar.org)
Initiative Co-lead	Monica Carvajal Yepes (m.carvajal@cgiar.org)
Science Group	Resilient Agrifood Systems
Start – end date	01 January 2022 – 31 December 2024
Geographic scope	**Regions** Central and West Asia and North Africa · East and Southern Africa · Latin America and the Caribbean · South Asia Southeast Asia and the Pacific · West and Central Africa **Countries** Bangladesh · Benin · Bolivia (Plurinational State of) · Burkina Faso · Burundi · Colombia · Côte d'Ivoire Ecuador · Egypt · Ethiopia · Ghana · India · Kenya · Lebanon · Malawi · Mali · Mexico · Morocco · Mozambique · Niger · Nigeria · Peru · Philippines · Rwanda · Senegal · Tanzania · United Republic · The Democratic Republic of the Congo · The Republic of the Sudan · The Socialist Republic of Viet Nam · Tunisia · Uganda · Zambia
OECD DAC Climate marker adaptation score[1]	**Score 1: Significant** The activity contributes in a significant way to any of the three CGIAR climate-related strategy objectives – namely, climate mitigation, climate adaptation and climate policy, even though it is not the principal focus of the activity.
OECD DAC Climate marker mitigation score[1]	**Score 0: Not targeted** The activity does not target the climate mitigation, adaptation and climate policy objectives of CGIAR as put forward in its strategy.
OECD DAC Gender equity marker score[2]	**Score 1B: Gender responsive** On the top of the minimum requirements for 1A, the Initiative/project includes at least one explicit gender equality outcome, and the Initiative/project team has resident gender expertise or capacity. The Initiative/project includes indicators and monitors participation and differential benefits of diverse men and women.
Website link	https://www.cgiar.org/initiative/13-plant-health-and-rapid-response-to-protect-food-and-livelihood-security/

[1] The Organisation for Economic Co-operation and Development (OECD) Development Assistance Committee (DAC) markers refer to the OECD DAC Rio Markers for Climate and the gender equality policy marker. For climate adaptation and mitigation, scores are: 0 = Not targeted; 1 = Significant; and 2 = Principal.
[2] The CGIAR Gender Impact Platform has adapted the OECD gender marker, splitting the 1 score into 1A and 1B. For gender equality, scores are: 0 = Not targeted; 1A = Gender accommodative/aware; 1B = Gender responsive; and 2 = Principal.
These scores are derived from Initiative proposals, and refer to the score given to the Initiative overall based on their proposal.

EXECUTIVE SUMMARY

The CGIAR Research Initiative on Plant Health (PHI) was organized around **five Work Packages (WP1-WP5)**, which collectively contributed to the Initiative's aim and objectives. During 2022-24, **PHI-WP1** implemented strategic activities to strengthen diagnostics and surveillance capacities for pests and diseases (P&D) across the global South. An initial assessment of capacity gaps in National Plant Protection Organizations (NPPOs) informed tailored development plans. Over 25 training events were held across Africa, Asia, Central and West Asia and North Africa (CWANA), and Latin America and the Caribbean (LAC) to enhance the technical capabilities of national partners in diagnosing and monitoring key P&D affecting crops such as banana, cassava, forages, fruit and vegetables, maize, potato, rice, and wheat. In collaboration with innovation partners, a suite of tools, ranging from molecular diagnostics to Artificial Intelligence (AI)-based imaging systems, was developed, improved, or validated to support early detection and response. PHI also supported national institutions in more than 26 low- and middle-income countries (LMICs) to strengthen surveillance of over 20 priority P&Ds across Africa, Asia, CWANA, and LAC. This work informed integrated disease management strategies and reinforced early warning systems.

PHI-WP2 implemented strategic activities across 10 outputs, focusing on data management and modeling tools for P&D risk assessment (e.g., rice leaf and neck blast, Fall armyworm [FAW], southern armyworm, and African armyworm), AI and machine learning tools for remote sensing and information and communication (ICT) apps for disease surveillance (e.g., banana bunchy top disease [BBTD], banana bacterial wilt, banana Fusarium wilt, cassava viruses, and wheat stem rust), sentinel sites for monitoring strain shifts (e.g., wheat stem rust, soybean rust, potato late blight, post-flowering stock rot in maize, rice yellow mottle virus, and yam anthracnose), and preparedness strategies against the invasive P&D (e.g., wheat blast, maize lethal necrosis (MLN), rice bakane disease, poleroviruses in chickpea, and fusarium head blight in wheat). An assessment of CGIAR-led initiatives identified P&D datasets for 48 P&Ds and mycotoxins in 26 crops from 38 countries and highlighted data management constraints and training needs. These insights shaped improvements planned for CGIAR's 2025-2030 Portfolio. PHI-WP2 demonstrated cutting-edge digital and data tools for plant health management, pest risk prediction, and preparedness.

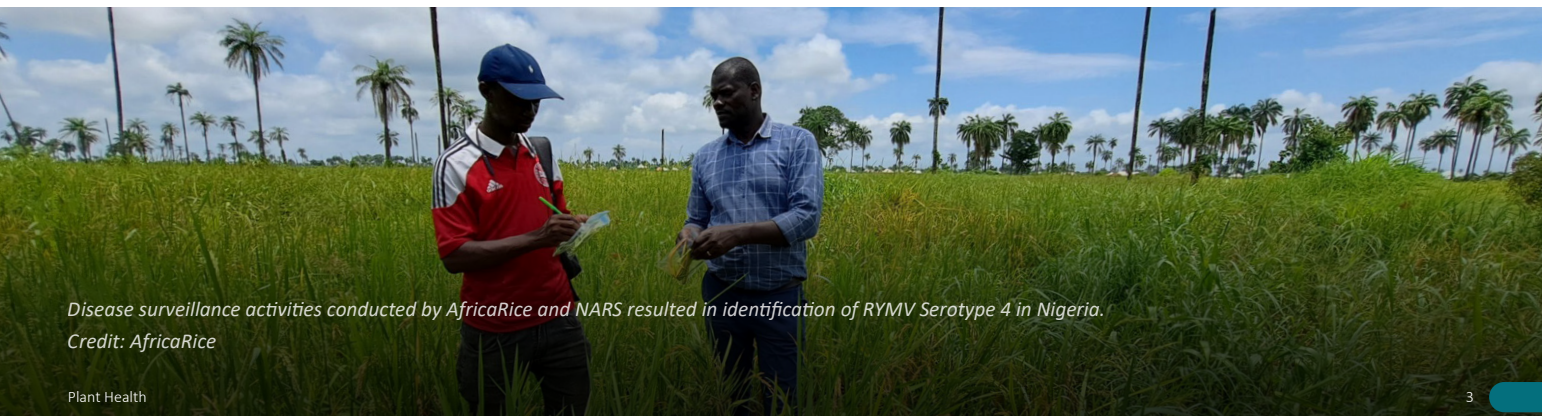
The **PHI-WP3** team implemented multi-institutional collaborative work on an array of eco-friendly innovations, including biological control, biopesticides, and ecological engineering for integrated management of prioritized diseases (e.g., BBTD, banana Fusarium wilt TR4, banana Xanthomonas wilt, MLN, wheat blast, Fusarium head blight, etc.), insect-pests (e.g., FAW), and parasitic weeds (e.g., in maize and faba bean). In 2024, the team also developed and validated ecofriendly management practices against groundnut stem rot, and rice yellow stem borer. and parasitic nematodes (e.g., in eggplant). Relevant technologies and innovations were integrated and evaluated and validated through participatory engagement of farming communities and extension personnel under the Plant Health Innovation Platforms. Capacity strengthening of national partners, extension workers, and farmers on integrated pest and disease management (IPDM) was undertaken in over 20 target countries. Decision support tools for potato late blight management and a Maize Clean Seed Production Tracker for MLN management were also developed and fine-tuned. In 2024, the WP3 team also formulated policy briefs for effective management of BBTD in Uganda, Rwanda, and Viet Nam.

From 2022 to 2024, **PHI-WP4** implemented integrated mycotoxin management (IMM) using a multi-sectoral strategy, including Aflasafe biocontrol, product development, testing, and registration, and large-scale implementation, nixtamalization, etc. Aflasafe commercialization expanded in 11 countries across Africa. Efficacy trials confirmed Aflasafe's effectiveness in multiple new countries, supporting commercialization efforts. Regulatory activities progressed in Burundi, the Democratic Republic of the Congo, Mali, Rwanda, Sudan and Uganda. Research optimized Aflasafe formulations for resilience under drought and heat stress. WP4 collaborated with over 57 organizations to expand IMM strategies, integrating mycotoxin solutions with local extension services and national regulatory frameworks. In 2024, despite the conflict, Sudan authorities granted a 5-year registration for Aflasafe SD01, the Democratic Republic of the Congo approved Aflasafe RDC01, and Burundi initiated registration for Aflasafe BU01. Through a World Bank co-funded project, Madagascar started an Aflasafe factory. IITA supported a CIMMYT-driven aflatoxin control program in Mexico. AfricaRice and CIMMYT explored mycotoxin decontamination technologies in rice and maize, respectively. WP4 formulated a policy brief for effective management of aflatoxin contamination across sub-Saharan Africa. WP4 also extended aflatoxin control in hazelnuts in Azerbaijan.

PHI-WP5 championed gender inclusion in a field traditionally focused on biophysical research. This shift recognizes that integrating gender and social considerations into technology design and scaling can boost the adoption of plant health innovations and strengthen farmer engagement in addressing both emerging and persistent pests and pathogens. PHI-WP5 established a community of practice and bridged gender data gaps by conducting 8 case studies from 12 countries. Based on the findings, recommendations for scaling were developed for farm advisory tools such as the PlantVillage app, the Tumaini app and a Potato Late Blight handheld decision support tool (HH-DST), informing national partners on achieving equitable impacts. PHI-WP5 also involved a PhD student and three masters students to facilitate interdisciplinary approaches. On impact evaluation, PHI-WP5 conducted four randomized controlled trials: 1) Aflasafe among maize producers in Nigeria; 2) FAW Push-Pull Technology in Uganda; 3) solar dryers to reduce aflatoxin in vegetables in Nigeria (in collaboration with WP4 and the CGIAR Research Initiative on Rethinking Food Markets; and 4) a FAW-tolerant maize variety in Zambia. Additionally, a study on MLN & FAW management in Kenya was conducted based on a large-scale phone survey.

	2022	2023	2024
PROPOSAL BUDGET	$11.00M	$13.00M	**$16.00M**
APPROVED BUDGET [1]	$9.33M	$8.49M [2]	**$9.43M** [2]

[1] The approved budget amounts correspond to the figures available for public access through the Financing Plan dashboard.
[2] These amounts include carry-over and commitments.



Disease surveillance activities conducted by AfricaRice and NARS resulted in identification of RYMV Serotype 4 in Nigeria.
Credit: AfricaRice

Section 2: **Progress towards End of Initiative outcomes**

Initiative-level theory of change diagram

This is a simple, linear, and static representation of a complex, non-linear, and dynamic reality. Feedback loops and connections between this Initiative and other Initiatives' theories of change are excluded for clarity.

CHALLENGE STATEMENT

- By 2050, more than two-thirds of humanity will live in urban areas, including 5.5 billion people in low- and middle-income countries (LMICs). The agrifood sector must adapt to feed growing urban populations, reduce health and environmental risks, and support economic opportunities for the urban poor. Health and climate crises require research to strengthen urban food system resilience, with a focus on more circular, scalable, equitable solutions for productive, green, and livable cities.
- Key challenges for urban and peri-urban (UPU) environments include pollution, land degradation, resource competition, growing social inequalities, and weak governance. Urban innovation capacity, supported by scientific research, can help UPU agrifood systems drive technological, institutional, and social change to secure food and livelihoods for future urban populations.
- CGIAR is well-positioned to provide global leadership, building on past and ongoing collaborative research. In urban areas, the agrifood sector often lacks visibility and support, leading to missed economic opportunities and heightened health and environmental risks. Five key entry points for UPU resilience stand out for immediate action: (1) enhancing UPU food productivity through improved access to better technologies, services, and clean environments; (2) strengthening informal urban food markets and rural-urban supply chains with improved technologies and business services, creating economic opportunities for women and youth; (3) improving urban food environments and promoting healthier diets for the urban poor to address malnutrition and diet-related noncommunicable diseases (NCDs); (4) supporting innovations for a circular bioeconomy by turning urban waste into safe and efficient resources for food production, driven by public-private partnerships; and (5) developing research capacities and tools to support UPU agrifood governance, innovation, and sustainable investment planning.
- In addressing these challenges, the Resilient Cities Initiative approaches UPU agrifood systems as dynamic urban systems, distinct from rural agriculture, and promotes cross-sector collaboration in urban contexts. It also works to better engage urban stakeholders and policymakers in agrifood dialogues for long-lasting impact.

RESEARCH QUESTIONS

- What approaches allow converging technological, institutional, and policy actions to reduce postharvest losses, and integrated mycotoxin management (IMM) to better recognize and reduce mycotoxin contamination at scale?

SPHERE OF **CONTROL**

Work Packages

Work Package 1

Enabling sustainable production of nutritious foods in (peri-) urban zones.

Work Package 2

Building inclusive and sustainable food markets and safeguarding supply chains.

Work Package 3

Strengthening circular bioeconomy, food safety and the urban environment.

Work Package 4

Improving food environments and consumer behavior for nutrition.

Work Package 5

Strengthening the evidence base and research & innovation capacities for UPU agrifood system governance and growth.

A farmer during the coffee seed harvest, coffee production in Africa.
Credit: Media Lens King/Shutterstock

SPHERE OF **INFLUENCE**

End-of-Initiative Outcomes

End-of-Initiative Outcome 1

At least 5,000 local MSMEs in food processing, marketing and agri-food service sectors can access and utilize business development toolkits, improved technologies, knowledge and skills, with strong participation by women and youth.

End-of-Initiative Outcome 2

At least 5,000 small-scale producers in Urban and Peri-urban (UPU) zones can access and utilize improved technologies, skills, know-how and management tools for safer, more sustainable and more efficient vegetable, livestock and fish production.

End-of-Initiative Outcome 3

Municipal authorities and their public and private sector partners in at least 6 cities and towns are made aware of evidence-based approaches, tools, and business models for planning, implementing and monitoring investments in a circular bio-economy and/or strategies to mitigate environmental and human health risks.

End-of-Initiative Outcome 4

At least 100,000 urban consumers benefit from nutrition programs that use evidence based UPU food environment and consumption toolkits, social assistance program guidance and profiles to improve diet quality and nutritional status.

End-of-Initiative Outcome 5

Urban planners and stakeholders participating in global networks of more than 200 cities representing over 400 million consumers use, promote and improve Research and Innovation tools and approaches developed by research, training institutions and civil society to accelerate UPU agri-food system development and strengthen urban resilience.

Action Area Outcomes

Resilient Agrifood Systems

1 **1** · Implementation partners (e.g. NARES, NGOs, private companies) actively support dissemination, uptake, and implementation of CGIAR innovations.

4 **2** · Due to CGIAR involvement, private sector actors invest in business practices or models that have the potential to improve livelihoods, climate resilience, promote sustainable and inclusive food systems, and boost consumption of healthy diets, especially among nutritionally vulnerable population groups.

2 1 **3** · CGIAR-NARS-SME networks use market segments, target product profiles to orient variety development and deployment towards those that provide larger scale benefits across the 5 Impact Areas.

3 5 3 **4** · National and local multi-stakeholder platforms are strengthened to become more effective and sustainable, addressing development trade-offs and generating strategies for effective food, land, and water systems transformation.

SPHERE OF **INTEREST**

Impact Areas

Nutrition, Health & Food Security

1 · End hunger for all and enable affordable health diets for the 3 billion people who do not currently have access to safe and nutritious food.

Poverty Reduction, Livelihoods & Jobs

4 · Reduce by at least half the proportion of men, women and children of all ages living in poverty in all its dimensions according to national definitions.

Gender equality, Youth & Social Inclusion

3 · Offer rewardable opportunities to 267 million young people who are not in employment, education, or training.

· Close the gender gap in rights to economic resources on, access to ownership of, and control over land and natural resources, for more than 500 million women who work in food, land, and water systems.

Climate Adaptation & Mitigation

2 · Equip 500 million small-scale producers to be more resilient to climate shocks, with climate adaptation solutions available through national innovation systems.

Environmental Health & Biodiversity

2 4 · Stay within planetary and regional environmental boundaries: consumptive water use in food production of less than 2500 km3 per year (with a focus on the most stressed basins), zero net deforestation, nitrogen application of 90 Tg per year (with redistribution towards low-input farming systems) and increased use efficiency, and phosphorus application of 10 Tg per year.

Field survey of Cassava Common Mosaic Virus and Cassava Frogskin Disease-associated pathogens in the northeastern cassava-growing region of Argentina. Credit: CIAT

Summary of progress against the theory of change

Between 2022 and 2024, the PHI team at CGIAR Centers, together with over 180 research, innovation, and scaling partners globally, made significant progress in achieving outputs and outcomes across five Work Packages.

PHI-WP1 made significant advances in strengthening P&D diagnostics, surveillance, and response systems across the global South. Building on the insights from a global online survey conducted in 2022, WP1 actively promoted the participation of LMICs in a growing global South diagnostics and surveillance network. This effort fostered regional collaboration across more than 10 countries, facilitated knowledge exchange, and supported joint capacity building tailored to regional needs (**EOIO 1**). In 2024, continued capacity-building workshops enhanced the diagnostic capabilities of NPPOs and NARES across Africa, Asia, CWANA, and LAC, with targeted training on advanced detection and surveillance tools. Substantial progress was made in developing and validating tools for early detection and monitoring. Molecular diagnostics and sequencing tools were deployed to detect and characterize priority pathogens (e.g., rice bacterial blight, Witches' Broom Disease in cassava, and multiple legume viruses including Alfalfa mosaic virus (AMV), Cucumber mosaic virus (CMV), Bean yellow mosaic virus (BYMV), and Pea seed-borne mosaic virus (PSbMV)), and made available to NPPOs and NARES to help counter established and emerging plant health threats and safeguard seed movement. AI-based innovations were also advanced rapidly, offering in-field alternatives for P&D detection. Drone and multispectral imagery achieved high-accuracy detection for cassava brown streak disease, rice blast, banana diseases, and major bean diseases, among others. Throughout 2024, WP1 supported surveillance activities in over 26 LMICs, covering more than 20 P&Ds. These efforts generated critical surveillance data not only to guide integrated disease management and support clean seed systems, but also to conduct risk assessment analyses (e.g., banana diseases such as BBTD and ***Fusarium*** wilt, helping inform national response strategies and policies briefs. The data has been instrumental in enhancing early warning systems and laying the foundation for sustainable, regionally connected surveillance networks globally (**EOIO 2**).

PHI-WP2 enhanced P&D data management, risk assessment tools, and preparedness in LMICs, addressing data-sharing constraints through improved tools, training, policy advocacy, and co-created outputs. Various tools and procedures established between 2020 and 2024 include web-based tools such as ILCYM for phenology-based insect life cycle modeling; a real-time AI media analysis tool established to track P&D reports and data made available on a dashboard; and the development and use of early warning systems for wheat blast and rusts in Bangladesh. AI-based tools, which are more efficient than conventional tools, were used for mapping the incidence of P&Ds, such as BBTD and wheat rust. EPIRICE models were utilized for rice disease forecasting in the Philippines, Côte d'Ivoire, and Uganda. Sentinel nurseries confirmed pathogen stability for some major diseases, such as ***Fusarium*** Head Blight (FHB), wheat blast, and MLN. Sentinel nurseries were also expanded for bean, soybean, wheat, and yam pathogens. Predictive models were developed for climate-driven P&D shifts. Risk assessments were refined for key pests and virus vectors. Forecasting tools were improved for ***Helicoverpa armigera*** in pigeonpea and chickpea. PathoTracer helped in rice blast isolate mapping. Seed biosecurity was focused on virus transmission in legumes and cereals. Overall, WP2 targeted more than 20 key P&Ds across 16 countries,

supporting proactive plant health management by NPPOs and strengthening long-term resilience.

The **PHI-WP3** team across six CGIAR Centers worked closely with over 65 partners to develop and deploy eco-friendly IPDM technologies and validated these through Plant Health Innovation Platforms. Multi-institutional and multidisciplinary collaborative efforts resulted in development and validation of diverse technologies and approaches, including host plant resistance, botanicals, biological control, biopesticides, and ecological engineering for integrated management of major diseases (e.g., BBTD, banana Fusarium wilt TR4, banana *Xanthomonas* wilt, chickpea and lentil viruses and their vectors, MLN, groundnut stem rot, and wheat blast, among others), insect-pests (e.g., African rice gall midge, yellow stem borer, cowpea pests, aphids and pod borers of food legumes, cassava whitefly, fruit fly, FAW, etc.), plant parasitic nematodes, and parasitic weeds of maize and Faba bean. Decision support tools were developed and fine-tuned to enable MLN-free commercial seed production, and potato late blight management. Training workshops on IPDM were organized in over 20 countries, including Bangladesh, Cambodia, Cameroon, Ecuador, Ethiopia, India, Kenya, Lebanon, Morocco, Mali, Mexico, Nigeria, Tunisia, Uganda, and Zambia. Gender and socio-economic factors significantly influence IPM implementation, highlighting the need for supportive national policies to facilitate access to ecofriendly pest management products and ensure broader adoption among farmers. Policy briefs for effective management of BBTD in Uganda, Rwanda, and Viet Nam were formulated. Training manuals were developed for major P&Ds, such as BBTD, and shared widely with stakeholders.

PHI-WP4 made significant advancements in IMM through extensive research, capacity building, and biocontrol commercialization efforts. Biocontrol formulations were optimized for improved resilience under drought and heat stress. Effectiveness trials were conducted across multiple countries, generating essential data to support regulatory approvals and accelerate commercialization in Burundi, the Democratic Republic of the Congo, Mali, Mexico, Rwanda, Sudan, and Uganda. Dossiers for the registration of biocontrol products were prepared and submitted to regulators. The WP4 team also developed strategic frameworks for scaling Aflasafe adoption in Burundi, Uganda, and Zambia. Technical support was extended to private manufacturers in, Burundi, the Democratic Republic of the Congo, and Mozambique for facility design, equipment installation, and process optimization to enhance local production capacities.

Research efforts also explored the impact of nixtamalization on maize safety and assessed mycotoxin risks in rice and wheat, contributing to broader food safety initiatives. Furthermore, WP4 strengthened scientific collaborations, including IITA's support for CIMMYT's aflatoxin mitigation initiatives in Mexico and AfricaRice's efforts across Africa, while also extending biocontrol applications to hazelnuts in Azerbaijan and maize in Greece, Serbia, Spain, and Turkey. These efforts underline the global applicability of WP4's innovations in IMM.

Responding to diverse farmers' needs and interests was one of the main challenges in technology adoption related to plant protection and farm advisory services. To address this challenge, **PHI-WP5** aimed to: 1) improve the capacity of national partners to conduct gender-responsive and socially inclusive needs assessments as a basis for designing tailored innovations (**EOIO 8**); 2) develop or improve the contents and delivery methods of IPDM and IMM innovations to increase adoption rates (**EOIO 5 & EOIO 7**); and 3) facilitate national partners to conduct equitable and inclusive scaling approaches (**EOIO 9**). It began with capacity development of NPPOs and NARES partners with a total of 108 participants from 27 countries joining an in-person training session to gain knowledge and skills on gender-responsive participatory approaches to disease identification, tool design and scaling methods in Asia, Africa and Latin America. Eight case studies were conducted and presented in monthly webinars which were attended by 38 participants, on average, per webinar. The study indicated significant gaps between scientifically validated IPM and IMM technologies developed by researchers and actual management practices by farmers. To close these gaps, the Gender and Plant Health Global Research Network exchanged ideas and conducted pilot interventions. Building on six scoping studies and needs assessments conducted in 2022, we carried out four randomized controlled trials (RCTs) in 2023-2024 to examine the adoption and impact of Aflasafe in Nigeria, Push-Pull Technology (PPT) in Uganda, solar dryers in Nigeria, and FAW-tolerant hybrid maize in Zambia. The results offer evidence-based policy recommendations for scaling IPDM and Integrated Market Management (IMM) approaches and thus contribute to **EOIO 9**. The results from the four RCTs are being used to develop science-based Plant Health Policy Briefs, providing rigorous evidence on effective scaling approaches and the impacts of PHI innovations. This will help create an enabling environment for research for development and the broader adoption of plant health innovations (**EOIO 10**).

PHI Training workshop to enhance the diagnostic capabilities of six NPPOs in LAC, organized by three CGIAR centers (CIMMYT, CIP, and the Alliance Bioversity-CIAT) at CIMMYT, México.

Credit: CIMMYT

Progress against End of Initiative Outcomes

This infographic provides a concise summary of the Initiative's progress toward achieving its Theory of Change End-of-Initiative outcomes for the 2022-2024 period. By drawing on reported results, it offers a comprehensive synthesis of progress made against the established outcome targets, highlighting the Initiative's overall impact and key achievements at the conclusion of this three-year cycle.

EOIO 1

NPPOs in at least eight targeted LMICs participate in the "Global Plant Diagnostic & Surveillance Network", dynamically exchanging data and knowledge on existing/emerging P&D.

EOIO 2

At least 20 national partners in 8 targeted LMICs use the existing/novel diagnostic and surveillance tools to effectively counter existing/ emerging plant health threats.

EOIO 3

At least eight target NPPOs increase their capacity to utilize epidemiological modelling data and decision support tools for pest risk assessment, and preparedness to counter prioritized P&D threats and new invasions.

EOIO 4

"Global Plant Health Consortium" comprising 40-50 institutions is operational, codeveloping and deploying IPDM innovation packages for effective plant health management.

EOIO 5

Adoption of eco-friendly and climate-smart IPDM innovations by at least three million smallholders across ten targeted LMICs results in a reduction in crop losses and use of toxic pesticides.

The WP1 team catalyzed active participation of NPPOs and NARES in over 10 targeted LMICs in LAC (Argentina, Colombia, Ecuador, Guatemala, Mexico, and Peru), Africa (Kenya, Tanzania and Uganda), and Asia (Bangladesh, Cambodia, India, Indonesia, Lao PDR, the Philippines, Thailand, and Viet Nam) through dynamic regional diagnostics and surveillance networks. Informed by a global capacity assessment conducted in 2022, the WP1 team during 2023 and 2024 facilitated regional collaboration across Africa, Asia, CWANA, and LAC, delivering tailored training workshops and technical support to strengthen national and regional diagnostic and surveillance systems. NPPOs and NARES benefited from targeted capacity building on molecular and AI-based tools for early detection of high-priority P&D affecting banana, cassava, rice, legumes, and beans. These efforts fostered collaboration for exchanging tools, and expertise to improve early detection and response. To ensure sustainability of these regional collaborations, continued investment is essential. Ongoing support will stabilize established collaborations, retain trained personnel, and promote continuous engagement, laying the foundation for a resilient, globally connected plant health surveillance system.

Between 2022 and 2024, a series of molecular, AI-based, and high-throughput genotyping tools for detection of major plant pathogens were developed, improved, or validated in collaboration with innovation partners. These tools were made available to at least 20 national partners across 26 countries through targeted training, workshops, and technical support during national surveillance campaigns. National partners applied these tools to generate critical surveillance data that informed P&D spread, monitored pathogen strain prevalence, guided risk assessment case studies, and identified priority regions where integrated disease management strategies are needed. The tools were deployed across major crops, including banana, cassava, potato, rice, maize, wheat, and legumes, enhancing countries' capacity to detect and monitor priority P&D such as *Fusarium* wilt, BBTD, FAW, wheat rusts, MLN, and others.

PHI-WP2 significantly strengthened P&D data management, enhanced decision-support tools for risk assessment, and improved preparedness against emerging plant health threats in LMICs. Addressing key constraints in data sharing, WP2 initiated improvement plans for implementation by the CGIAR Sustainable Farming Science Program, incorporating advanced data tools, targeted training, policy advocacy, and co-created outputs. Enhanced and newly developed modeling tools contributed to predictive models for assessing P&D severity curves, population shifts, and risk trends. Sentinel nurseries demonstrated the benefits of early detection and validated the effectiveness of control measures. Overall, WP2 targeted more than 20 economically important P&Ds across 16 countries, directly supporting NPPOs, and has laid a foundation for long-term resilience against emerging and invasive P&Ds in LMICs.

The PHI-WP3 team, in partnership with over 70 non-CGIAR partners, including an array of research, innovation and scaling partners, has codeveloped and deployed IPDM packages against prioritized plant health threats. "Plant Health Innovation Platforms" in Kenya and Lebanon undertook work on integrating, codeveloping and co-validating IPDM innovation packages of viruses and their vectors on Faba bean, and FAW in maize, through participatory engagement of researchers, extension personnel, and smallholder farmers.

WP4 made significant progress in promoting the adoption of aflatoxin biocontrol as part of an IMM strategy. By collaborating with private sector partners, WP4 facilitated the use of Aflasafe in 11 targeted countries, strengthening supply chains, and increasing the availability of safe and nutritious food and feed. Support was provided to five Aflasafe manufacturers and 11 distributors, enhancing local production and distribution capacity. Additionally, WP4 partnered with national stakeholders to advance policy frameworks that integrate IMM solutions into food security and food safety regulations. To ensure accessibility and affordability, WP4 worked with farming communities in LMICs to promote cost-effective pre- and post-harvest IMM innovations. Over 100,000 farmers received training on mycotoxin mitigation techniques, and technical assistance was provided to more than 10 extension agencies and 20 private sector entities to facilitate adoption. Programs partnering with WP4 demonstrated the effectiveness of IMM interventions along crop value chains, providing scalable models for widespread implementation. Through multi-sectoral engagement, WP4 outcomes allowed IMM efforts to expand within and beyond Africa; for example, through collaborations with the World Bank-supported mycotoxin control projects in Madagascar and Sierra Leone.

Progress against End of Initiative Outcomes

EOIO 6

At least 10 private sector partners in targeted countries use aflatoxin biocontrol as part of integrated mycotoxin management resulting in enhanced availability of safe and nutritious food and feed.

EOIO 7

National partners and farming communities in targeted LMICs use affordable and easy-to-use pre- and post-harvest integrated mycotoxin management innovations for mitigating mycotoxin contamination of food crops.

EOIO 8

The plant health research community in at least six targeted LMICs uses needs assessment evidence and data to develop demand-driven, equitable and scalable IPDM and IMM innovations.

EOIO 9

National and regional partners in at least six LMICs utilize validated scaling approaches for P&D detection and surveillance, IPDM and IMM.

EOIO 10

Based on science-based Plant Health Policy Briefs, investors and decision-makers in targeted regions create an enabling environment for research for development, and the scaling of plant health innovations.

WP4 enhanced the adoption and scaling of aflatoxin biocontrol through strategic partnerships with the private and public sector. Efficacy trials generated crucial data, facilitating product registration in multiple countries including Burundi, the Democratic Republic of the Congo, Mali, Mexico, Rwanda, Sudan, and Uganda, which has been key to advancing regulatory approval and commercialization in those countries. Technical support was provided to five private-sector Aflasafe manufacturers and 10 distributors across 11 African countries, strengthening supply chains and ensuring the broader availability of aflatoxin biocontrol products. Additionally, commercialization strategies were developed for Burundi, Uganda, and Zambia, outlining best practices for scaling Aflasafe and improving market readiness. Manufacturers in Burundi, the Democratic Republic of the Congo, and Mozambique received support in facility design, equipment installation, and process optimization, enabling them to establish sustainable production facilities. Biocontrol applications in Mexico were expanded, and WP4 supported partners in developing biocontrol strategies for several European countries. Multiple private sector partners in the target countries integrated biocontrol into their mycotoxin management practices, contributing to safer, more nutritious food and feed systems.

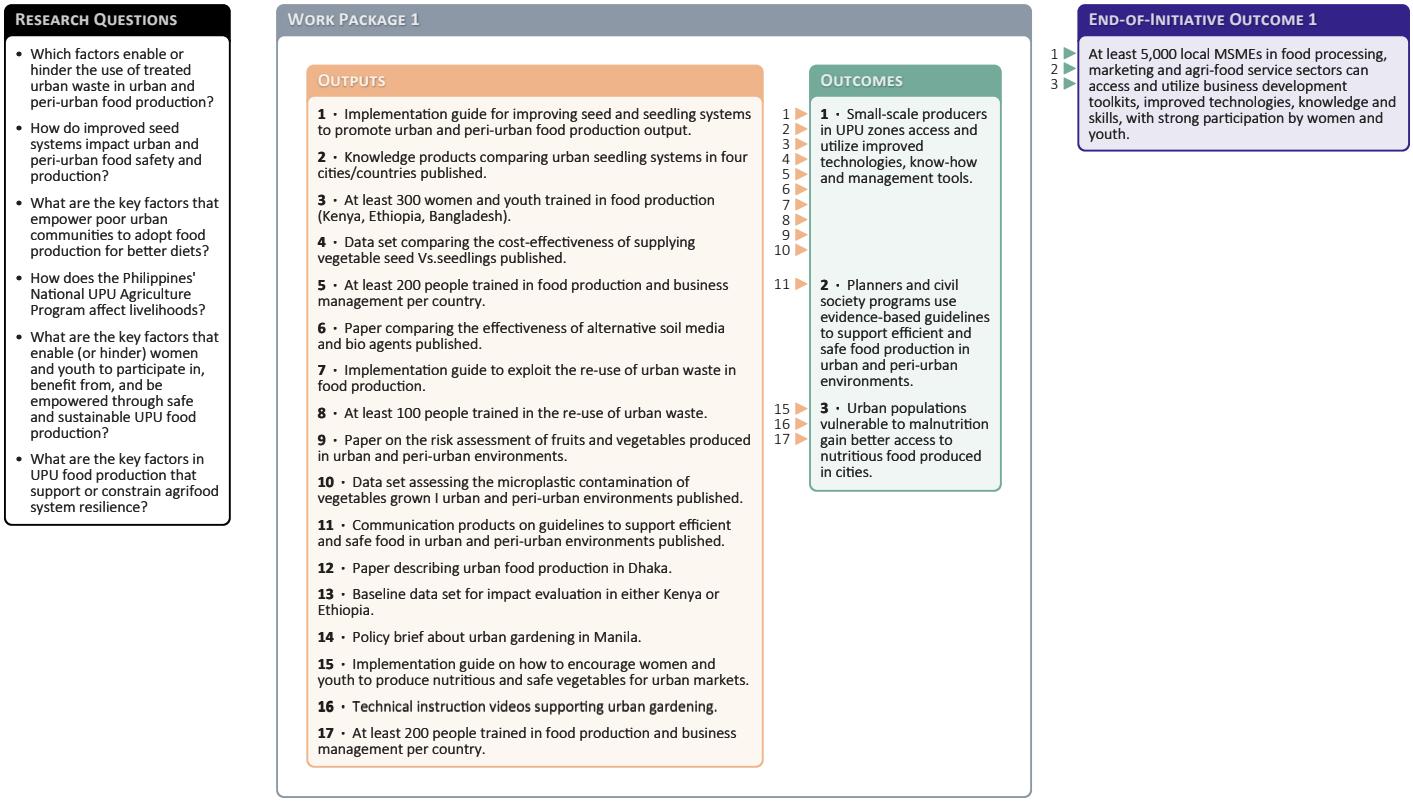
Between 2022 and 2024, WP4 partnered closely with national stakeholders, private sector partners, and farming communities to implement IMM strategies. WP4 provided technical support to five Aflasafe manufacturers and 11 distributors, who collaborated with aflatoxin-conscious private sector companies, NGOs, and governments to strengthen the local production and consumption of mycotoxin-safe crops, that is, with at least 80 percent less mycotoxins than unprotected crops. Through these collaborations, WP4 played a critical role in ensuring the availability of safe and nutritious food and feed in 11 targeted countries. The participating farmers received training on mycotoxin mitigation techniques, and more than 10 extension agencies and 20 private sector entities were provided with technical assistance to facilitate the adoption of IMM innovations. These efforts resulted in the development of replicable, scalable models for integrating IMM into crop value chains, contributing to broader food safety and security objectives. WP4 also supported policy frameworks that integrate IMM solutions into national food safety regulations for increased adoption of cost-effective, easy-to-use IMM strategies to reduce mycotoxin contamination in food and feed crops.

Participatory needs assessment tools were developed by interdisciplinary teams consisting of both social and biophysical scientists. These tools were shared with at least 32 national partners across 27 countries through targeted training and workshops in the Gender and Plant Health Global Research Network. CGIAR partners applied the tools in case studies on rice pests and diseases in Benin, the Philippines, and Uganda; potato late blight in Peru; banana fusarium tropical race 4 in India, Rwanda and Benin; maize FAW in East Timor and the Solomon Islands; and cassava mosaic disease in Kenya, leading to developing demand-driven, equitable and inclusive IPDM & IMM innovation design and delivery approaches. Insights from case studies were also shared in a monthly webinar series.

Building on six scoping studies and needs assessments conducted in 2022, PHI carried out four RTCs in 2023 and 2024 to examine the adoption and impact of Aflasafe in Nigeria, Push-Pull Technology in Uganda, solar dryers in Nigeria, and FAW-tolerant hybrid maize in Zambia. The results offer evidence-based policy recommendations for scaling IPDM and IMM approaches. Findings from the impact evaluations were presented at several conferences. The full realization of the Initiative's outcomes will require more time.

The results from the four RCTs conducted in 2023 and 2024 are being used to develop science-based Plant Health Policy Briefs, providing rigorous evidence on effective scaling approaches and the impacts of PHI innovations. In 2024, the PHI team also formulated policy briefs for effective management of BBTD in Rwanda, Uganda, and Viet Nam. Policy analysis to understand institutional coordination, current priorities and perceptions of decision-makers was undertaken, drawing on cases from three countries in Asia, Africa, and Latin America. A policy brief was developed for gender-responsive and socially inclusive scaling approaches to plant health with the focus on the Andes region. Several additional policy briefs have been formulated in 2024 based on the work carried out during 2022-2024 and will be shared with relevant stakeholders in 2025 . These continued efforts will help create an enabling environment for research for development and the broader adoption of plant health innovations against major pests, diseases, and parasitic weeds.

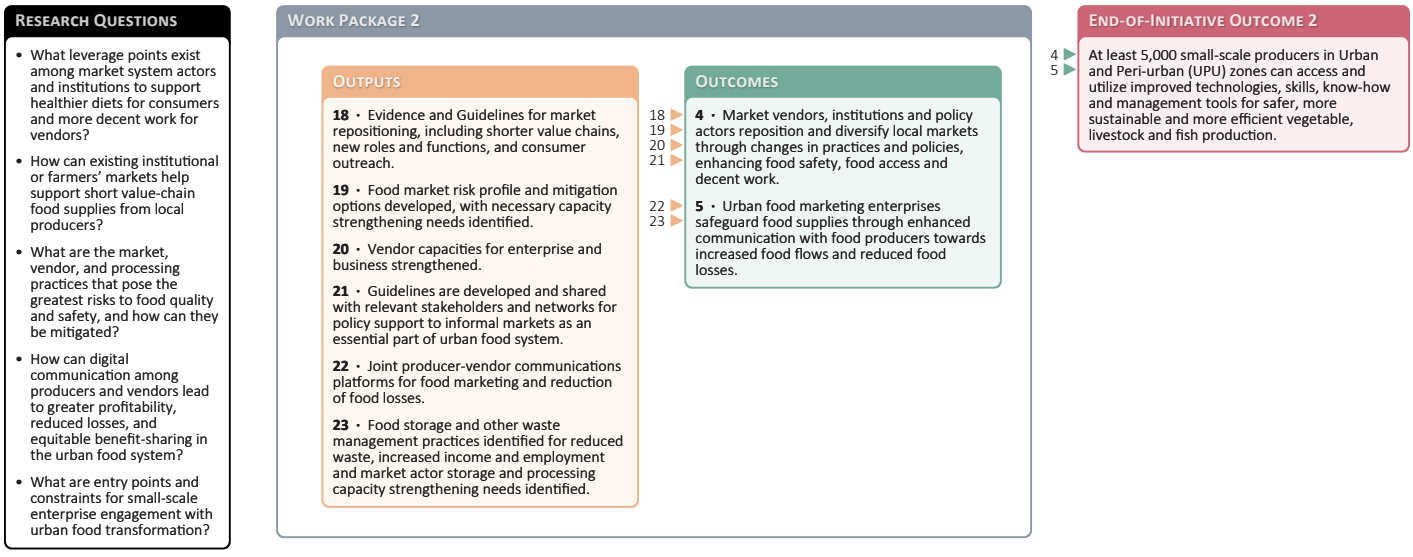
WP1: Bridging knowledge gaps and networks: Plant health threat identification and characterization



Work Package 1 progress against the theory of change

WP1 focused on strengthening the diagnostic and surveillance capacities of NPPOs and NARES in targeted LMICs, while facilitating the two-way exchange of knowledge, from local to global and global to local, on research approaches, tools, and technologies for the detection, characterization, and surveillance of priority P&D. Between 2022 and 2024, WP1 advanced along two main pathways: one aimed at bridging network and knowledge gaps (**WP1-OP1** and **OP2**), and the other centered on the development, exchange, and deployment of tools and methods (**WP1-OP3** and **OP4**). Strategic efforts focused on identifying and addressing capacity gaps in diagnostics and surveillance through targeted training, knowledge exchange, and network-building. These efforts were guided by a 2022 global survey conducted across 26 countries in Africa, Asia, CWANA, and LAC, which informed the development of context-specific capacity-building plans for implementation in 2023 and 2024, and intentionally included a gender lens to ensure inclusive participation (**WP1-OP1** & **OP2**; **WP5-OP3**). Over 25 regional workshops and training sessions across LAC, Africa, CWANA, and Southeast Asia were organized. Regional collaborations were reinforced through initiatives like the AfRice-HEALTH network and the expansion of the Global-BioNET and SRBSDV-BioNet, which standardized detection protocols and fostered information exchange across Asia and Africa. These actions not only enhanced national capacities but also laid a strong foundation for sustainable, regionally connected surveillance systems. **Under Pathway 2**, a series of molecular, AI-based, and high-throughput genotyping tools for diagnostic, characterization, and surveillance were co-developed with innovation partners (**WP1-OP3**). These tools, ranging from MinION sequencing, multiplex RT-PCR, SNP markers for pathogen genotyping, drone-based imaging and AI detection models AI detection models, were adapted to target high-priority threats in banana, cassava, rice, potato, wheat, and legumes. drone-based imaging and AI detection models enabled high-accuracy disease detection in cassava (95 percent accuracy for CBSD), rice (98 percent accuracy for blast), banana (between 75 and 99 percent for detecting healthy and BXW-infected stems) and beans (90 percent accuracy for five major diseases). Simultaneously, new pathogen catalogues and reference materials were created to support harmonized diagnostics and early warning systems. Moreover, surveillance campaigns were conducted in more than 26 LMICs and 20 pests and diseases (**WP1-OP4**). These campaigns generated critical data on P&D distribution, strain variation, and pathogen evolution, using platforms like NextStrain, FIA, ODK-based surveillance and Tumaini. Surveillance efforts generated data that is available for regional risk assessments, and integrated management strategies. WP1 made significant strides in providing countries with the tools and evidence needed for timely, data-driven responses to emerging crop health threats.

WP2: Risk assessment, data management and guiding preparedness for rapid response

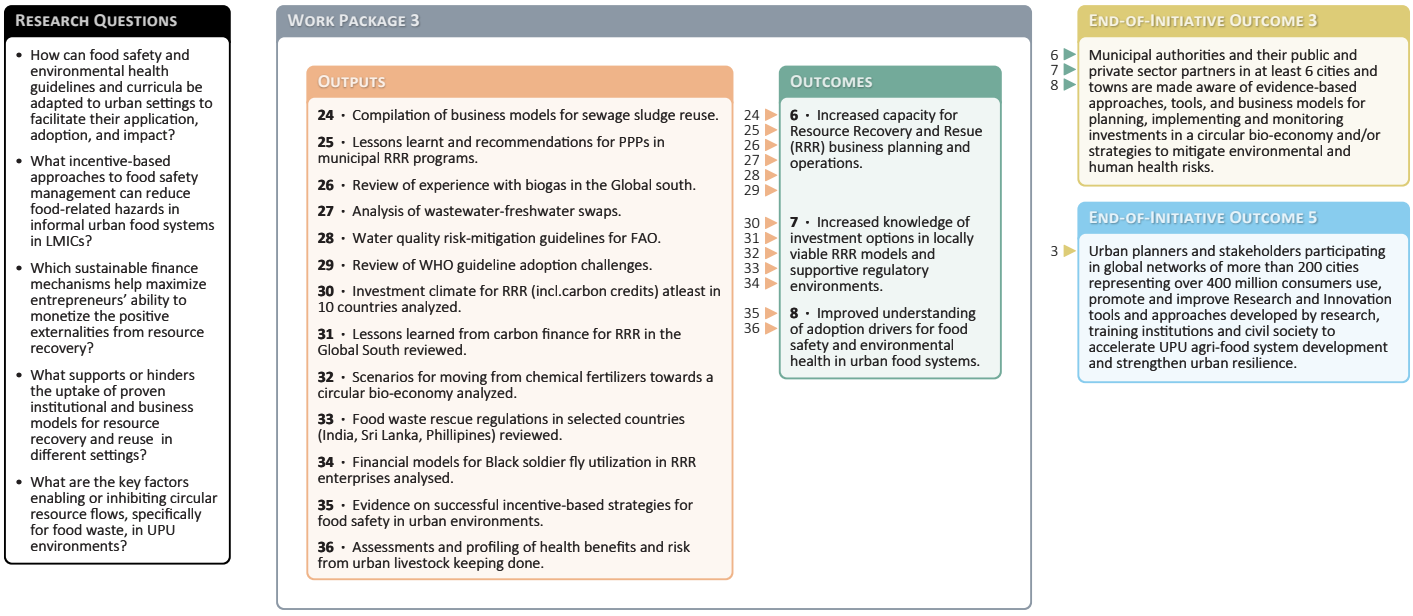


Work Package 2 progress against the theory of change

In 2024, the PHI-WP2 team developed predictive models to forecast climate-driven shifts in priority P&Ds across Africa, Asia, and Latin America (**WP2-05**). The new ILCYM – v4.0 enables web-based insect life cycle modeling, improving accessibility and processing speed. The wheat blast early warning system was validated in Bangladesh (**WP2-05**). AI-based banana mapping using remote sensing and drone data improved the mapping of bananas in West Africa for BBTV surveillance (**WP2-05**). Vulnerability mapping of banana landscapes in Uganda to BBTV and satellite-based static and dynamic crop host distribution maps enhanced wheat stem rust monitoring in Ethiopia (**WP2-09**). Rice disease forecasting advanced with EPIRICE-models for leaf and neck blast, bacterial blight in the Philippines, Côte d'Ivoire and Uganda (**WP2-06**). Sentinel nurseries in Bangladesh, Mexico and Zambia found no virulence shifts in FHB and wheat blast (**WP2-06**). Phenology models for ***Myzus persicae*** and ***Tuta absoluta*** and whiteflies (MEAM1) refined pest risk assessments (**WP2-07**). WP2 developed an in vitro protocol for assessing banana aphid life cycle on Musa (**WP2-06)**, and conducted a mapping of suitable release areas for the parasitoid ***Dolichogenidea gelechiidivoris*** for the classical biocontrol of ***Tuta absoluta*** using temperature-dependent phenology models. Forecasting models were enhanced for ***Helicoverpa armigera*** in pigeonpea and chickpea (**WP2-07**).

The Maize Seed Field and MLN Tracker was piloted in Kenya. The PathoTracer tool was improved for rice blast isolate mapping (**WP2-06**). Sentinel nurseries for bean anthracnose and angular leaf spot races were established in Uganda; in LAC for ***Magnaporthe oryzae;*** and in Malawi, Morocco, and Zambia for yellow, stem, and leaf rust resistance (**WP2-06**). The team characterized pathogen variation in anthracnose affecting African yam bean in Nigeria, analyzed the diversity of ***Colletotrichum*** species causing cowpea anthracnose in Nigeria, and investigated the etiology of post-flowering stalk rot (PFSR) in maize in South Asia. Seed biosecurity efforts focused on virus seed transmission in cowpea, chickpea and faba bean (**WP2-06**). A real-time AI media analysis tool for the top five P&Ds was developed (WP2-06). Lastly, strategies to improve plant health from natural and human-made causes and a biosecurity preparedness plan for rice diseases were developed. Awareness is key to preparedness. The PHI-WP2 team disseminated outputs related to Biosecurity Measures for emerging and invasive P&Ds through various scientific platforms and advocacy events (**WP2-09**). PHI-WP2 outputs support the dynamic assessment of public health risks in targeted LMICs and guide the appropriate preparation and development of response capabilities for local and regional institutions, facilitating surveillance in risk-prone areas.

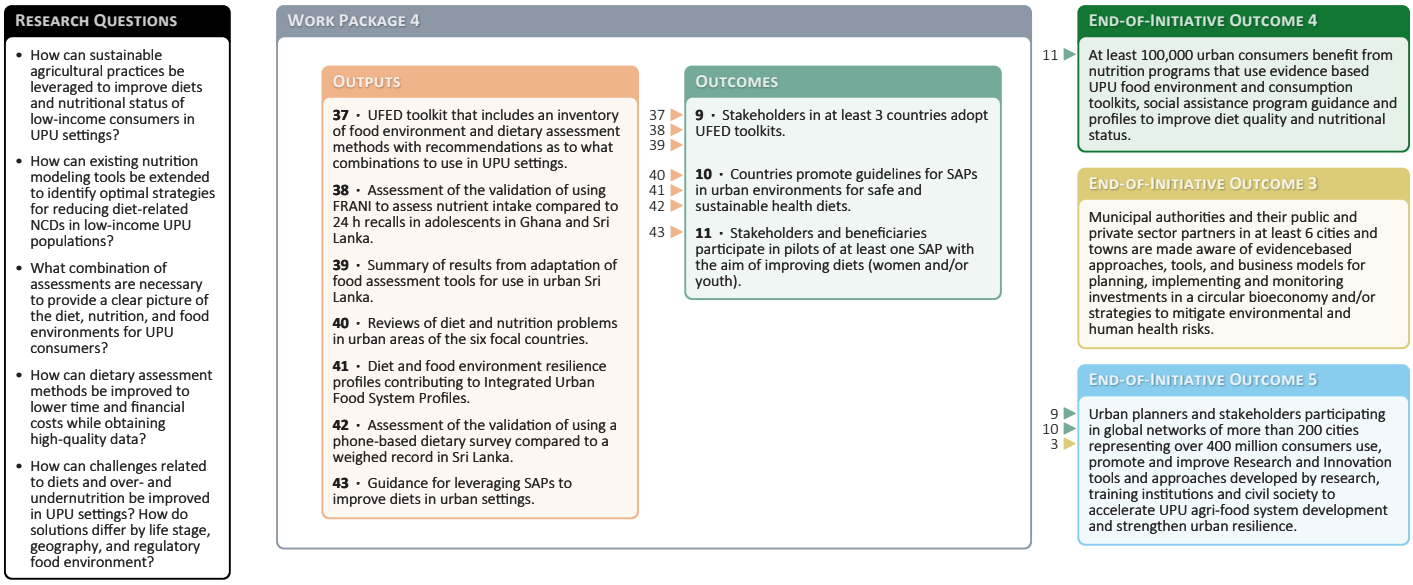
WP3: Integrated disease and pest management solutions for threat mitigation



Work Package 3 progress against the theory of change

From 2022 to 2024, the PHI-WP3 team made significant progress on several fronts, especially on development and validation of an array of innovations, including biological control (e.g., BBTD, ***Fusarium*** wilt, and ***Xanthomonas*** wilt; FAW; root knot and burrowing nematodes of vegetables), biorationals and biopesticides (e.g., African rice gall midge and rice yellow stem borer, aphids and pod borers of food legumes; aphid vector of BBTV; FAW on maize; cassava whitefly, fruit fly, etc.), and ecological engineering (e.g., rice pests; legume pests). In 2024, a seed treatment protocol for removing MLN virus contamination was developed, and validated using a specially fabricated prototype (**WP3-OP2**). Plant Health Innovation Platforms – for example, at Kiboko (Kenya) and at Qos Elias (Lebanon) – enabled participatory engagement of farmers and extension personnel in demonstration and validation of various IPM-based innovations for management of insect-pests like FAAW in maize, and viruses and their vectors on food legumes (**WP3-OP4**). Decision support tools for MLN virus-free clean commercial seed production in maize and for potato late blight management were developed and fine-tuned (**WP3-OP5)**. Capacity building to strengthen knowledge and technical skills on various aspects of IPDM (across nine crops) was undertaken through various formal and informal workshops, benefiting over 700 national partners (~40 percent women), including post-graduate students, scientists, and extension personnel, and over 2000 farmers (~45 percent women) in over 20 countries, including Bangladesh, Ecuador, Ethiopia, India, Kenya, Lebanon, Mali, Mexico, and Zambia. The topics included production and exchange of pathogen-free clean seed/planting materials, integrating host plant resistance with biological control, community-based biopesticide production, and gender and social inclusion in plant health management. (**WP3-OP3 & OP7**). Strong linkages were established with complementary projects on plant health management (e.g., FAO's Plant Health efforts) toward operationalizing a "Global Plant Health Consortium" (**WP3-OC1)**.

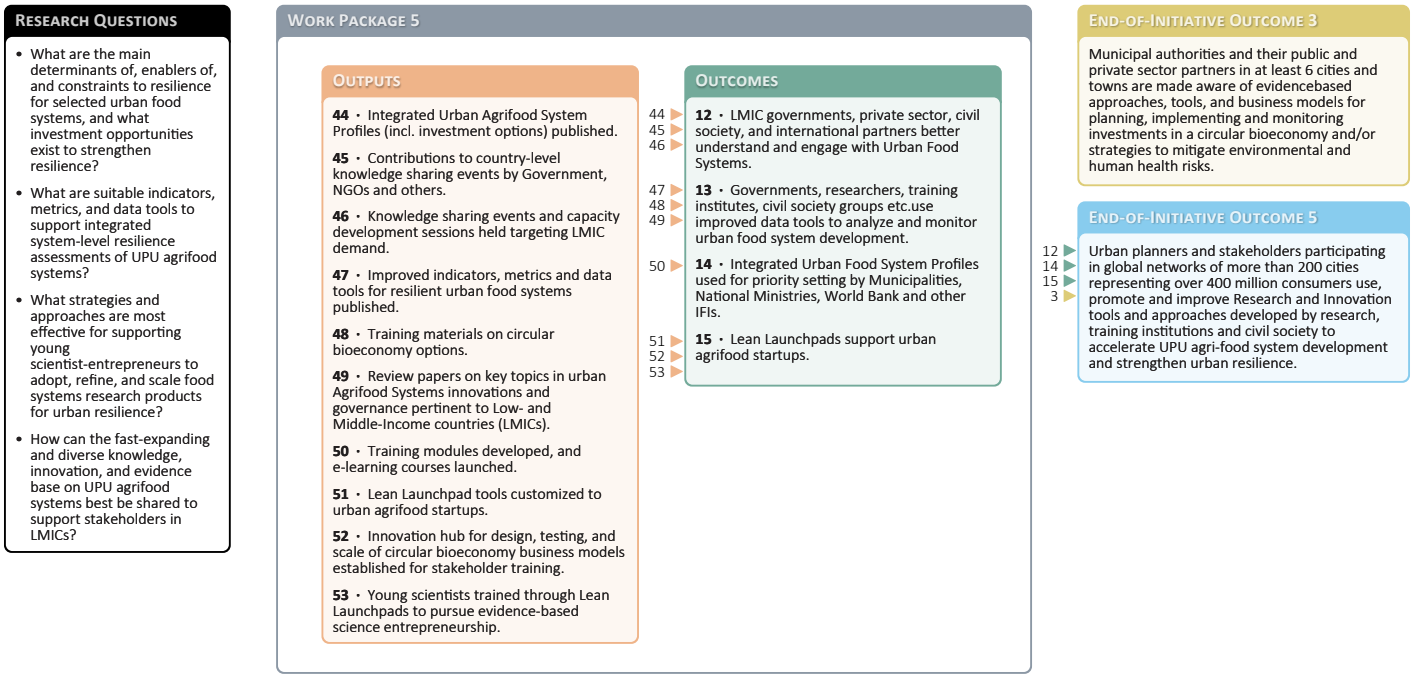
WP4: Tools and processes for protecting food chains from mycotoxin contamination



Work Package 4 progress against the theory of change

Between 2022 and 2024, PHI-WP4 made significant progress in developing and scaling IMM innovations, leveraging a partnership-based approach to achieve substantial outcomes. The WP4 theory of change emphasizes collaboration among demand, innovation, and scaling partners. WP4 tested the effectiveness and scalability of IMM innovations through field testing, participatory research, and consultations with key stakeholders. Through commercialization strategies, investors fora, and public-private partnerships, WP4 refined the framework for scaling biocontrol solutions and other IMM strategies. Aflasafe's five-phase commercialization approach was followed and adapted where necessary. Key partnerships enabled the signing or renewing of manufacturing and distribution agreements for scaling across multiple countries. Six additional bioprotectants were successfully registered with regulators, marking a key milestone in biocontrol innovation globally (only four other products of this type exist globally). Partnerships with key organizations, such as NARES, regulators, and the private sector, were instrumental in this achievement. Manufacturers and distributors were licensed through technology transfer and licensing agreements. WP4 also helped design scaling strategies for increased availability and adoption of biocontrol in target geographies. Alternative processing technologies like nixtamalization, and several post-harvest innovations, were assessed for their effectiveness in reducing mycotoxins. In 2024, WP4 formulated a policy brief for effective management of aflatoxin contamination across sub-Saharan Africa. Thus, WP4's achievements were enabled through active collaboration with farmers, researchers, governments, input suppliers, policymakers, regulators, NGOs, and private-sector actors. Several countries are now considering food safety as a priority and have integrated food safety and aflatoxin control into national regulations. However, challenges, including recurrent and new conflicts in some target countries, and limited funding for scaling, remain. Moving forward, CGIAR scientists working on mycotoxin management will continue to refine their approaches to development, scaling and commercialization of IMM innovations under the Sustainable Farming Science Program, building on the successes of the past three years.

WP5: Methods for inclusive and equitable scaling for achieving impacts



Work Package 5 progress against the theory of change

PHI-WP5, a cross-cutting Work Package, developed and deployed tools and approaches to overcome socio-economic barriers to adoption—one of the major challenges in scaling plant health innovations. The team from diverse disciplinary backgrounds conducted interdisciplinary research to identify knowledge gaps and propose participatory approaches to ensure inclusive and equitable impacts by considering specific needs of women, youth, and vulnerable groups (**WP5-OP1 & OP2**). The gender and plant health global research network with over 250 members played a role as a platform facilitating a functional interface between biophysical and social scientists, knowledge sharing among plant health researchers and downstream partners (**WP5-OP3**). The usability of decision support tools was assessed for Potato Late Blight HH-DST, the PlantVillage app for cassava diseases and FAW, and the Tumaini app for banana diseases with recommendations for scaling strategies (**WP5-OC1**). Insights from case studies (8 studies from 12 countries) were shared through monthly webinars with national partners at an average of 38 participants per seminar (**WP5-OC2**). Policy analysis to understand institutional coordination, current priorities and perceptions of decision-makers was conducted, drawing on the cases from three countries in Asia, Africa, and Latin America. A policy brief was developed for gender-responsive and socially inclusive scaling approaches to plant health with a focus on the Andes region.

PHI-WP5 also made progress towards equitable and inclusive scaling of plant health innovations to achieve greater impacts in resource-limited farming communities. Since 2022, WP5 had conducted four RCTs contributing to **WP5-OP4** and **WP5-OP5**: 1) Aflasafe among maize producers in Nigeria – two rounds of data collection and interventions were completed; 2) FAW Push-Pull Technology in Uganda – household baseline and adoption data collection, along with two rounds of interventions, were completed; 3) Solar dryers to reduce aflatoxin in vegetables in Nigeria (in collaboration with WP4 and RFM) – efficacy analysis and baseline data collection were completed, and the intervention is ongoing; 4) FAW-tolerant maize variety in Zambia – baseline data collection and interventions were completed. Additionally, a study on MLN and FAW management in Kenya was conducted based on a large-scale phone survey.

Work Package progress rating summary

WORK PACKAGE	PROGRESS RATING & RATIONALE
1	On track PHI-WP1 successfully identified key knowledge gaps and worked to address these by establishing networks across LAC, Africa, and Asia to facilitate sharing of knowledge, tools, and surveillance strategies for plant health threat identification. Significant progress was made under the four major outputs. However, budget reductions since the start of the Initiative required scaling back certain activities, particularly those related to surveillance; consequently, adjustments were made to the number of target countries and institutions originally defined under EOIO1 and EOIO2.
2	On track PHI-WP2 remained on track and successfully met major commitments across 10 key outputs. These outputs led to developing pest risk emergence models, data tools, including AI/machine learning-based tools, procedures, and use cases for diverse and economically significant P&Ds affecting various crops across all targeted sub-regions. The Initiative also facilitated cross-learning and adoption of innovations from one sub-region to another. The team anticipates continuation of this critical work under CGIAR's Sustainable Farming Science Program from 2025, to further strengthen innovations, promote the use of decision-support tools, and enhance partners' capacity for pest risk analysis and proactive plant health management.
3	On track PHI-WP3 progress is well aligned with the theory of change, with several key achievements, including: a) co-creation of eco-friendly and climate-smart IPDM innovations against targeted plant health threats in various crops, including rice, maize, wheat, food legumes, potato, sweet potato, banana, cassava, and tomato; c) integrating, identifying and validating the most effective, affordable, and scalable IPDM packages through the Plant Health Innovation Platforms (e.g., in Kenya and Lebanon); d) training researchers, extension personnel, and farmers on IPDM for effective scaling; e) establishing strong linkages with complementary initiatives/projects led by non-CGIAR institutions for coordinated implementation of plant health management.
4	On track PHI-WP4 achieved significant progress against its objectives. Key research questions have been addressed, and IMM solutions have been successfully developed, tested, and scaled. Capacity was built among partners at three CGIAR Centers (IITA, CIMMYT and AfricaRice). The scaling of biocontrol solutions, particularly Aflasafe, in multiple countries is a notable success. Regulatory approvals in new countries pave the way for larger scaling. Despite funding challenges and regulatory delays, WP4's strategic partnerships and collaborative approach ensured continued success and impact.
5	On track PHI-WP5 made progress largely in line with the planned activities and expected outcomes, supported by strong regional networks that fostered interdisciplinary research, gender integration, and social inclusion. At least five knowledge products (journal publications), based on the work done under this WP, are in the pipeline for publication in 2025. PHI-WP5 initially planned to conduct four RCTs at the start of the Initiative in 2022. However, due to unexpected funding cuts in 2023, two RCTs were canceled. After securing increased funding in 2024, the team managed to add two other RCTs. As a result, a total of four RCTs were conducted between 2023 and 2024; the two added RCTs will require an additional year to complete.

Definitions

On track

- Progress largely aligns with Plan of Results and Budget and Work Package theory of change.
- Can include small deviations/issues/delays/risks that do not jeopardize success of Work Package.

Delayed

- Progress slightly falls behind Plan of Results and Budget and Work Package theory of change in key areas.
- Deviations/issues/delays/risks could jeopardize success of Work Package if not managed appropriately.

Off track

- Progress clearly falls behind Plan of Results and Budget and Work Package theory of change in most/all areas.
- Deviations/issues/delays/risks do jeopardize success of Work Package.

Section 4: **Quantitative overview of key results**

This section provides an overview of results reported and contributed to, by the CGIAR Initiative on Plant Health from 2022 to 2024. These results align with the CGIAR Results Framework and Plant Health's theory of change. Further information on these results is available through the CGIAR Results Dashboard.

The data used to create the graphics in this section were sourced from the CGIAR Results Dashboard on 04 April 2025. These results are accurate as of this date and may differ from information in previous Technical Reports. Such differences may be due to data updates throughout the reporting year, revisions to previously reported results, or updates to the theory of change.

Overview of results by category

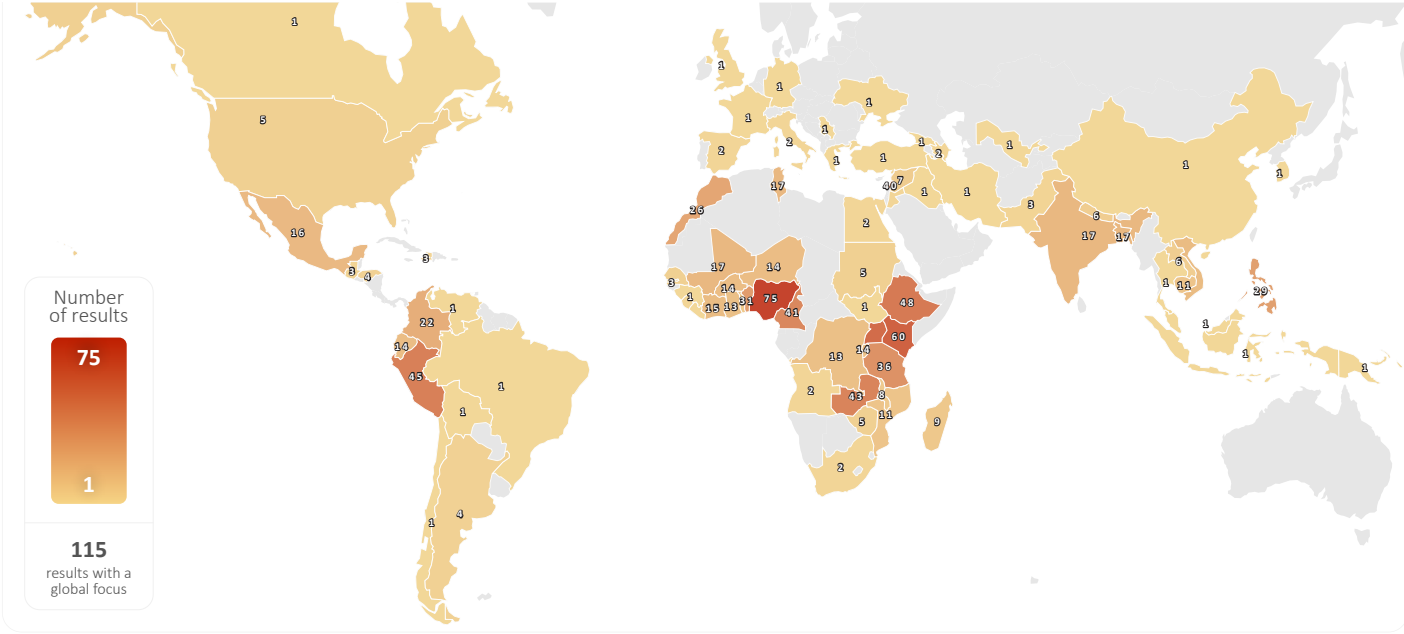
Outputs

- Knowledge products 236
- Other outputs 230
- Innovation development 127
- Capacity sharing for development 97

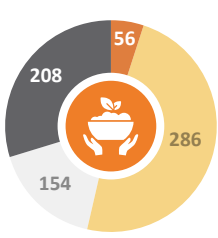
Outcomes

- Innovation use 9
- Other outcomes 5

Geographic focus of PHI's work

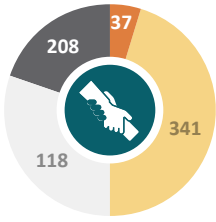


Contributions of results to the CGIAR Impact Areas



Nutrition, health and food security

704



Poverty reduction, livelihoods and Jobs

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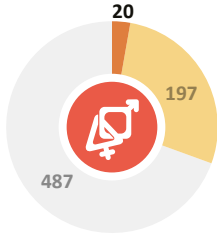

Gender equality, youth and social inclusion

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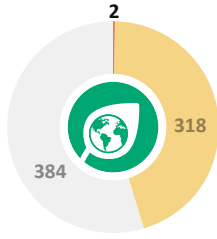

Climate adaptation and mitigation

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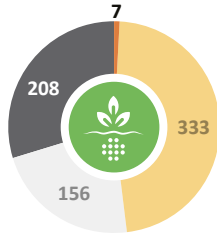
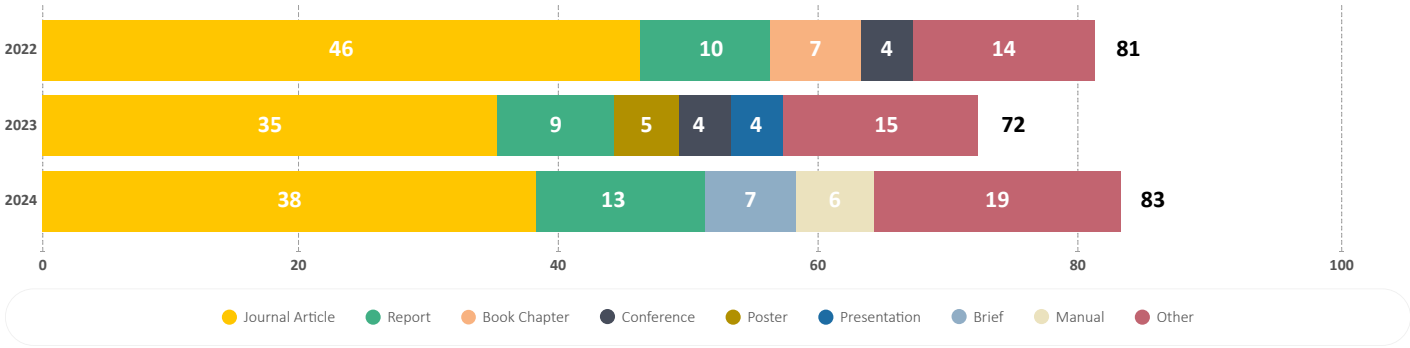


Environmental health and biodiversity

704

- **2 = Principal:** Contributing to one or more aspects of the Impact Area is the principal objective of the result. The Impact Area is fundamental to the design of the activity leading to the result; the activity would not have been undertaken without this objective.
- **1 = Significant:** The result directly contributes to one or more aspects of the Impact Area. However, contributing to the Impact Area is not the principal objective of the result.
- **0 = Not targeted:** The result has been screened against the Impact Area, but it has not been found to directly contribute to any aspect of the Impact Area as it is outlined in the CGIAR 2030 Research and Innovation strategy.
- **Not applicable:** Pertains to 2022 reported results when only information on Gender and Climate impact area tagging was available.

Knowledge products by type

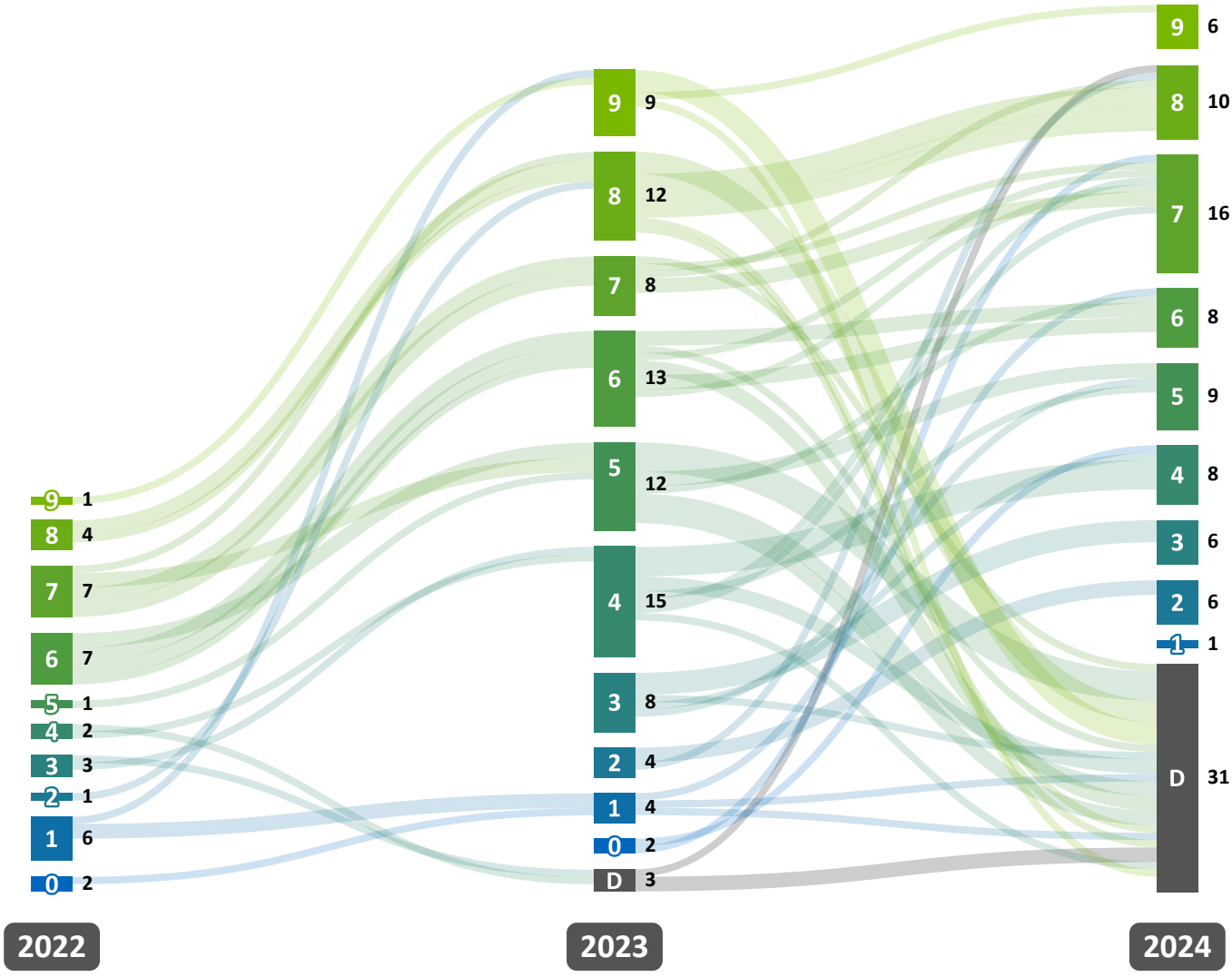


Innovation readiness level

Pipeline overview
# of innovations

9	**Proven Innovation** The innovation is validated for its ability to achieve a specific impact under uncontrolled conditions	14
8	**Uncontrolled Testing** The innovation is being tested for its ability to achieve a specific impact under uncontrolled conditions	16
7	**Prototype** The innovation is validated for its ability to achieve a specific impact under semi-controlled conditions	20
6	**Semi-Controlled Testing** The innovation is being tested for its ability to achieve a specific impact under semi-controlled conditions	15
5	**Model/Early Prototype** The innovation is validated for its ability to achieve a specific impact under fully-controlled conditions	18
4	**Controlled Testing** The innovation is being tested for its ability to achieve a specific impact under fully-controlled conditions	17
3	**Proof of Concept** The innovation's key concepts have been validated for their ability to achieve a specific impact	11
2	**Formulation** The innovation's key concepts are being formulated or designed	7
1	**Basic Research** The innovation's basic principles are being researched for their ability to achieve a specific impact	7
0	**Idea** The innovation is at idea stage	1

Innovations readiness levels progression (2022-2024))



9 Proven Innovation · 8 Uncontrolled Testing · 7 Prototype · 6 Semi-Controlled Testing · 5 Model/Early Prototype · 4 Controlled Testing · 3 Proof of Concept · 2 Formulation · 1 Basic Research · 0 Idea · D Discontinued

PHI-WP1 OUTPUTS

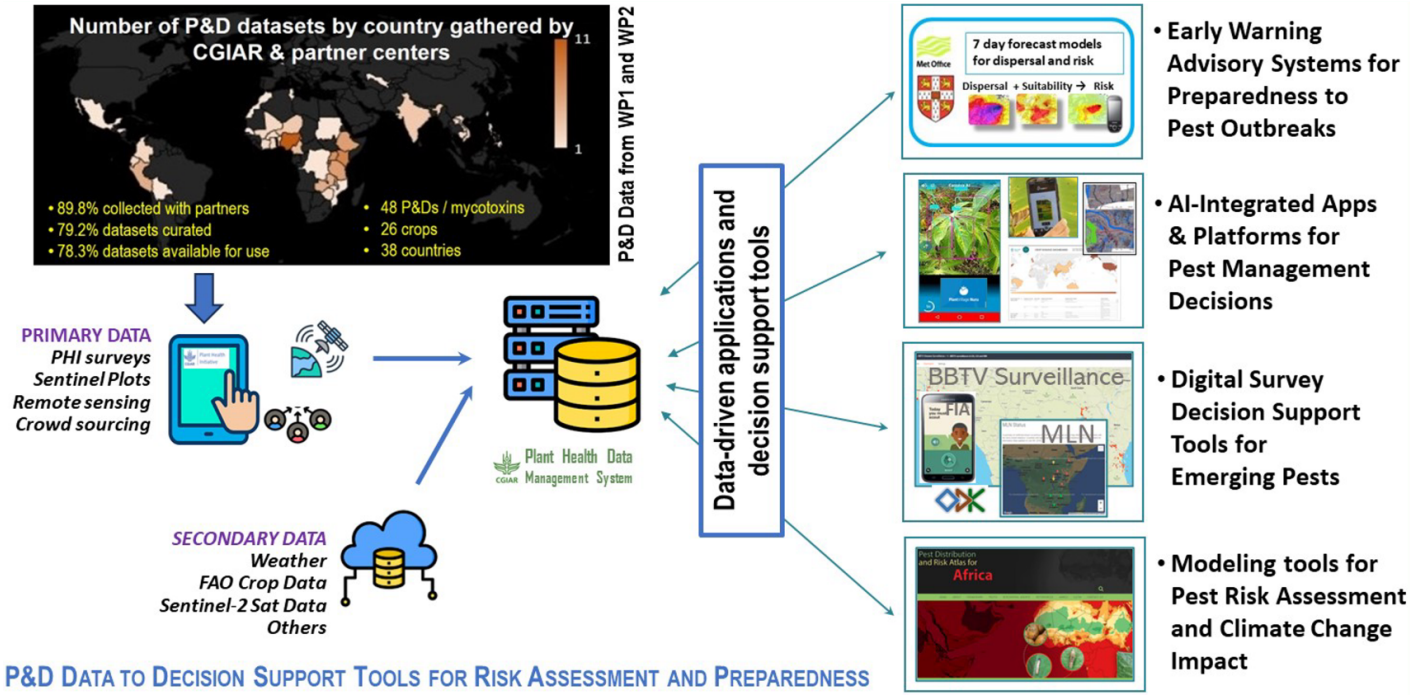
One baseline global south survey on gaps for diagnostics and surveillance

Over 15 training sessions to improve diagnostics

Over 20 molecular and image-based (AI) tools for detection, monitoring and surveillance

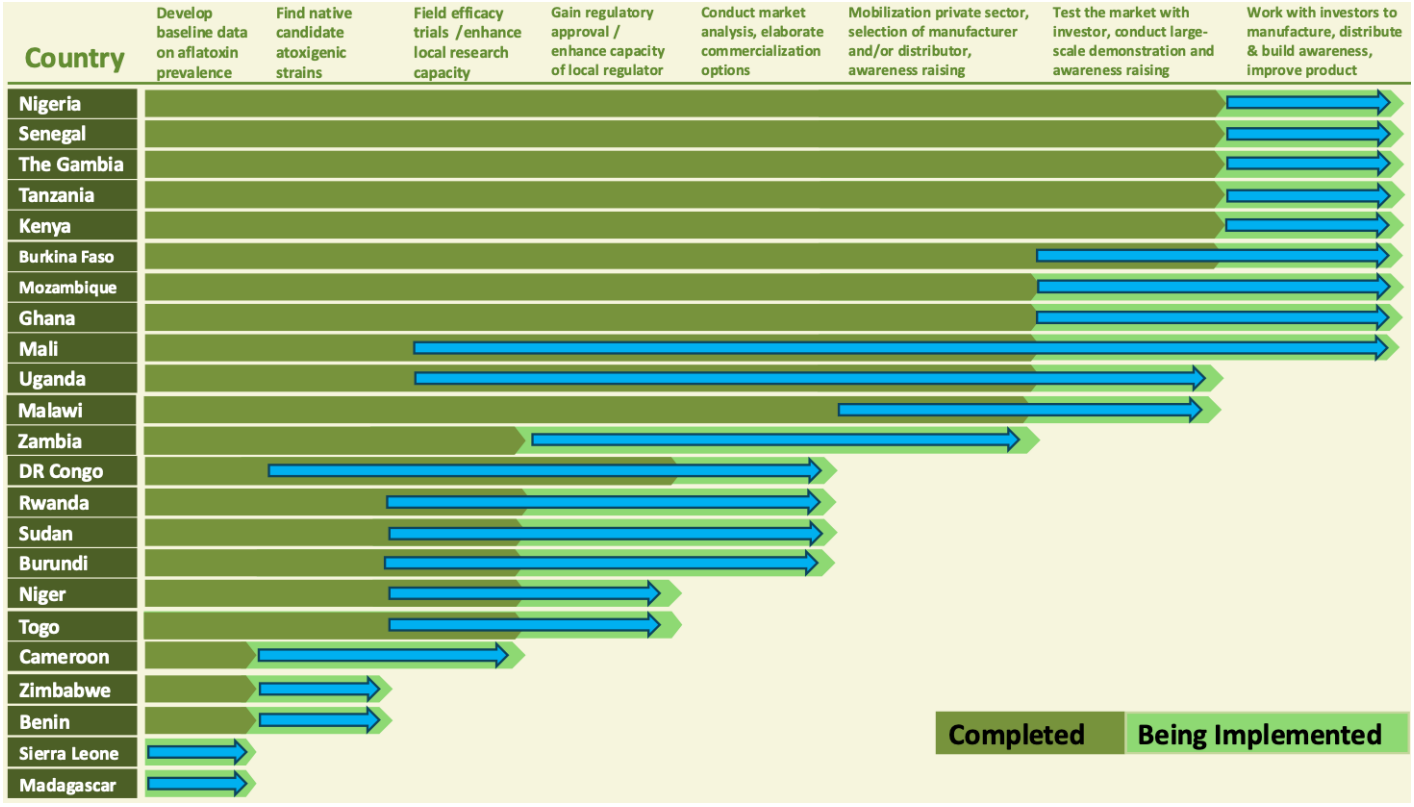
Over 23 surveillance activities for over 20 P&Ds in 8 crops

PHI-WP2: DATA TO DECISION SUPPORT TOOLS FOR PEST RISK ASSESSMENT, PREPAREDNESS, AND CONTROL

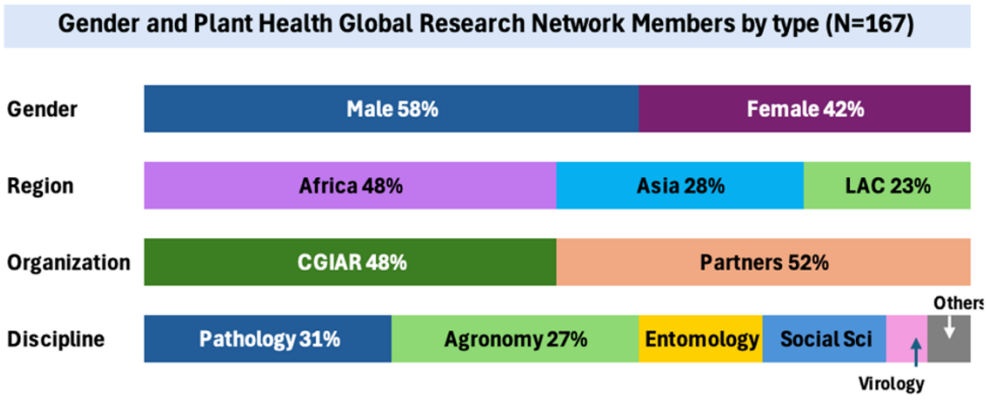


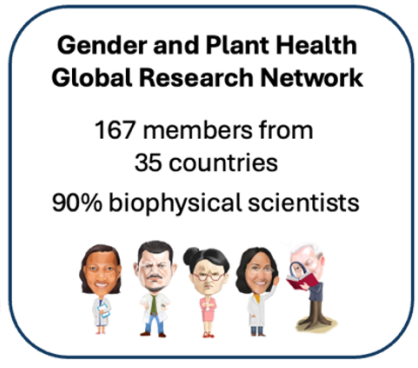
P&D DATA TO DECISION SUPPORT TOOLS FOR RISK ASSESSMENT AND PREPAREDNESS

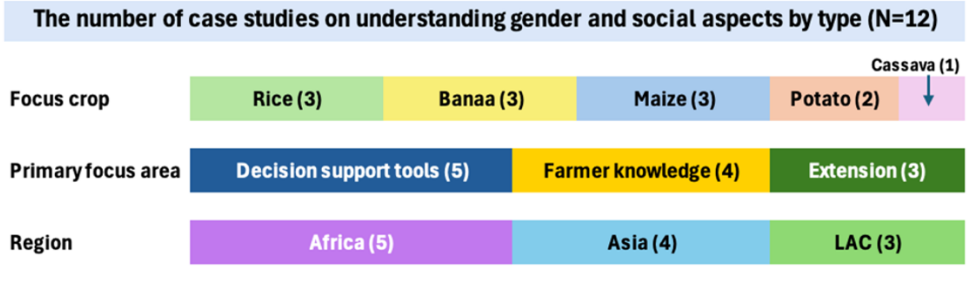
PHI-WP2 focused on developing and strengthening pest and disease (P&D) data management (WP2-OP4), as well as modeling and prediction tools for (i) risk assessment and early warning advisories (WP2-OP5); (ii) predicting climate change impacts on pest dynamics (WP2-OP5); (iii) preparedness for rapid response to invasive and emerging threats, including geographic and host shifts (WP2-OP6); (iv) preventing pest spread through seed flows (WP2-OP7); (v) prioritizing pests for national and regional preemptive management plans (WP2-OP9); and (vi) providing data-driven pest risk advisories to policymakers and donors (WP2-OP10).

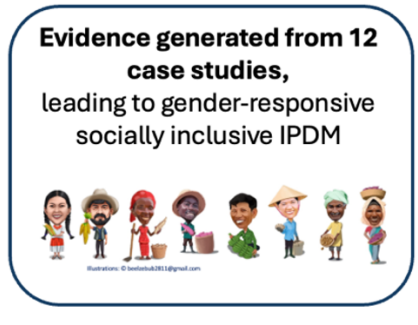


The pathway for scaling aflatoxin biocontrol products and progress across 23 countries in Africa. Effectively addressing each stage (X-axis) – through research, delivery, and partnership actions – is necessary for successfully scaling the atoxigenic-based biocontrol technology. In the final stage, there needs to be strong interface among partners, making this a dynamic process. The blue arrows indicate where PHI-WP4 supported the process all through 2022 to 2024.





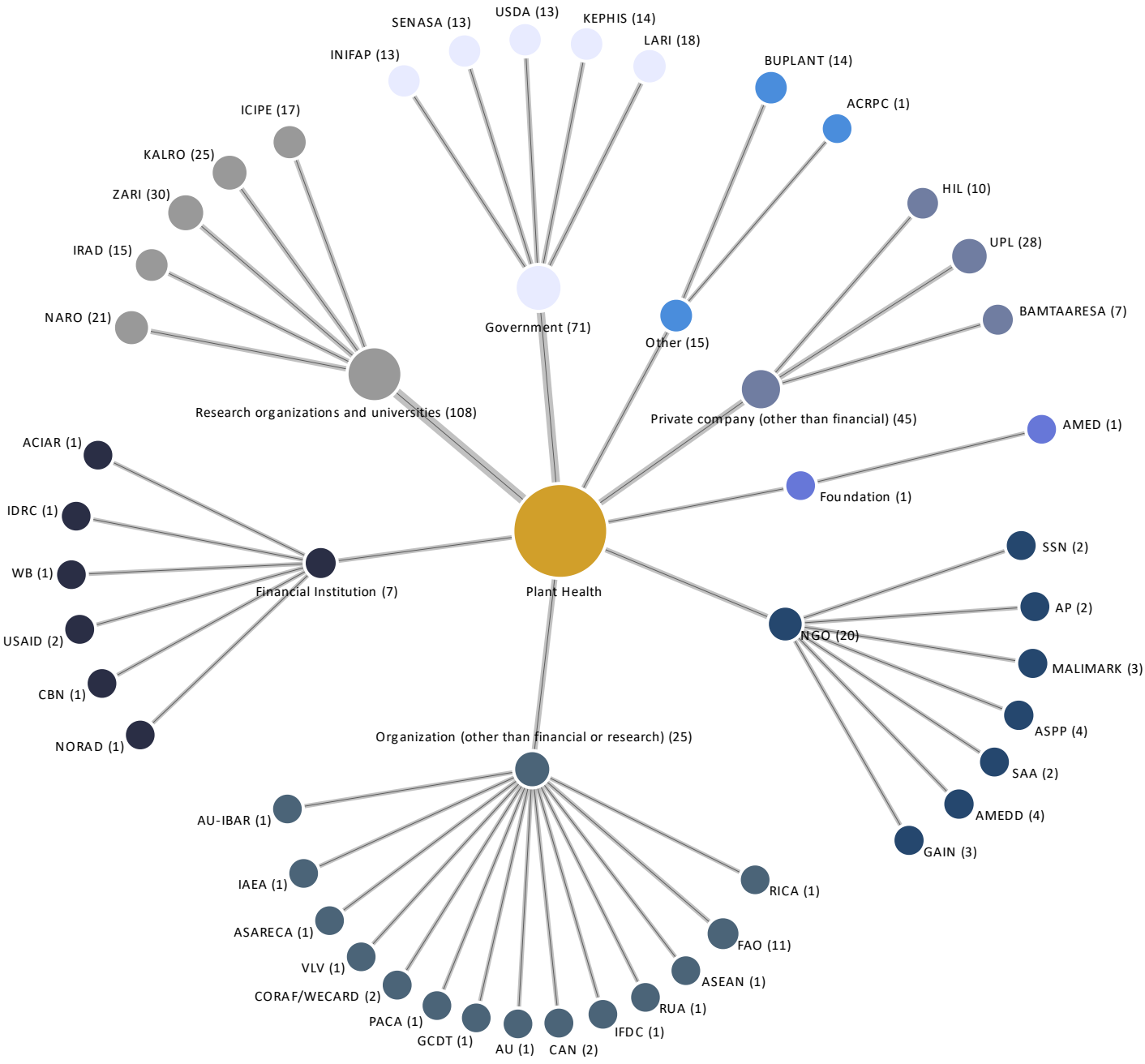




PHI-WP5, through the Gender and Plant Health Global Research Network and case studies, generated evidence to support the gender-responsive and socially inclusive design and delivery of plant health innovations.

Training Nepalese researchers on Tissue Blot Immunoassy for identification of lentil viruses.
Credit: ICARDA

Plant Health's external partners



The diagram maps the external partners of PHI, organized by partner type. The numbers in brackets represent the number of results each partner has contributed to, reflecting the scale and diversity of collaborations. To allow for a clearer view, a maximum threshold of five partners was applied for each typology. The list of partner acronyms is available here.

Partnerships and Plant Health's impact pathways

Between 2022 and 2024, the PHI team collaborated with over 377 partners across 74 countries, including international agricultural research centers (IARCs) (e.g., CABI , icipe, World Vegetable Center), institutions as part of NARES, NPPOs, universities, governmental organizations, private companies, and Non-Government Organizations (NGOs), among others. All these partners contributed to the implementation of various activities under the PHI Work Packages. Out of 180 non-CGIAR partners, 90 organizations were demand partners from 45 countries, 108 were innovation partners from 47 countries, and 82 were scaling partners. Some partners played more than one role, as described here. Some partners are involved in ongoing efforts through bilateral projects, which PHI is leveraging to extend, adopt, and scale plant health innovations in the global South.

PHI-WP1 collaborated with 65 partners across 34 countries to advance its goal of strengthening P&D diagnostics and surveillance in the global South. These partnerships were distributed across four regions: 18 countries in Africa, 6 in Asia, 6 in LAC, and 4 in CWANA, with additional innovation partners extending into Europe. Leveraging the strategic presence of CGIAR Centers in the global

South and their expertise in pathogen identification, characterization, and surveillance, WP1 facilitated collaborations with NPPOs, NARES, universities, and ministries of agriculture. Strong innovation efforts in Africa (10 partners) and Asia (8 partners), and Europe, and a balanced mix of demand, innovation, and scaling activities in LAC, played a critical role in support of innovations.

PHI-WP2 collaborated with 48 partners across 38 countries to advance data management and its applications in pest risk assessment, risk modeling, monitoring, and predicting pest emergence, as well as strengthening biosecurity strategies to enhance preparedness in the LMICs. These partnerships involved innovation, demand, and scaling and have spanned 6 regions: 9 in WCA, 12 in ESA, 3 in South Asia, 5 in SEA, 6 in LAC, and 3 in CWANA, with additional innovation partners in Europe and the United States of America. The WP2 team developed "use cases" in collaboration with NPPOs, NARES, universities, intergovernmental agencies, and ministries of agriculture. These efforts aided in developing risk mitigation strategies for economically important P&Ds, such as FAW, MLN, BBTV, FoCTR4, wheat rust, and wheat blast.

Between 2022 and 2024, over 70 innovation and scaling partners, including IARCs, NARES, NPPOs, NGOs, universities, and the private sector, were involved in implementing various activities under **PHI-WP3,** codeveloping eco-friendly and climate-smart IPDM innovations, formulating and validating inclusive and affordable IPDM packages for prioritized plant health threats through plant health innovation platforms, training farming communities and extension personnel on IPDM in over 20 countries across Africa, Asia, and LAC, and helping the deployment of IPDM-based technologies for the benefit of farming communities.

PHI-WP4 established and strengthened key partnerships for advancing IMM innovations. Demand partners, including NARES, ministries of agriculture/health, and NGOs, provided critical resources to reach farmers and ensure the adoption of IMM solutions. Private sector partners, such as GRUMA in Mexico, BAMTAARE, HarvestField Industries Limited, KOPPERT, AtoZ, AflaLivre, SAPHYTO, and UPL, facilitated scaling of aflatoxin biocontrol solutions. Partnerships with phytosanitary national regulators, WFP, FAO, and mycotoxin-conscious public sector organizations proved critical for sustainability of the initiative. A highlight in 2024 was the registration of Aflasafe products in Burundi, the Democratic Republic of the Congo, and Sudan. Initiation of new complementary projects in Madagascar and Sierra Leone created a conducive environment for scaling. Public-private partnerships strengthened through PHI were integral to advancing food safety and security, empowering communities, and driving sustainable IMM adoption in Africa and Latin America. Further, collaboration on biocontrol development will continue with partners from several European countries, for leveraging South-North synergies.

PHI-WP5 formed the Gender and Plant Health Global Research Network with 250 members from 35 countries. It is a platform to facilitate interdisciplinary research and interventions for scaling of plant health innovations and achieving equitable impacts. A total of 108 participants from 27 countries joined in-person workshops to gain knowledge and skills on gender-responsive participatory approaches to disease identification, tool design and scaling methods in Asia, Africa and Latin America. PHI-WP5 also partnered with icipe, WorldVeg, CABI, ZARI-Zambia, NSPRI-Nigeria, and the University of Bordeaux-France on impact assessment.

In 2024, using pooled funding, PHI disbursed sub-grants totaling USD 456,527 to 32 non-CGIAR partners. These included IARCs such as CABI, icipe, and WorldVeg; advanced research institutions like the John Innes Centre (UK) and CIRAD (France); 18 NARES organizations; 4 universities; 3 national plant protection organizations (NPPOs); and 2 private sector entities. Of this total, CIMMYT disbursed USD 234,588 to 14 non-CGIAR partners. USD 221,939 was disbursed by AfricaRice, Bioversity, ICARDA, IITA, and IRRI to implement specific work plans with defined deliverables, complementing CGIAR Centers' efforts.

Participants of the Rice Seed Health Workshop (November 2024) at the Speed Breeding Facility in IRRI-Phillippines. Credit: IRRI

Section 6: **CGIAR Portfolio linkages**

Portfolio linkages and Plant Health's impact pathways

Between 2022 and 2024, PHI worked closely with several CGIAR Initiatives from the three Science Groups. Linkages and joint outputs were reported in collaboration with five Initiatives under Genetic Innovation, two under Resilient Agrifood Systems (RAFS), and one under Systems Transformation. Some examples are highlighted below:

- The **Accelerated Breeding** Initiative (ABI) and the **Seed Equal I**nitiative contributed to the breeding and deployment, respectively, of improved varieties with host plant resistance (disease-/parasitic weed-/insect-pest resistance), against various plant health threats, including resistance to wheat blast and FHB, MLN, FAW, and Striga in maize, and Bacterial leaf blight (BLB) in rice. **(PHI-WP3). PHI-WP2** also had significant interaction with ABI, especially on the establishment of sentinel sites (WP2-OP5) for monitoring the emergence of host plant resistance-breaking strains/pathotypes (WP2-OP6) for diseases such as wheat stem rust, rice blast, FHB of wheat, maize lethal necrosis, soybean rust, rice yellow mosaic virus, and yam mosaic virus. The combined efforts helped the PHI team harness data and characterize strains to improve resistance phenotyping and advise breeding program design to develop broad-spectrum resistance.
- The Genebanks Initiative (GBI) supported the development, improvement and validation of an array of diagnostic tools and protocols, and engagement with the NPPOs in the regional diagnostic hub network through a series of training sessions (**PHI-WP1).** The other significant partnership that was maintained throughout the duration of the Initiative was with the Germplasm Health Units (GHUs) under GBI. The GHUs' seed surveillance data for P&Ds were useful for **PHI-WP2** activities on biosecurity risks to seed delivery pathways (**WP2-OP7**) and to enhance integrated seed health protection strategies to prevent the transboundary spread of pathogens. Efforts will be made to sustain these linkages in the Sustainable Farming Science Program.
- Resilient Agrifood Systems (RAFS) Initiatives contributed to the theories of change of WP3, WP4 and WP5, including interactions with the **Fragility to Resilience in Central and West Asia and North Africa Initiative** to strengthen the capacities of national scientists and technicians for management of different plant health threats (**WP3**); the **Excellence in Agronomy Initiative** helped to gain understanding of gender-based roles in rice-based systems, and diversification of cropping systems for pest management; and the **Asian Mega-Deltas Deltas Initiative** co-developed research design with PHI and implemented surveys to understand men and women farmers' responses to rice pests and diseases in a changing climate – this information is critical to mainstream gender for more equitable and inclusive plant health management and impacts in Southeast Asia (**WP5**); PHI also collaborated with the **Rethinking Food Markets Initiative** to evaluate the impacts of solar dryers on vegetables in Nigeria (**WP4** & **WP5**). These linkages supported progress towards PHI's end of Initiative outcomes OC1, OC2, OC3, OC5, OC8 and OC1.
- The **National Policies and Strategies (NPS) Initiative**: PHI-WP4 established a strong partnership with NPS, especially to help align integrated mycotoxin management (IMM) technologies with national regulatory frameworks and ensuring the scalability and adoption of IMM solutions. NPS provided valuable insights into policy development, which aided in guiding the integration of mycotoxin-safe food strategies into national policies; this is crucial for large-scale adoption.
- The **Rethinking Food Markets (RFM) Initiative**: PHI-WP4 and WP5 collaborated with RFM on evaluating the impacts of a solar dryer intervention on reducing mycotoxin contamination in vegetables in Nigeria. This collaboration enabled WP4 and WP5 to develop market-driven strategies that promoted the use of solar drying technology, which significantly reduced mycotoxin levels in crops, benefiting farmers and the value chains. These synergies strengthened PHI's approach to scaling IMM solutions, contributing to sustainable agricultural practices and safer food systems in affected regions.

Bilateral projects played a crucial role in complementing the work of PHI. The progress obtained to date would not have been possible without diverse funding sources. A few examples from 2024 are given below:

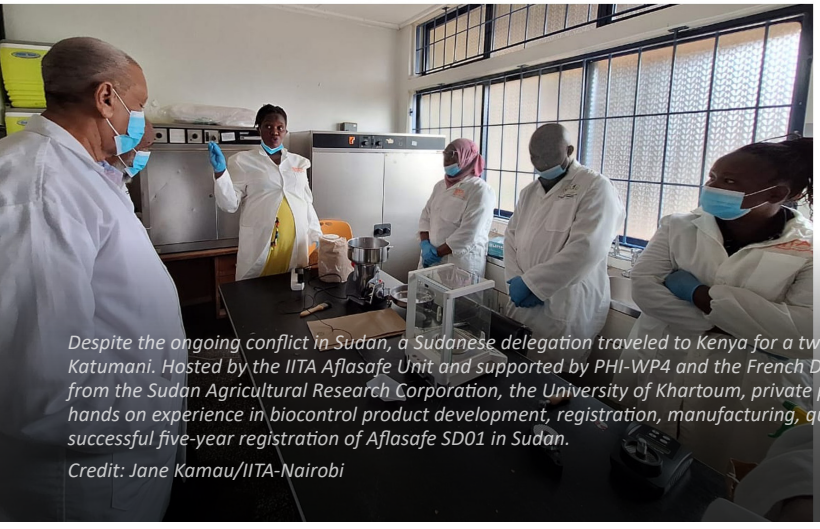
- The Wheat Disease Early Warning and Advisory System (DEWAS) project funded by the Gates Foundation and FCDO-UK enabled continuation of key wheat disease surveillance, diagnostics and forecasting in eight core countries (Bangladesh, Bhutan, Ethiopia, Kenya, Nepal, Pakistan, Tanzania, Zambia), and complemented PHI-WP1.
- Surveillance work on BBTV and capacity development of NARS partners (Kenya, Tanzania, and Uganda) (PHI-WP2: 18867) benefitted from complementary funding from the USAID/USDA-FAS projects on Controlling BBTV Outbreak in East Africa, and FAO TCP funding for Emergency Management of BBTV, awarded to IITA.
- Research on development and application of the PathoTracer 2.0: Advanced Rice Disease Management through Dynamic Data Visualization and Analysis (PHI-WP2: 8689) benefitted from complementary funding by the Gates Foundation (Transformative strategy for controlling rice disease in developing countries Phase II) and the Rural Development Administration (Korea) ((Temperate Rice [Japonica] Research Consortium), awarded to IRRI.
- Long-term work on remote sensing modelling and static and dynamic crop host distribution maps for wheat stem rust monitoring in Ethiopia (PHI-WP2: 9183) was co-funded by the European Space Agency, awarded to CIMMYT. The Swedish Research Council-Sweden and ICAR-India Projects contributed to PHI training activities on wheat blast and other wheat diseases (PHI-WP3).
- Work on the establishment of the sentinel nurseries for monitoring virulence variation in anthracnose and angular leaf spot races of beans in Uganda (PHI-WP2: 13605) was co-funded by USAID under the Accelerated Varietal Improvement and Seed Delivery of Legumes and Dryland Cereals in Africa (AVISA) Project awarded to the Alliance of Bioversity International and CIAT (ABC).
- The work on understanding the effects of climate change on sweet potato insect pests, Acraea acerata and Cylas puncticollis in Africa (PHI-WP2: 15321) was co-funded by GIZ (Predicting climate change induced vulnerability of African agricultural systems to major insect pests through advanced insect phenology modeling, and decision aid development for adaptation planning), awarded to CIP.

- Research and capacity development work on training farmers and extension officers in Malawi and Zambia to establish sentinel plots for early warning of soybean rust (PHI-WP2: 19876) was co-funded by USAID [FTF-Soybean Innovation Lab], awarded to IITA.
- The ASEAN-CGIAR Innovate Project funded by ACIAR and UK Aid (FCDO) complemented PHI-WP3 work for strengthening the capacity of NARES and NPPOs to manage regional prioritized transboundary pests and diseases in Southeast Asia, such as cassava mosaic disease, FAW on maize, sweet potato foot rot, and major rice pests and diseases.

Incursion of a new Yellow Rust race Pst S16 in farmers' wheat fields in Nakuru, Kenya. Credit: CIMMYT

Partnerships for progress: Scaling mycotoxin management in Africa and the Americas

The CGIAR Research Initiative on Plant Health's efforts on mycotoxin management have continued advancing technology transfer to public and private partners across Africa and the Americas.



Despite the ongoing conflict in Sudan, a Sudanese delegation traveled to Kenya for a two-week aflatoxin biocontrol training at the Aflasafe Facility in KALRO-Katumani. Hosted by the IITA Aflasafe Unit and supported by PHI-WP4 and the French Development Agency, the training event brought together representatives from the Sudan Agricultural Research Corporation, the University of Khartoum, private partner CTC Group, and the National Pesticide Council. Participants gained hands on experience in biocontrol product development, registration, manufacturing, quality control, and field application, key steps that contributed to the successful five-year registration of Aflasafe SD01 in Sudan.

Credit: Jane Kamau/IITA-Nairobi

Primary Impact Area

Contributing Initiative

Rethinking Food Markets

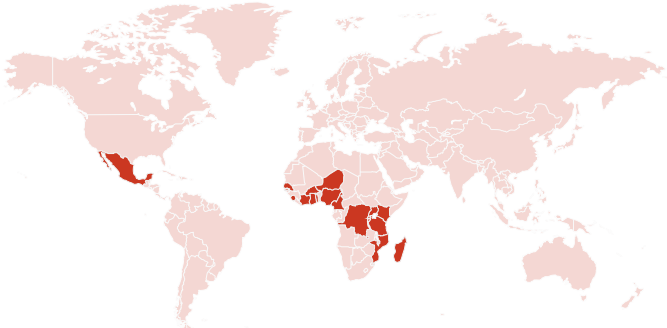
Contributing Centers

AfricaRice · CIMMYT · IITA

Contributing external partners

AflaLivre · AtoZ Textiles Limited · BAMTAARE SA · FAO · FOFIFA · GRUMA · HarvestField Industries Limited · INIFAP · INRAN · IRAD · IER · KALRO · Koppert · McGill University · NARO · SAPHYTO · SLARI · USDA-ARS · WFP · Zambia Agricultural Research Institute

Geographic scope



Regions: Sub-Saharan Africa · Latin America and the Caribbean

Countries: Burkina Faso · Burundi · Cameroon · Cote D'Ivoire · DR Congo · Ghana · Kenya · Madagascar · Mexico · Mozambique · Niger · Nigeria · Senegal · Sierra Leone · Tanzania · Togo · Uganda

In 2024, the CGIAR Research Initiative on Plant Health (PHI) accelerated the scaling of mycotoxin control technologies across Africa and the Americas. By strengthening partnerships with public and private entities, PHI streamlined the transfer of pre- and post-harvest solutions—including biocontrol and advanced processing and storage technologies—needed for achieving effective mycotoxin management. Regulatory approvals were obtained, manufacturing facilities were established, and manufacturing/ distribution licensee selection was conducted in some countries, paving the way for enhanced food safety and improved market access in key regions.

In 2024, significant progress was made in developing, testing, registering, and scaling mycotoxin control technologies, benefiting public and private partners across Africa and the Americas. The year was marked by strengthened stakeholder collaboration, extensive technology validation, and large-scale deployment efforts to mitigate the devastating impact of mycotoxins in maize, groundnut, and rice – while also benefiting sorghum.

A key highlight of 2024 was the continued scaling of Aflasafe biocontrol products to mitigate aflatoxin contamination in Burkina Faso, Gambia, Ghana, Kenya, Mali, Mozambique, Nigeria, Senegal, Tanzania. The testing phase of Aflasafe was completed in Burundi, the Democratic Republic of the Congo, and Uganda, where farmers reported significant reductions in aflatoxin contamination. These results demonstrate the country-specific product's potential to improve food safety and market access. Despite the ongoing conflict in Sudan, a Sudanese delegation traveled to Kenya for a two-week aflatoxin biocontrol training at the Aflasafe facility in KALRO -Katumani. Hosted by IITA and supported by PHI-WP4 and the French Development Agency. The training event contributed to the successful five-year registration of Aflasafe SD01 in Sudan, ensuring that crucial mycotoxin mitigation efforts could continue even in challenging circumstances. A government delegation from Burundi also visited Kenya Agricultural and Livestock Research Organization (KALRO)-Katumani for a one-week training visit. IITA also initiated two World Bank-funded projects in Madagascar and Sierra Leone to develop country-specific Aflasafe products. In addition, IITA's collaboration with international partners like United States Department of Agriculture-Agricultural Research Service (USDA-ARS), Università Cattolica del Sacro Cuore, Cranfield University, and FAO played a crucial role in the development, testing, and expanding of biocontrol technologies.

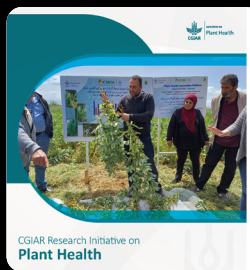
Substantial progress was also achieved in scaling aflatoxin biocontrol in Mexico. In 2024, the United States Environmental Protection Agency (US-EPA) registered AF36-Prevail biocontrol product was tested across maize-growing regions in the country. Trials consistently demonstrated high effectiveness in reducing aflatoxin, generating critical data for extending registration of AF36-Prevail to Mexico. CIMMYT also collaborated with local storage technology providers and food processors to mitigate mycotoxin risks. By engaging both public and private sector actors, CIMMYT made significant progress in expanding access to these solutions.

AfricaRice focused on improving rice storage techniques to mitigate mycotoxin contamination. In 2024, solar-powered, hermetic storage technologies were tested in several locations, demonstrating effectiveness in reducing contamination and improving post-harvest handling. These storage solutions will be further evaluated in combination with other pre- and post-harvest technologies, to offer an integrated approach to reducing mycotoxins risks. Over 500 stakeholders participated in training workshops that emphasized the importance of post-harvest technologies for improving food safety, better nutrition, and market access.

A central theme throughout the year was the focus on inclusive, multistakeholder engagement. PHI-WP4 continued emphasis on the importance of understanding local contexts and collaborating with farmers, government bodies, non-governmental organizations, and private companies to scale mycotoxin mitigation technologies. In Kenya, for instance, training workshops and field demonstrations conducted by KALRO, the World Food Programme, Koppert, Delish and Nutri and IITA introduced over 5,000 farmers to Aflasafe and improved pre- and post-harvest techniques. This collaborative approach ensured that these technologies were effectively used by farmers, ensuring production of safer crops for their own consumption and market opportunities. Overall, through concerted efforts, PHI successfully facilitated adoption of mycotoxin mitigation strategies in 2024, reducing contamination in staple crops, improving food safety, and providing better opportunities for farmers to access premium markets.

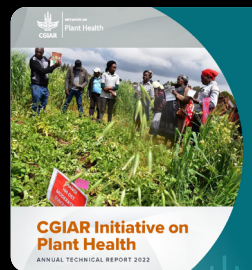
In 2024 (and in early 2025), high-level political support for aflatoxin control increased significantly. Heads of States (e.g., in Uganda and Sierra Leone) and ministers of agriculture in various countries actively advocated for coordinated national strategies to address mycotoxin contamination, recognizing its implications for food safety, public health, and economic stability. This political momentum is critical for driving policy reforms, securing investments, and accelerating the adoption of mycotoxin mitigation technologies.

> The mission to KALRO-Katumani was critical to have Aflasafe SD01 becoming Sudan's first bioprotectant-registered product. Through IITA's effective technology development, testing, registration, and transfer, this innovation will significantly strengthen Sudan's food safety systems and reduce aflatoxin contamination, benefiting farmers and consumers alike."
>
> Prof. Azhari Omer, Professor of Pesticide Chemistry and Toxicology, University of Khartoum and Sudan National Pesticide Council member, Sudan



2022 key result story

CGIAR-led Plant Health International Network has mapped the priorities for pest and disease detection and response efforts in the Global South



2023 key result story

Data-driven smart tools for countering emerging crop pests and diseases in Africa, Asia, and Latin America

CGIAR

INITIATIVE ON

Plant Health

Plant Health surveillence team collecting wheat yellow rust samples in 2024 in a farmer's field in Timau, Kenya.

Credit: CIMMYT