# CGIAR System 3-Year Business Plan (2019-2021) Companion Document

## Rapid-response preparedness to newly emerging pests and diseases, and crises: What CGIAR can deliver quickly

Business Plan Action: **1.3 - Deepen the portfolio through new thematic strategies and initiatives**

Purpose: This document sets out a draft approach on processes through which the System Management Board might consider and trigger future coordinated CGIAR rapid response measures to agricultural and humanitarian crises based on the system's existing scientific strengths and resources.

Document Status: The System Council is requested to provide strategic input and guidance on the draft strategy, to inform its further development before submission to the System Management Board for approval and discussion on implementation actions at its 12th meeting in December 2018.

---

**Document category: Working document of the System Council**
There is no restriction on the circulation of this document

Prepared by: CIMMYT with inputs from CRP Leaders & System Management Office

---

## Purpose

1.     CGIAR has been involved in developing rapid responses with other global, regional, and national players to agricultural and humanitarian crises based on the system's existing scientific strengths and resources. A key CGIAR strength is that its Centers and long-term partners are based in those countries, in which many such crises occur, enabling timely response. Triggered by consideration of the serious challenge posed by the arrival of the crop pest, fall army worm in Africa (SC 6th Meeting – Berlin May 2018) Funders asked the SMB to consider how this sort of rapid response capacity might be nurtured in CGIAR. This recognizes that surveillance and adequate responses to a larger number of threats and diseases may be required from CGIAR and global community in the future.

2.     This paper describes processes through which the SMB might consider, and trigger coordinated CGIAR rapid response measures in the future. A list of current key agents of concern is provided.

## Background

3.     CGIAR has provided rapid responses to international efforts in three areas of activity:

   a.   Support based on existing CGIAR materials and expertise after disaster (e.g. Seeds of Hope Rwanda, retraining of fishermen communities and introduction of aquaculture after tsunami, restoring destroyed cassava sector in South-East Nigeria following flooding);
   b.   research or convening of a research response to a new disease or pest threat to developing countries, for which CGIAR has something uniquely to offer (e.g. on-going efforts by CIAT&IITA in South East Asia after outbreaks of Cassava Mosaic Disease). To be effective, CGIAR needs to stay abreast of the emerging challenges, to gauge their severity, analyze potential responses which CGIAR can provide based on its comparative advantage and to organize research or coordination, both amongst the appropriate components of the CGIAR system and with research partners.
   c.   Strengthening any rapid response by building the capacities of the national plant protection agencies, especially plant quarantine services, who play key frontline roles in our collaborative efforts in surveillance, monitoring, and management programs.

4.     Maintenance breeding against pests and diseases is a routine part of CGIAR's crop, livestock and fish breeding program strategies. However, CGIAR has joined or initiated consortia of research players and agencies to respond, for example, to wheat rusts and blast with accelerated breeding approaches, when these threats became urgent globally. There is thus the need to distinguish global or regional emergency issues from current program goals, scope and timelines. Triggered by consideration of the serious challenge posed by the arrival of the crop pest, fall army worm, in Africa, the SC has asked the SMB to consider how to put CGIAR's response capacity on a more solid footing. This recognizes that a) under conditions of changing climate and parasite and vector distributions, the frequency of agricultural disease may increase and b) that emerging threats represent quite different sorts of threats to human health (e.g. Anti-microbial resistance) and agricultural and

livestock and fish industries, some of which CGIAR has previously successfully fostered (e.g. the global growth in tilapia farming now threatened by the emergence of Tilapia Lake virus).

5.    This paper examines how best CGIAR can make contributions to the global community's rapid response to newly emerging pests and diseases having substantial impact on livelihoods at the multinational level, e.g. "derailing" pests and diseases.

6.    **The position of CGIAR and Potential Enabling Factors for Success**

   a. A critical focus
   b. Initial expert assessment, ex-ante impact assessment
   c. Many Partners involving the whole spectrum, from advanced to basic research, extension, communicators, politicians and farmers
   d. Surveillance and monitoring
   e. Screening and Phenotyping platforms (with links to surveillance)
   f. Enabling tools and technologies and rapid breeding approaches
   g. Fast track variety release and promotion
   h. Information dissemination (and data management)
   i. Continual engagement resulting in community building
   j. Investments in capacity building for human and infrastructure development
   k. Strong champions with clear messages

7.    **CGIAR SWOT for Rapid Response Preparedness**

| Strengths | Opportunities |
|---|---|
| ▪ Relevant long-term, multi-crop, multi-regional knowledge and experience, in both historical and future-predictive perspectives<br>▪ Expertise on livestock diseases and networks to facilitate early response<br>▪ Centers and their networks cover major food & feed crops for nutritional and food security<br>▪ Respected convener role | ▪ Better learning, know-how sharing, applied research on decision-making and communications approaches, processes, tools<br>▪ Greater cross-crop/disease/agro-ecological zone scientific collaboration: Innovation in R4D design & delivery<br>▪ Develop comprehensive sets of products & services along preparedness-to-rapid response pathway |

| Weaknesses | Threats |
|---|---|
| <ul><li>Moving and connecting people across Centers when needed (e.g. rapid response)</li><li>CGIAR scientists' knowledge base fragmented, too few experts, at times not well connected, organizational memory / reinvent the wheel</li><li>CGIAR administrative services designed for conventional research, constrains rapid deployment</li></ul> | <ul><li>Climate change drives new, emerging and more ferocious pests and disease outbreaks</li><li>New, non-traditional players offer detection and monitoring and solutions</li><li>Some big advanced research institutes push internationalization</li></ul> |

8. **Examples of recent CGIAR rapid responses to crises (see Annex II)**

    a. Centers with crop(s) mandates and AgriFood-CGIAR Research Programs have assessed the relative (per crop) importance of pests and diseases (see Phase II Proposals) and periodically update their assessments. This guides CRPs' W1&2 allocation and bilateral fundraising.

    b. Examples of recent or ongoing emergency challenges: Fall Army Worm in maize and other crops, maize lethal necrosis, highly virulent cereal & legume rusts, aflatoxins in several crops, blast in wheat and millets, parasitic weeds, Rift Valley Fever, African swine fever, Highly Pathogenic Avian Influenza, Tilapia Lake Virus (TiLV) – but also wider, more complex responses to crises or chronic vulnerability that incorporate the pests/diseases dimension.

9. **CGIAR's scientific and on-the-ground capabilities for preparedness and rapid response.**

    **A. Germplasm improvement-based strategies: CGIAR has**

        a. Precision phenotyping competence, innovation, locations, to screen lines at all stages of development (e.g. testing sites, reference isolates, protocols, etc.)

        b. Maintains and has access to greater diversity of germplasm; NARS and private sector work with a much narrower range of diversity.

        c. Maintains continuous pipelines along pre-breeding-to-farmers'-fields pathway: Scientists can quickly react at the right point.

        d. International testing networks (not for all crops) as a prerequisite for rapid response. For example, the International Wheat Improvement Network (IWIN) allows pre-emptive action to combat threats from new emerging diseases in developing countries. When a (new) disease occurs in a particular area, resistant lines can be identified, and seed multiplied rapidly and shared with SME and farmers. At national level, Ug 99- and wheat blast-resistant varieties were identified and multiplied within one year.

        e. Accelerated breeding approaches: Genomic Selection, Double Haploids, Single Seed Descent, Shuttle Breeding, Speed Breeding, and Multi-disciplinary Breeding Teams.

**B. Integrated Pests Management (IPM) and disease control strategies**
   a. Rapid diagnostic tools and scouting for early warning at different levels and scales, including for livestock and fish diseases (farmer, community, national, regional);
   b. Affordable and cost-effective IPM strategies, involving location/region specific good agricultural practices (GAPs) including pre-emptive management, options such as biological control, bio-pesticides, cultural means for controlling a pest, pesticide selection and application options, post-harvest transport and storage solutions, etc.;
   c. Long-term management of risks of pests, fish and livestock diseases (e.g. comprehensive approach to introducing pest-specific natural enemies; better landscape management for natural pest suppression, using both technical and institutional approaches);
   d. Use or build partnerships for scaling out solutions;
   e. Phytosanitary procedures for safeguarding germplasm exchange, movement and collections, clean seed production and safe germplasm exchange procedures, to prevent risk of pest and pathogen spread.
   f. In future, CGIAR Centers and its partners could address human health risks associated with increased pest outbreak risks (e.g. exposure to pesticide residues, occupational hazard, anti-biotics resistance, changes in ecosystems or environmentally mediated health impacts, health effects associated with lower consumption due to lower yields).

**C. Foresight/-warning systems**
   a. Forecasting of risks: Pest Risk Analysis (PRA), risk maps (e.g. based on population dynamics);
   b. Pest/disease risk modeling using process-based climate response models, in combination with GIS risk mapping tools; model crop connectivity; risk assessment approaches
   c. Risk-based surveillance approaches and systems for rapid detection, reporting and emergency response action, for example wheat rust surveillance and in-field sequencing in Ethiopia that integrates transnational surveillance with in-field gene sequencing.
   d. Possible future CGIAR strategy: Regional or global surveillance systems **that monitor and prevents outbreaks/disasters are better than post-disaster rapid response systems. S**table funding could be directed to **maintain a preventive strategy** (virtual infrastructure, monitoring capabilities and technologies, risk assessment, team assemblage, intervention packages), whilst an emergency fund is directed to implement a rapid response (see also Annex 1).

**D. Partnerships**
   a. Existing research- or extension/development-driven partnerships at sub-national, national, regional (FLAR for rice in LAC) and global levels (IWIN for wheat globally);
   b. Existing capacity building activities at national level (e.g. Nigeria and West African countries: IITA Germplasm Health Unit and Virology and Molecular Diagnostics Unit regularly trains staff of the National Plant Quarantine Services in

new diagnostic techniques and hands-on upgrading of skills, access to upgraded or new equipment via collaborative projects).

c. The Big Data Platform as a mechanism to set up pan-CGIAR digital partnerships that can enhance CGIAR capabilities for multi-country pest and disease foresight, surveillance, and response (e.g. for large-scale predictive modeling, digital data capture and integration, and rapid response enabled by mobile or sensor networks). For example, the Platform has a subscription with the high- resolution satellite imagery provider DigitalGlobe.

d. Operate pan-CGIAR innovation processes, to foster new partnerships that can accelerate the adoption and use of leading-edge data science tools across the organization. For example, CRPs' competitive partner grants, innovation awards, or Big Data Platform's Inspire grants (e.g. for machine-learning aided, in-field disease diagnosis in cassava and in-field gene sequencing of wheat rust. Key learning: Multi-country data sources and collaborations are a key factor of success for digitally-enabled disease surveillance).

e. Public Private Partnerships and enable Seed Systems to rapidly respond to pre-release strategic seed multiplication, variety release accreditation, and market driven seed distribution.

**E. Know-how/Learning mechanisms** (option for the future, question of scope, which drives resources and organization)

a. In future, CGIAR could make use of learning from past experience by easy-access guidance/information services for a range of rapid response types (e.g. to inform the next design of a new seed distribution program). CGIAR could develop such information products and make them available to interested platforms (such as bio-security platforms, the TAAT initiative of the African Development Bank). CGIAR would thus support emergency response organizations (including WFP, FAO and others) in designing their responses, with or without direct CGIAR support. The Big Data Platform-developed Global Agricultural Research Data Innovation and Acceleration Network (GARDIAN), could support such services (gardian.bigdata.cgiar.org).

b. CGIAR could invest in the use of big data and artificial intelligence systems that scan social media outputs related to pests and diseases outbreaks.

**10. Lessons learnt**

a. "Derailing" pests and diseases reduce household food security and incomes, increase food prices, change cropping patterns, and entail a set-back to the seed industry; small enterprises may go bankrupt. New pathogens and insect pests' all contribute to genetic erosion since local landraces are susceptible.

b. There are no acceptable alternative approaches other than use by farmers of resistant varieties and IPM. A broad basis of genetic diversity is essential in breeders' materials and populations. Reliance on genetic diversity held in CGIAR genebanks is an important resource to combat diseases and pest.

c. Ex-ante assessment (site similarity) can predict potential areas of outbreaks and risk. There is a systematic approach developed such as Pest Risk Analysis (PRA) and Pest

Risk Atlas for Africa that use pest risk modeling and GIS mapping of potential risk areas under current and future climates, which builds the basis for informing development and relief organizations and national programs about the potential risks, improve their and farmers preparedness and capacity, and establish effective quarantine and monitoring systems. Centers must include new/emerging pests foresighting in their strategic research portfolios.

d. Emerging pests are normally already recognized as pests in other regions. A fast response to emerging pests and diseases requires anticipatory breeding and programs with strong information from pest monitoring to invest in current and potentially threatening diseases.

e. CGIAR international evaluation and dissemination networks are exemplary to illustrate power of international germplasm testing. These collaborative networks allow pre-emptive actions to combat threats from new emerging diseases in developing countries. They act as vehicles for information and knowledge exchange. If a disease is identified to occur in a new area, resistant, agronomically suitable lines can be quickly identified, and pre-release seed multiplication can begin.

f. A fast response to emerging pests and diseases requires breeding and research programs to investigate likely diseases that have been prioritized as a significant threat to resource poor farmers, and fragile food production value chains.

g. Extensive use of fungicides / pesticides is often not a viable, sustainable or ecological option, since fungicides / insecticides are not released, or are not available in economically affordable quantities in the threatened countries for use against the new or newly virulent disease.

h. The economics and behavior of pest management are complex, involving knowledge/awareness, perceptions, access to inputs, information, and technical support, tradeoffs between health and consumption/income, risk preferences, etc.

i. Coordination and collective action are also needed to manage the negative externalities from pesticide-based pest control, or to conserve natural enemies for natural pest regulation ecosystem services, ideally to prevent pest species from reaching a pest status, by maintaining an ecologically balanced system, in which natural enemies keep pest populations in check.

j. Partnership is essential for the success of any preparedness and rapid response. The capabilities described at Annex could be coalesced more meaningfully and for this, global IT partners are key, including for collaborative tools development. CGIAR uses Microsoft Azure, which includes in its suite of services machine learning/AI, support for deployment and management of Internet of Things sensor networks, high-resolution weather, image access and analysis tools, and storage and computation.

## 11. Proposed Next Steps

a. Assess CGIAR successful, rapid response interventions, and recognize factors leading to success or failure.

b. Agree on next steps to develop a business model for rapid (!) response services and preparedness supporting such services. In this context, consider implementing small, strategic consultancy, to assess CG capacities and design mobilization contingency plans for a select number of emergency/rapid response types.

c. SMB to assess and develop strategic decision making and prioritization routines (see

Annex 1 for considerations).

d. Determine if there are generic capacities to be retained or cultivated (e.g. spatial disease data, agency liaison responsibilities on behalf of CGIAR).

## Annex I: Suggested steps in the consideration by the System Management Board of potential topics warranting a CGIAR rapid response

1. The System Management Board should have a standing item on its meeting agenda to receive reports (i.e. roughly 3-4 times a year). The item provides space for update reports by individual Centers or collaborations on any current rapid response efforts (e.g. fall army worm) or new items could be tabled provided by any element of CGIAR.

2. Agreement on criteria for engagement - generally covering two areas of activity:
   a. support (at different engagement levels; to be further defined) based on existing CGIAR materials after disaster (e.g. Seeds of Hope Rwanda: Retraining of fishermen communities and introduction of aquaculture after tsunami);
   b. research or convening of a research response to a new threat to developing country agricultural system <u>for which CGIAR has something uniquely to offer, including about preventive approaches based on effective monitoring / surveillance.</u>

3. Considerations in formulating a CGIAR response to urgent issues:

   a. Formal or informal request for CGIAR engagement/support by a global, regional or national body.
   b. Should understand that if the threat is large / continental / global, we must expect to be working through consortia of actors.
   c. SMB identifies whether subject requires a multi-CRP emergency response (exceptional project) or constitutes a continuing challenge that requires an additional research element of an existing program, or new CRP collaboration.
   d. To enhance a CGIAR voice and coordination of activities, SMB should identify either a lead Center or a multi-Center Task Force to be spokesperson and/or key actor for CGIAR (and will expect them to make regular updates as per above).
   e. SMB identifies whether additional linkages to global actors need to be planned/ regulated to ensure best CGIAR interface with international efforts e.g. not so much research but knowledgeable liaison e.g. with FAO/ IFIs / govts. Determines if these entail extra FTE costs at the nominated Center or centrally.
   f. SMO charged with managing a coherent CGIAR funding request (or allocation) based on responsible Center and all other contributing CGIAR elements – e.g. additional surveillance (c.f. IRRI use of satellite data to determine rice crop damage after typhoons); rapid epidemiological study based on NARS contacts; Big Data (modelling projections, correlates), Genebank mobilization, physiological analysis of resistance mechanisms (most likely with ARI partners), key research for resistance genes or bio-control agents (more than one crop and potentially several Centers), phenotyping testing (often one needs extra

facilities if it is a disease organism one wants to separate from existing sites) collaboration and meeting costs. For new diseases this could be 3 years plus project. For something like AMR there might be an emergency management aspect and then a longer educational program around best practices - again, CGIAR unlikely to be acting alone here.

g. The above is an alternative to a reserve fund for potential responses in this area –a mechanism that has not been favored for other aspects of portfolio research in the present funding climate.

h. A communications plan should be part and parcel of the planned response. System Management Office communications would be detailed to create a communication plan appropriate to CGIAR's scientific contribution (this requires, in the best cases, intensive interaction with other players so that the stories are factual and complementary (e.g. WHO and FAO on avian influenza). This may, depending on the nature of the emergency, be an almost 1.0 FTE requirement for the duration and require science oversight.

i. There should be agreement for frequent review of progress (metrics for this) and then evaluation and review of lessons learned to maintain the responsive capacity of the system.

## Annex II: Examples of recent CGIAR rapid response actions and/or responses to disease challenges

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| IITA, Bioversity | Stellenbosch University, Mozambique national partners, private sector farm | Banana Fusarium Tropical Race 4 | Contribute/ provide improved variety, risk assessment | Banana | Asia, Middle East and Africa | Biotic |
| Center genebanks (ITPGRFA Annex 1) | | Phytosanitary security of germplasm conserved in genebanks and germplasm distributed from the centers | Management, Standards | Multi | Global | Biotic |
| CIAT | | Preemptive contribute/provide improved variety for resistance to begomoviruses in Andean beans | Contribute/provide improved variety | Beans | South America | Biotic |
| IITA, CIAT | | Cassava whitefly project | | Cassava | Africa, Global | Biotic |
| CIAT | | Virtual portal to communicate emerging cassava phytosanitary constraints in Asia, Americas | Platform, Advisory | Cassava | Global | Biotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| CIAT, IITA | | Cassava Mosaic Virus: Emergency response and long-term management strategy, Cambodia and Vietnam | Advisory, Strategy | Cassava | Southeast Asia | Biotic |
| CIAT, IITA | | Develop road map for strengthened global surveillance systems | Strategy | Multi | Global | Biotic |
| CIMMYT | | Wheat blast | Contribute/provide improved variety | Wheat | South Asia | Biotic |
| CIMMYT | NARS and farmers in 31 countries; John Innes Center (UK), Big Data Platform | Wheat stem rust (Ug99) monitoring & contribute/provide improved variety | Contribute/provide improved variety | Wheat | Africa, Asia | Biotic |
| CIMMYT | | Grey leaf spot | Contribute/provide improved variety | Wheat | Asia | Biotic |
| CIMMYT | | Australia Russian wheat aphid strategic contribute/provide improved variety | | Wheat | Australia | Biotic |
| CIMMYT | | Disease resistance screening in hot spots (rusts, leaf diseases, wheat blast, insects) | Contribute/provide improved variety | Wheat | Global | Biotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| CIMMYT, IITA | | Maize lethal necrosis | Contribute/provide improved variety (pre-emptive), IPM, Advisory | Maize | ESA East Southern Africa, West Africa | Biotic |
| CIP | | Australia late blight emergency preparedness | | Potato | Australia | Biotic |
| CIP | | Leafminer fly forecast models, IPM and classical control | | Potato | Global | Biotic |
| CIP | | Tomato leafminer forecast models and IPM | Monitoring, IPM | Tomato | Global | Biotic |
| CIP, icipe, IITA | | Pest risk modeling, mapping and adaptation to climate change | Monitoring, Advisory, Strategy | Multi | Global | Biotic |
| CIP, IITA, Bioversity | | Pest risk analysis for emerging pests and diseases | | Multi | Rwanda, Burundi, Uganda, DRC | Biotic |
| IITA), CIMMYT | | Fall armyworm | IPM, contribute/prov ide improved variety | Maize, sorghum, millet, cowpea | Africa, Asia | Biotic |
| GLDC/ICRISAT | | Blast in pearl millet and finger millet- more virulent strains | | Millet | Asia, Africa | Biotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| GLDC/ICRISAT | | Maruca vitrata (pod borer) in Pigeonpea | | Pigeonpea | South Asia | Biotic |
| GLDC/ICRISAT | | Sorghum shoot fly-increasing trend | | Sorghum | South Asia | Biotic |
| IITA/GLDC | | Maruca vitrata (pod borer) in cowpea | | Cowpea | Africa and the rest of the world | Biotic |
| IITA | | BIMAF, climate-pest interaction | Climate change, Strategy | Multi | Africa | Abiotic, Biotic |
| IITA/A4NH | | Disease resistance screening in hot spots (CBSD, CMD, banana diseases, soybean rust) | IPM, contribute/provide improved variety | Multi | East and Southern Africa | Biotic |
| IITA | | Drought tolerant screening in pest hot spots (cassava, maize) | Strategy, contribute/provide improved variety | Cassava, maize | Sub Saharan Africa | Abiotic, biotic |
| IITA | | Integrated soil fertility management (soil & pest interaction) | Strategy, contribute/provide improved variety | Multi | Sub Saharan Africa | Abiotic, biotic |
| IITA | | Emerging foliage thrips on cowpea (Hydatothrips adolfifriderici) | | Cowpea | SSA Sub Saharan Africa | Biotic |
| IITA | | Soybean rust | Contribute/provide improved variety | Soybean | Africa | Biotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| IITA, icipe | | Emerging root knot nematode species on various crops | | Multi | SSA Sub Saharan Africa | Biotic |
| IITA | | Integrated response to | Strategy, Advisory aflatoxin outbreaks | Multi | Africa | Biotic |
| IITA | | Aflatoxin mitigation and control | Biological control, policy, Integrated approach | Maize, groundnut, sorghum | Africa, Pakistan | Food safety, trade |
| IITA | | Epidemiology of yam nematode | Contribute/provide improved variety | Yam | Nigeria | Biotic |
| IITA, Bioversity | | Managing BBTV outbreaks | Risk assessment, epidemiology, strategy | Banana | Africa | Biotic |
| IITA | | Managing Xanthomonas Wilt | Genetic transformation, cultural practices, contribute/provide improved | Banana | East Africa | Biotic |
| IITA, Bioversity | | Surveillance, epidemiology and control of Xanthomonas Wilt | Monitoring | Banana | East Africa | Biotic |
| IITA, | | Surveillance, epidemiology and control of Pratylenchus lesion nematodes | Control through cultural practices Monitoring | Banana | East Africa | Biotic |
| IITA, Bioversity, CIP, CIAT | | RTB disease and pest damage surveillance with AI smartphone app | Monitoring | Multi | Global | Biotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| IITA, CIAT | | Cassava disease surveillance platform; brown streak disease surveillance; Cassava Mosaic Disease (CMD) taskforce; pandemic mitigation | Monitoring, Platform, Advisory, Strategy, contribute improved varieties | Cassava | Africa, South East Asia, ECA (East Central Africa), | Biotic |
| IITA, icipe | | Emerging root knot nematode species on various crops | Monitoring, Platform, Strategy | Multi | Sub Saharan Africa | Biotic |
| GLDC/ICRAF | | Jujube (Ziziphus mauritiana) and tamarind (Tamarindus indica) fruit pests | | Fruit trees | Sahel region | Biotic |
| GLDC/ICRAF | | Shea (Vitellaria paradoxa) and Pterocarpus erinaceus leaf diseases | | Trees | Sahel region | Biotic |
| GLDC/ICRAF | | Baobab (Adansonia digitata) leaf beetle | | Trees | Sahel region | Biotic |
| IITA, icipe, CIMMYT | | FAW | Advisory, Monitoring, Strategy, Biological control | Maize (multi) | Sub Saharan Africa | Biotic |
| IITA | | Preventive control and recovery plans for cassava brown streak; pre-emptive contribute/provide improved variety | Monitoring, Advisory, Strategy, contribute/provide improved variety | Cassava | West Africa | Biotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| IITA | | NURU, an artificial intelligence system for digital emergency response | Mobile App for real-time detection of crop pests and diseases | Multi (starting with cassava) | East Africa (Tanzania, Kenya) | Biotic |
| IITA | | Mapping of insecticide residues in mosquito breeding sites found in and around agricultural settings | Monitoring Strategy | Multi (rice, vegetables) | West Africa | Biotic |
| IITA | | Tropical neglected diseases (e.g. Buruli ulcer, Lymphatic filariasis | Monitoring, | Multi (rice, lowlands, flooded areas) | West Africa | Health |
| IITA | | One-Health Initiative under a changing climate) | Upheld by 4 inter-connected pillars (Soil, Animal, Water, Plant for improved Human Health) | | West Africa | Health |
| IITA, icipe, CIP | | Distribution, epidemiology and control of Potato cyst nematode | IPM, Advisory | Potato | Kenya | Biotic |
| GLDC/ICRISAT | | Aflatoxin contamination | | Multi | Global | Biotic & Food safety |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| GLDC/ICRISAT | | Dry root rot, emerging threat to chickpea in SAT environments | | Chickpea | South Asia | Biotic and production constraint |
| GLDC/ICRISAT | | Phytophthora blight of Pigeonpea under changing climate | | Pigeonpea | Asia | Biotic and production constraint |
| GLDC/ICRISAT and ICARDA | | Ascochyta blight in chickpea-evolving more virulent forms | | Chickpea | Global | Biotic and production constraint-set back to seed industry |
| CIMMYT, CCAFS | | El nino climate fluctuations, resiliency | Advisory, agronomy, contribute/provide improved variety | Multi | Global | Climate, Natural disasters |
| CIAT | | Malnutrition forecasting | Advisory | Multi | Global | Health |
| CGIAR | | Risk management | Advisory, Management | NA | CGIAR center strategies | Institution al |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| WLE | | Determine how rapid response needs can be avoided or reduced, by AR4D working at multi- functional landscapes level; agro- ecosystem management in farming systems | Strategy, Advisory | Multi | Global | Multi; pests, diseases only one part |
| Bioversity | | Digital emergency response | Mobile based damage data collection, national | NA | Costa Rica | Natural disasters |
| CCAFS | | Maps rescue millions, forecasting and response | | Multi | Global | Natural disasters |
| CCAFS | | Earth science, big data, climate portal | Advisory | Multi | Global | Natural disasters |
| CGIAR | | Disaster management | | Multi | Global | Natural disasters |
| CIMMYT | | Re-establish national maize seed bank | Seed for genebank | Maize | Philippines, Guatemala | Natural disasters |
| CIMMYT | | Rebuilding livelihoods | | Multi | Nepal | Natural disasters |
| IWMI | | Response to water disasters | | Multi | Global | Natural disasters |
| HarvestPlus, multi-Center | | Biofortification: sorghum, millet, rice, wheat, maize | Contribute/provide improved variety | Multi | Global | Nutrition & Health |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| PIM, FP4 (Social Protection for Agriculture and Resilience) | | Instruments to address chronic vulnerability, crisis, and post-crisis recovery | Policy, Advisory, Platform | NA | Global | Policy |
| CIAT | | Seed systems security | | Multi | Global | Seed |
| CIMMYT | | Emergency seed recovery | Seed distribution | Cereals | Ethiopia | Seed |
| CIMMYT | | Global wheat variety releases | Contribute/provide improved variety | Wheat | Global | Seed |
| CIMMYT | | Ug99 strategic candidate variety deployment | Contribute/provide improved variety | Wheat | East Africa, West Asia, South Asia | Seed |
| CIP | | Emergency potato and sweetpotato seed support | Seed distribution | Sweet potato | Ethiopia | Seed |
| CGIAR | | Seeds of Hope | | Multi | Rwanda | Social disaster |
| CIAT, IITA, CRS | | Agricultural innovations | | Multi | Global | Technologies |
| LIVESTOCK/ILRI, genebank | Icipe and NARS: KALRO (Kenya), NaLIRRI (Uganda) and EIAR (Ethiopia). | Napier stunt and smut | Contribute/provide improved variety; offer alternative forage species | Napier | East Africa | Biotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| LIVESTOCK/ILRI, CIAT | Papalotla (private seed company) | Brachiaria spittlebug | Contribute/provide improved variety (noting that there is a whole range of different spittlebug species) | Brachiaria | Asia | Biotic |
| A4NH/ILRI | CDC (USA), DTRA (USA), KEMRI, State Vet Service (Kenya) | Rift Valley fever | Risk mapping, response decision making framework; genotyping | Cattle, small ruminants | East Africa | Biotic |
| FISH/LIVESTOCK/ WorldFish, ILRI | Univ of Bern (Switzerland), Univ of Sterling (UK) | 'Summer mortality' in farmed fish | Disease investigation, | Tilapia | Egypt | Biotic |
| FISH/WorldFish | | Newly emerging Tilapia Lake Virus (TiLV) | Disease investigations, surveillance and control strategies | Tilapia | Asia and Africa | Biotic |
| A4NH/ILRI | Makerere, FLI, Uni Sydney, Centre of Foreign Animal Disease Canada | Emerging zoonotic disease | Risk mapping, surveillance and prevention strategies | Livestock and poultry | Global | Biotic |
| A4NH/LIVESTO CK /ILRI, IFPRI | FAO, World Bank, OIE, AU-IBAR, Royal Veterinary College, Tufts University | Highly pathogenic avian influenza | Risk mapping, surveillance, prevention, response strategies | Poultry | South East Asia, Africa | Biotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| LIVESTOCK/ILRI | FAO PAAT, IAEA, CIRDES, Free University-Berlin | Trypanocidal resistance | Diagnosis, surveillance, control strategies | Cattle, small ruminants | Africa | Biotic |
| A4NH/LIVESTOCK/ FISH/ILRI, WorldFish | Royal Veterinary College, Hanoi University Public Health, LSHTM (UK), ICAR (India), SUA (Tanzania), KEMRI (Kenya), PHFI (India) | Antimicrobial resistance | Diagnosis, surveillance, control strategies | Livestock, Fish | Global | Biotic |
| ILRI/Big Data Platform | Farm.ink | Surveillance of animal health and engagement of animal health experts in a social media group with over 30,000 farmers | Farm.Ink | Multi (livestock) | East Africa | Biotic |
| Big Data/CIAT | Viamo | Phone-based surveys on any aspect of agri-food system to any mobile phone in the world/ interactive content related to farming recommendations or market system participation | Interactive voice response engagement directly with producers and agri-food system actors on crop health recommendations/ rapid phone-based surveys to any mobile phone in the world | Multi | Global | Biotic/abiotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| Big Data/CIAT | Digital Globe | High resolution commercial satellite imagery made available for monitoring, surveillance, modeling and foresight analysis | High resolution commercial satellite imagery made available for modeling and foresight analysis | Multi | Global | Biotic/abiotic |
| Big Data/IFPRI | Amazon Web Services | Virtual Private Cloud for common analytic environment for open CGIAR data and increasingly public and commercial imagery, applicable to modeling and foresight analyses | Cloud –based data search, discovery and dissemination bridging all open CGIAR repositories plus the ability to integrate commercial and public imagery for analysis | Multi | Global | Biotic/abiotic |
| IRRI | Intertek, NARS | Field diagnostics of pathogen "races" using SNP markers | Monitoring, IPM, contribute/provide improved variety | Rice | Global | Biotic |
| IRRI | PhilRice | PRiSM: awareness of disease affected areas and yield loss | Strategy, Advisory, Monitoring | Rice | Philippines | Biotic |
| IRRI | | Rice Weed identification and management | Monitoring, IPM | Rice | Asia | Biotic |
| IRRI | TARI, CABI, others | Catalog of natural pest enemies | Strategy, Advisory | Rice, others | Asia | Biotic |

| Center | Key partners (non-CGIAR, CGIAR) | Response | Product or Service | Crop(s) | Affected Region | Type |
|---|---|---|---|---|---|---|
| IRRI | NARS | Pathotracer: decision support system for breeders | Strategy, Advisory, contribute/provide improved variety | Rice | Asia | Biotic |
| IRRI | | Rice Doctor: a virtual diagnostic tool for farmers | IPM | Rice | Global | Biotic |