Version: 12 September 2018

3-Year System Business Plan Companion Document:
Rapid-response preparedness to newly emerging pests and diseases, and crises: What the CGIAR can deliver quickly

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

Document Status: Draft strategy for input by the System Council during SC7

Request to SMB: For exploration and discussion on scope, gaps or other issues to address

---

Purpose

1. The CGIAR has been involved in developing rapid responses with other global players to agricultural and humanitarian crises based on the system's existing scientific strengths and resources. 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 the CGIAR. This recognizes that surveillance and adequate responses to a larger number of threats and diseases may be required from the 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. The CGIAR has provided rapid responses to international efforts in two 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); and

b. research or convening of a research response to a new disease or pest threat to developing countries, for which the CGIAR has something uniquely to offer. To be effective, the CGIAR requires to be abreast of the emerging challenges, to gauge their severity, analyze potential responses which the 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.

4. Maintenance breeding against pests and diseases is a routine part of the CGIAR's crop breeding program strategies. However, the 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 the 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 industries, some of which the 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 the 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 the 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 ▪ Relevant long-term, multi-crop, multi-regional knowledge and experience, in both historical and future-predictive perspectives ▪ Centers and their networks cover major food & feed crops for nutritional and food security ▪ Respected convener role	**Opportunities** ▪ Better learning, know-how sharing, applied research on decision-making and communications approaches, processes, tools ▪ Greater cross-crop/disease/agro-ecological zone scientific collaboration: Innovation in R4D design & delivery ▪ Develop comprehensive sets of products & services along preparedness-to-rapid response pathway
Weaknesses ▪ Moving and connecting people across Centers when needed (e.g. rapid response) ▪ CGIAR scientists' knowledge base fragmented, too few experts, at times not well connected, organizational memory / reinvent the wheel ▪ CGIAR administrative services designed for conventional research, constrains rapid deployment	**Threats** ▪ Climate change drives new, emerging and more ferocious pests and disease outbreaks ▪ New, non-traditional players offer detection and monitoring and solutions ▪ Some big advanced research institutes push internationalization

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, 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) strategies**

a. Rapid diagnostic tools and scouting for early warning at different levels and scales (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, (e.g. comprehensive approach to introducing pest-specific natural enemies);
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.

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.

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

10. Lessons learnt (examples for germplasm)

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 fore-sighting 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.

11. Proposed Next Steps

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

b. SMB to assess and develop strategic decision making and prioritization routines (see Annex 1 for considerations).

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

Annex I

Suggested steps in the consideration by the SMB of potential topics warranting a CGIAR rapid response

1. SMB 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 the CGIAR.

2. Agreement on criteria for engagement - generally covering two areas of activity:
    a. support 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 for which the CGIAR has something uniquely to offer.

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

    a. Should understand that if the threat is large / continental / global, we must expect to be working through consortia of actors.
    b. 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.
    c. To enhance a CGIAR voice and coordination of activities, SMB should identify a lead Center to be spokesperson and/or key actor for the CGIAR (and will expect them to make regular updates as per above).
    d. 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.
    e. 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.

f. 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.
g. A communications plan should be part and parcel of the planned response. SMO 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.
h. 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	Response	Product or Service	Crop(s)	Affected Region	Type
Bioversity, IITA	Banana Fusarium Tropical Race 4	contribute/provide improved variety	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
CIAT	Cassava whitefly project		cassava	Global	Biotic
CIAT	Virtual portal to communicate emerging cassava phytosanitary constraints in Asia, Americas	Platform, Advisory	cassava	Global	Biotic

Center	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	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

Center	Response	Product or Service	Crop(s)	Affected Region	Type
CIMMYT	Disease resistance screening in hot spots (rusts, leaf diseases, wheat blast, insects)	contribute/provide improved variety	wheat	Global	Biotic
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		Multi	Rwanda, Burundi,	Biotic

Center	Response	Product or Service	Crop(s)	Affected Region	Type
	emerging pests and diseases			Uganda, DRC	
GLDC (ICRISAT and IITA), CIMMYT	Fall armyworm	IPM, contribute/provide 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
GLDC/ICRISAT	Maruca vitrata (pod borer) in Pigeonpea		pigeonpea	South Asia	Biotic
GLDC/ICRISAT	Sorghum shoot fly-increasing trend		sorghum	South Asia	Biotic
GLDC/IITA	emerging foliage thrips on cowpea (Hydatothrips adolfifriderici)		cowpea	SSA Sub Saharan Africa	Biotic
GLDC/IITA	Soybean rust	contribute/provide improved variety	soybean	Africa	Biotic
GLDC/IITA, icipe	Emerging root knot nematode species on various crops		multi	SSA Sub Saharan Africa	Biotic
IITA	Integrated response to	Strategy, Advisory	Multi	Africa	Biotic

Center	Response	Product or Service	Crop(s)	Affected Region	Type
	aflatoxin outbreaks				
IITA	Epidemiology of yam nematode	contribute/provide improved variety	potato	Nigeria	Biotic
IITA, Bioversity	Managing BBTV outbreaks		Banana	Africa	Biotic
IITA, Bioversity	Surveillance, epidemiology and control of Xanthomonas Wilt	Monitoring	Banana	East Africa	Biotic
IITA, Bioversity	Surveillance, epidemiology and control of Pratylenchus lesion nematodes	Monitoring	Banana	East Africa	Biotic
IITA, Bioversity, CIP, CIAT	RTB disease and pest damage surveillance with AI smartphone app	Monitoring	Multi	Global	Biotic
IITA, CIAT	Cassava disease surveillance platform; brown streak disease surveillance; Cassava Mosaic Disease (CMD) taskforce;	Monitoring, Platform, Advisory, Strategy	cassava	Africa, South East Asia, ECA (East Central Africa),	Biotic

Center	Response	Product or Service	Crop(s)	Affected Region	Type
	pandemic mitigation				
IITA, *icipe*	Emerging root knot nematode species on various crops		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	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	Response	Product or Service	Crop(s)	Affected Region	Type
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
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

Center	Response	Product or Service	Crop(s)	Affected Region	Type
CGIAR	Risk management	Advisory, Management	NA	CGIAR center strategies	Institutional
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

Center	Response	Product or Service	Crop(s)	Affected Region	Type
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
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

Center	Response	Product or Service	Crop(s)	Affected Region	Type
CIP	Emergency potato and sweetpotato seed support	seed distribution	sweetpotato	Ethiopia	Seed
CGIAR	Seeds of Hope		Multi	Rwanda	Social disaster
CIAT, IITA, CRS	Agricultural innovations		Multi	Global	Technologies
LIVESTOCK/ILRI, genebank	Napier stunt and smut	contribute/provide improved variety	Napier	East Africa	Biotic
LIVESTOCK/ILRI, CIAT	Brachiaria spittlebug	contribute/provide improved variety	Brachiaria	Asia	Biotic
A4NH/ILRI	Rift Valley fever	Risk mapping, response decision making framework; genotyping	Cattle, small ruminants	East Africa	Biotic
FISH/LIVESTOCK/ WorldFish, ILRI	'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

Center	Response	Product or Service	Crop(s)	Affected Region	Type
A4NH/ILRI	Emerging zoonotic disease	Risk mapping, surveillance and prevention strategies	Livestock and poultry	Global	Biotic
A4NH/LIVESTOCK /ILRI, IFPRI	Highly pathogenic avian influenza	Risk mapping, surveillance, prevention, response strategies	Poultry	South East Asia, Africa	Biotic
LIVESTOCK/ILRI	Trypanocidal resistance	Diagnosis, surveillance, control strategies	Cattle, small ruminants	Africa	Biotic
A4NH/LIVESTOCK/ FISH/ILRI, WorldFish	Antimicrobial resistance	Diagnosis, surveillance, control strategies	Livestock, Fish	Global	Biotic