BecA-CSIRO aflatoxin project:

Capacity and Action for Aflatoxin Reduction in Eastern Africa (CAAREA)

biosciences eastern and central africa

CSIRO

Australian AID

ILRI INTERNATIONAL LIVESTOCK RESEARCH INSTITUTE

KARI

HarvestChoice Better Choices, Better Lives

Queensland Government Department of Employment, Economic Development and Innovation

The University Of Queensland Australia

Queensland Alliance for Agriculture & Food Innovation

University of Minnesota

CAAREA Phase II Objectives

Focus: aflatoxin in preharvest maize in Kenya and Tanzania.
Considered ongoing projects for synergy and impact.

1. Establish aflatoxin diagnostics platform at BecA-ILRI
2. Characterize maize fungi from around Kenya and Tanzania
3. Screen maize germplasm for resistance
4. Test modelling as a potential predictive tool and use to contextualize findings regionally (risk map)
5. National breeders will affect subsequent changes to maize breeding programs in Kenya and Tanzania
6. Capacity building

Phase II output highlights

biosciences eastern and central africa

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Aflatoxin/nutritional analysis capacity lacking in East Africa

Comprehensive labs lacking for research and capacity building.

Regulator lab capacity limited and long delays to results.

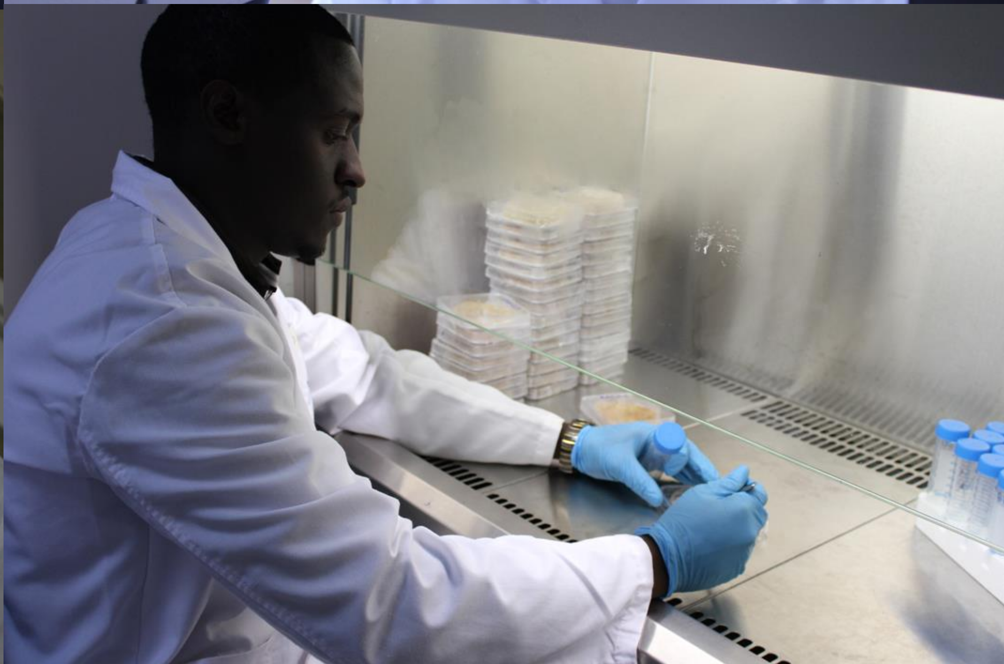
Private sector labs emerging, but limited capacity and expensive.

Lack of reference labs for the community.

2009-mid 2011
BecA aflatoxin team/lab bench

Aug-Nov 2011
Univ of Nairobi (Okoth lab)

BecA-ILRI Hub mycotoxin platform



Mycotoxin-nutritional analysis platform

Diagnostics development

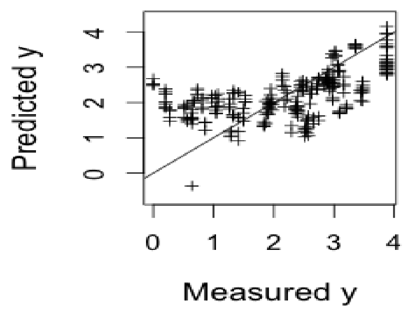
Gold standard diagnostics established and validated (at BecA and in Australia).

New diagnostics suited to African context under development:

- Electronic nose: AusAID PhD student from 2014
- NIR: calibration development (within samples)

Sampling protocols under development.

KEY INSIGHT: Single kernel screening potential, key intervention for impact at mills. Blending for diagnostics is wrong!



Modeling: risk mapping and prediction

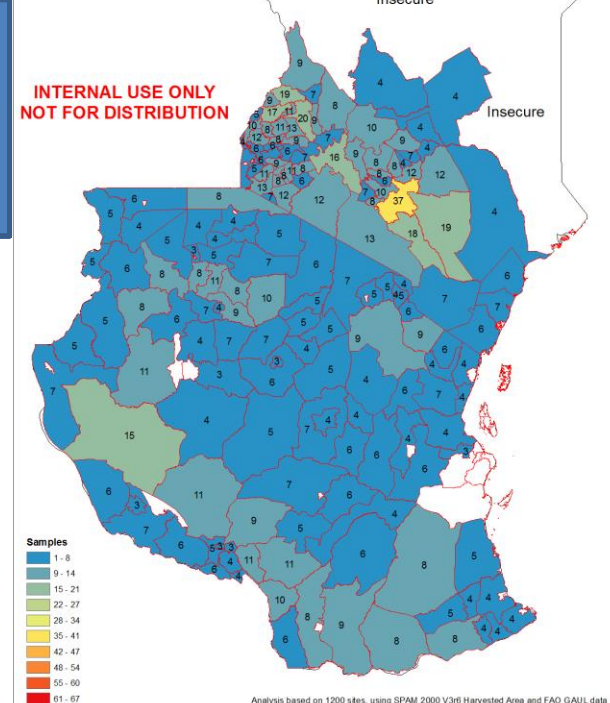
Component 1: risk mapping, GxE(xM) analysis

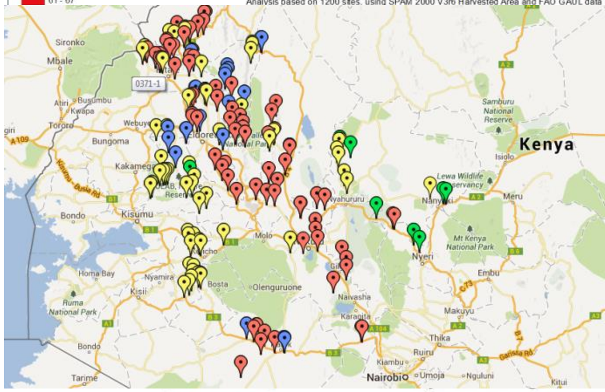
Survey team/tools finalized.

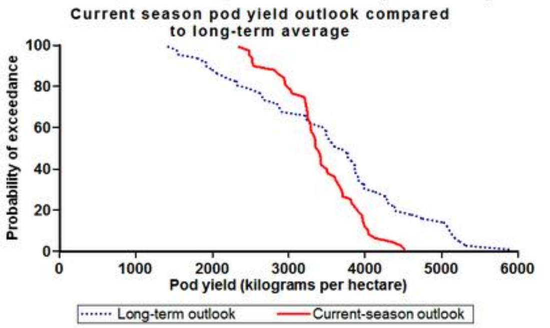
Ongoing on farm survey to generate risk maps and other tools.

Component 2: APSIM modeling

First APSIM model developed for aflatoxin in maize – accurate in field trial prediction.







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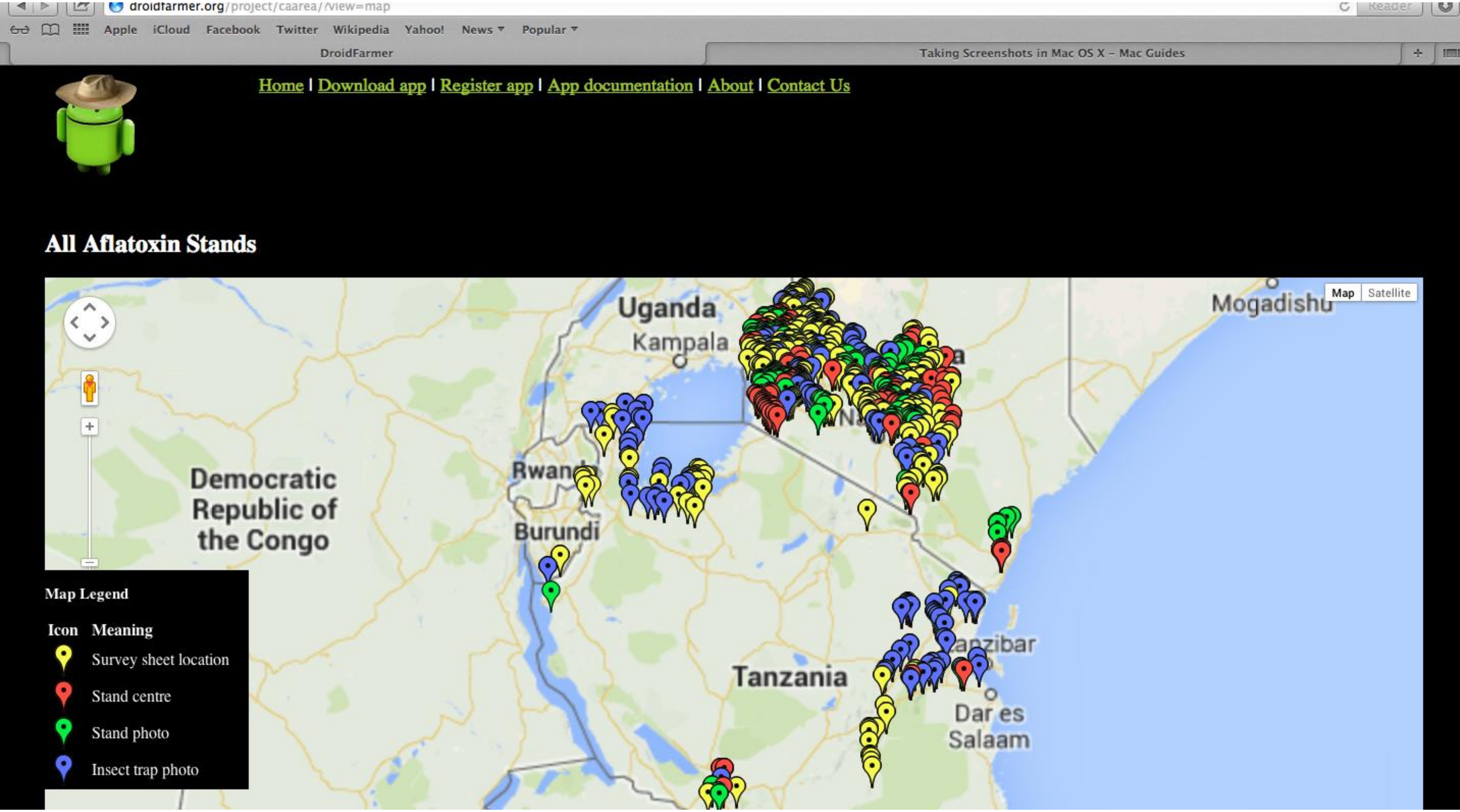


Inoculated Field Trials

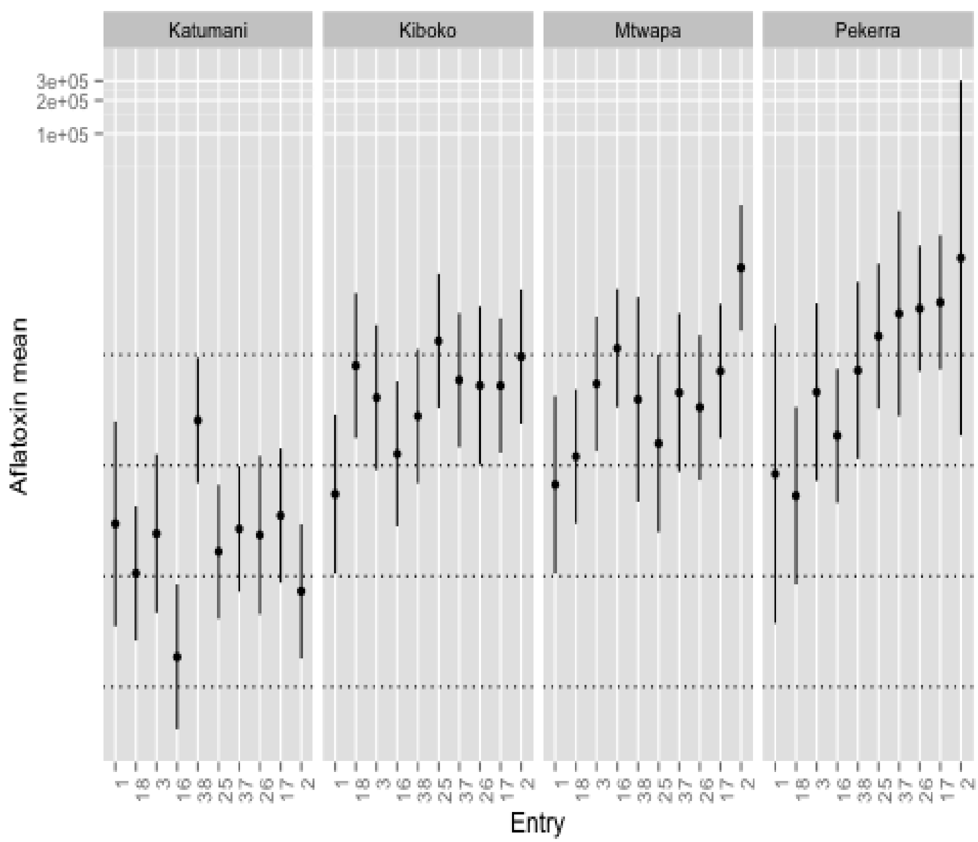
Led by KARI and ARI.

Team, design and regulatory approvals.

Fungal survey, inoculum production, NARI capacity and teamwork.

First inoculated aflatoxin field trials in the region (KARI and ARI).

Significance between genotypes (analysis ongoing) → BREEDING.



Capacity building

Capacity building

Institutional capacity:

BecA-ILRI Hub platform

NARI capacity and international linkages

Human capacity:

Team/network

BecA team expertise

Graduate students: 4 MSc, 4 PhD (3 AusAID scholarships)

ARI and KARI teams

6 ABCFs hosted

Regional capacity:

Platform used by 10 institutions (aside from CAAREA) with >12 more coming/in discussion. Includes Nutrition PhD program.

Established accepted lab design (milling) for aflatoxin work in Kenya.

Linked with PACA for use on priority issues – ABCF nominations.

Next phase

An integrated, multi-technology strategy for reducing aflatoxin risk and addressing contaminated maize is at the heart of phase III:

Effectively addressing aflatoxin will require the context-specific, tuned set of interventions to:

1) reduce the risk of aflatoxin accumulation in the first place, on farm (pre- and post-harvest).

2) conduct surveillance and use other means (eg, APSIM) to predict emerging high risk geographical areas as the growing season progresses

3) target interventions to test and remove/decontaminate aflatoxin-containing maize (above the legal limit) from maize on farms and at mills.

Move current activities and outputs to impact

Activities:

1) Establish a vehicle to address aflatoxin contamination across the food chain
2) Enhance and expand use of the BecA-ILRI Hub platform
3) Support the development of node labs (NARI, Uni, private sector; Kenya, Tanzania, Ethiopia)
4) Validate and deploy mobile diagnostics
5) Validate and pilot interventions for contaminated grain (sorting, decontamination)
6) Finalize risk mapping and advance APSIM model (pathosystem research)
7) Validate integrated sets of aflatoxin intervention measures on farm, at storage and in mills
8) Capacity building

Move current activities and outputs to impact

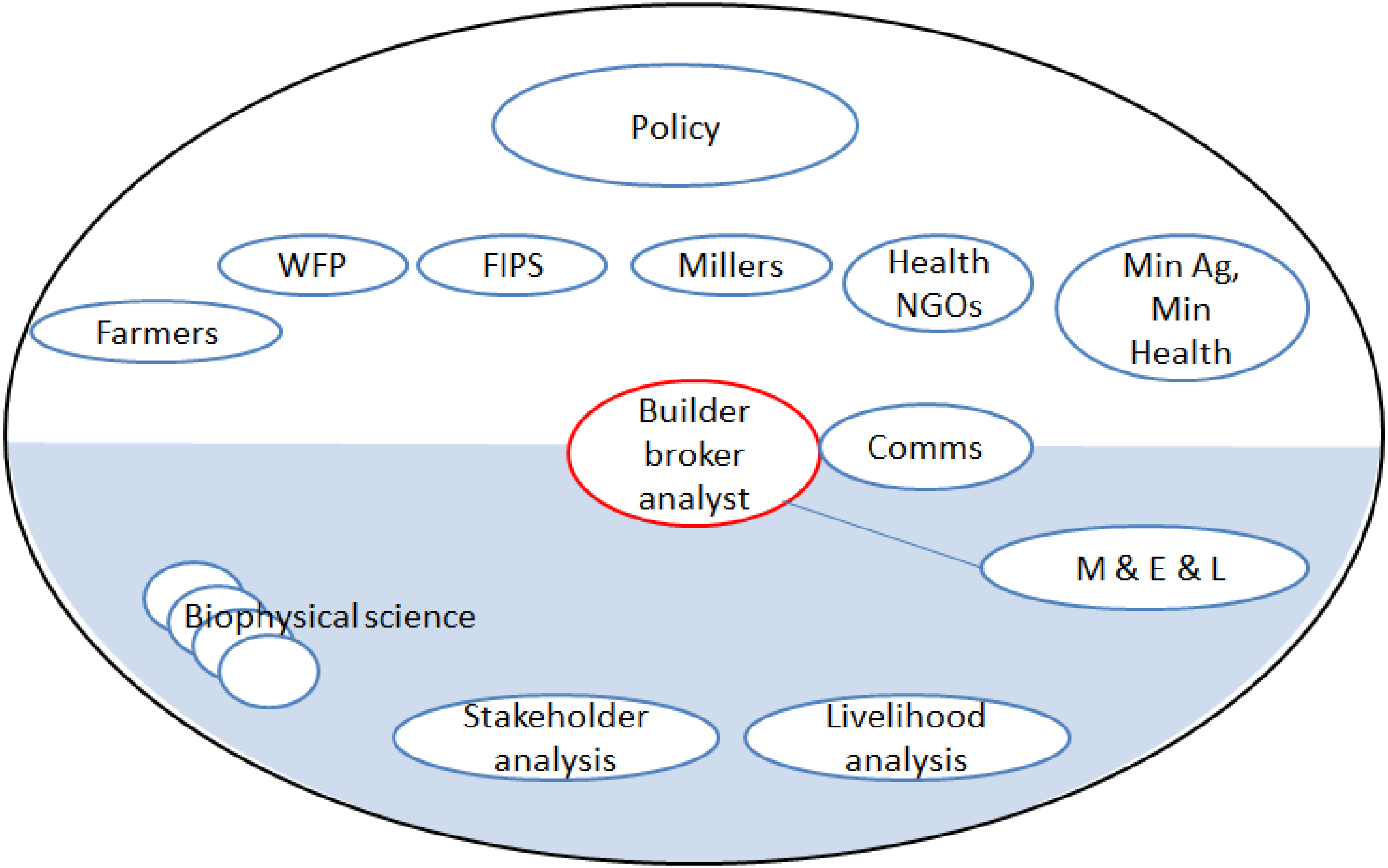
Next phase intervention levels:

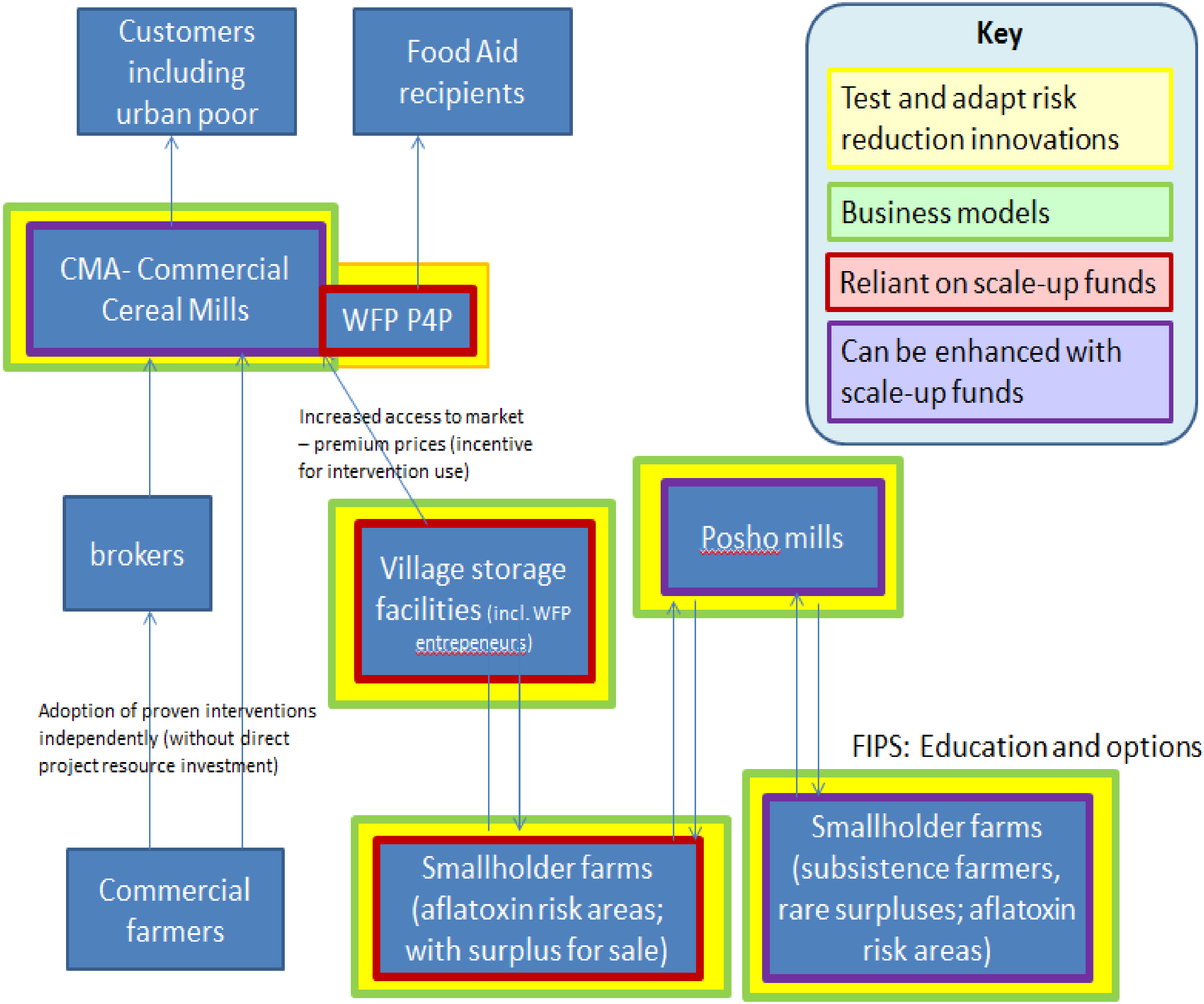
1) **Reduce risk as much as possible on farm (varieties, management)**

2) **Surveillance to identify emerging hotspots (APSIM, mobile/networked diagnostics)**

3) **Targeting interventions as issues emerge (testing, decontamination, alternative uses)**

4) **R4D alliance – enabling environment, vehicle addressing the problem. COLLABORATIONS FOR INTERVENTION PILOTING**


Policy
WFP
FIPS
Millers
Health NGOs
Min Ag, Min Health
Farmers
Builder broker analyst
Comms
M & E & L
Biophysical science
Stakeholder analysis
Livelihood analysis


Customers including urban poor
Food Aid recipients
Key
Test and adapt risk reduction innovations
Business models
Reliant on scale-up funds
Can be enhanced with scale-up funds
CMA- Commercial Cereal Mills
WFP P4P
Increased access to market – premium prices (incentive for intervention use)
brokers
Village storage facilities (incl. WFP entrepeneurs)
Posho mills
Adoption of proven interventions independently (without direct project resource investment)
FIPS: Education and options
Commercial farmers
Smallholder farms (aflatoxin risk areas; with surplus for sale)
Smallholder farms (subsistence farmers, rare surpluses; aflatoxin risk areas)

Integrated system for aflatoxin reduction

Appropriate varieties and management

Drying and storage

Selling/processing

Varieties matched to environments
Management practices
Integration of best practices and interventions

In season surveillance:
-APSIM model, track emerging risk areas
-mobile diagnostics

Contaminated grain:
-mobile diagnostics
-kernel sorting
-decontamination (traditional or advanced-mobile)

Integration of others' technologies – **collaboration** (eg, drying, storage systems,…)

Next phase

- Vehicle/Innovation platform
- Policy – PACA
- Biophysical sciences:
  - Mycotoxin/nut analysis platform – novel diagnostics *(hosting)*
  - Mycotoxin analysis along the value chains
  - Sampling/analytics platform
  - Pathosystem-fungal diversity (ABCFs,…)
  - Breeding
  - Decontamination
  - sorting
  - Mobile testing and decontamination
- Piloting interventions
  - Subsistence farmers (FIPS)
  - Commercial mills (CMA)
  - (potential) WFP

Estimated impact

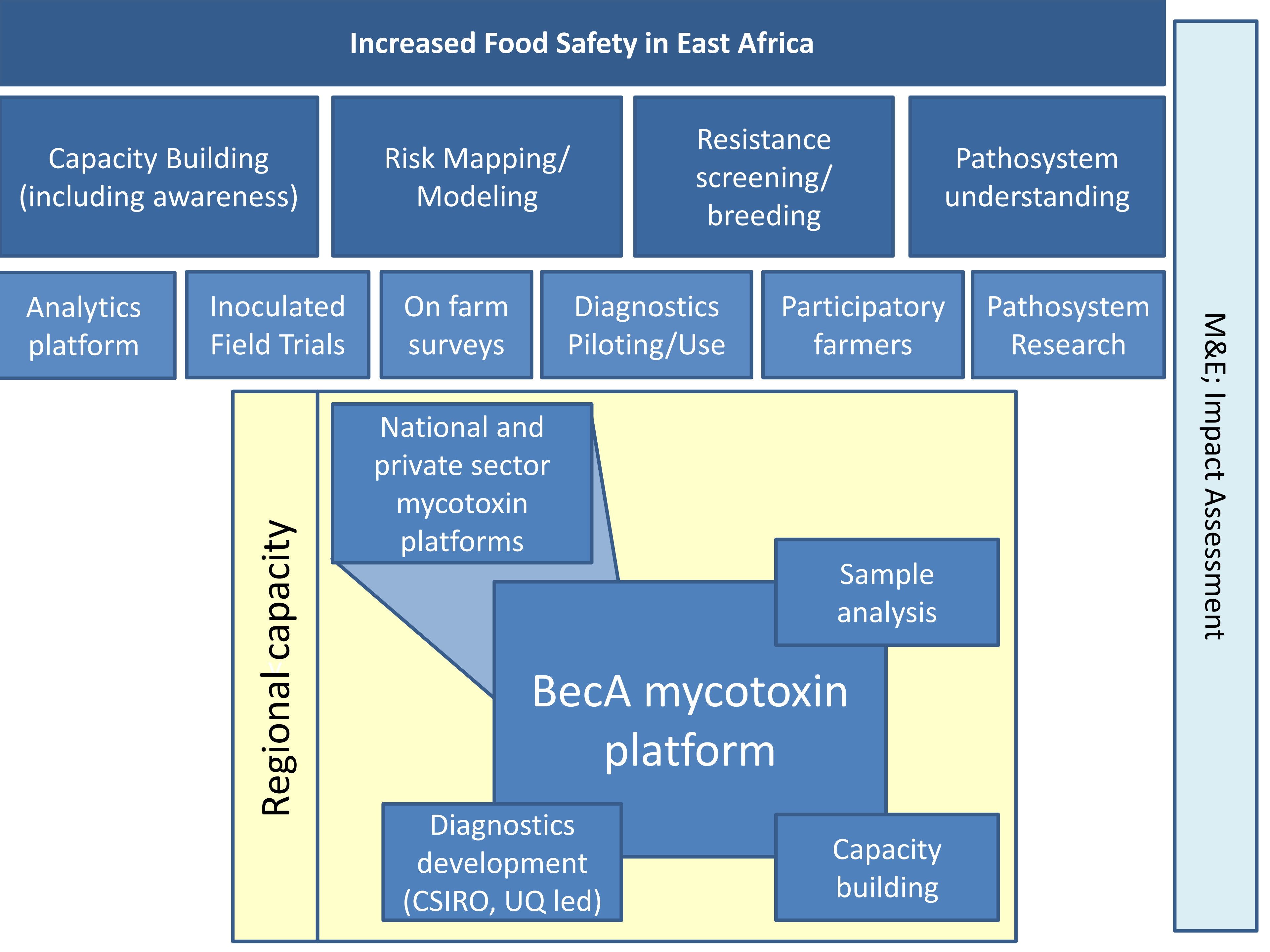
Uptake of improved varieties, Kenya & Tanzania: 10.6 million

Kenya Cereal Millers Association – sampling/diagnostics: 10 million

Additional pathways to impact:

World Food Program

FIPS Pilot with ~100,000 people, scalable to their 1 million farmers (Kenya and Tanzania)


Increased Food Safety in East Africa
Capacity Building (including awareness)
Risk Mapping/ Modeling
Resistance screening/ breeding
Pathosystem understanding
Analytics platform
Inoculated Field Trials
On farm surveys
Diagnostics Piloting/Use
Participatory farmers
Pathosystem Research
Regional capacity
National and private sector mycotoxin platforms
Sample analysis
BecA mycotoxin platform
Diagnostics development (CSIRO, UQ led)
Capacity building
M&E; Impact Assessment

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<u>Project team:</u>

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QDAFF/BecA-ILRI Hub: Warwick Turner

KARI: James Karanja (national maize breeder), Anne Gichangi (socioeconomist) and teams

ARI: Arnold Mushongi (national maize breeder) and team

Ministry of Agriculture: Deogratias Lwezaura (agricultural economist) and team

Open University of Tanzania: Said Massomo (plant pathologist)

CSIRO: Ross Darnell (biometrician); Nai Tran-Dinh (mycologist); Stephen Trowell and Amalia Berna (biosensor technology)

CSIRO/HarvestChoice: Darren Kriticos (ecological modeller; risk mapping leader)

Univ. Queensland/QAAFI: Mary Fletcher (natural product organic chemist), Glen Fox (NIR, cereal chemist), Loraine Watson (lab management)

QDAFF: Yash Chauhan (APSIM modelling)

Cornell University: Rebecca Nelson (molecular plant pathologist) and Michael Milgroom (fungal population biologist)

HarvestChoice/Univ. Minnesota: Phil Pardey and Jason Beddow

University of Pretoria/HarvestChoice: Frikkie Liebenberg

Thank you

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The Open University of Tanzania — Quality Education for All

HarvestChoice Better Choices, Better Lives

Queensland Government Department of Employment, Economic Development and Innovation

The University of Queensland Australia — Queensland Alliance for Agriculture & Food Innovation

Cornell University

University of Minnesota

Phase III – Policy Engagement

Diagnostics and sampling protocols
With testing capacity, what are actions/options for contaminated maize?

Breeding
With screening capability/information, what are regulations for susceptibility/resistance in commercial varieties?

Risk mapping
Interactive decision making tools to model cost and impact of interventions.

Estimated impact

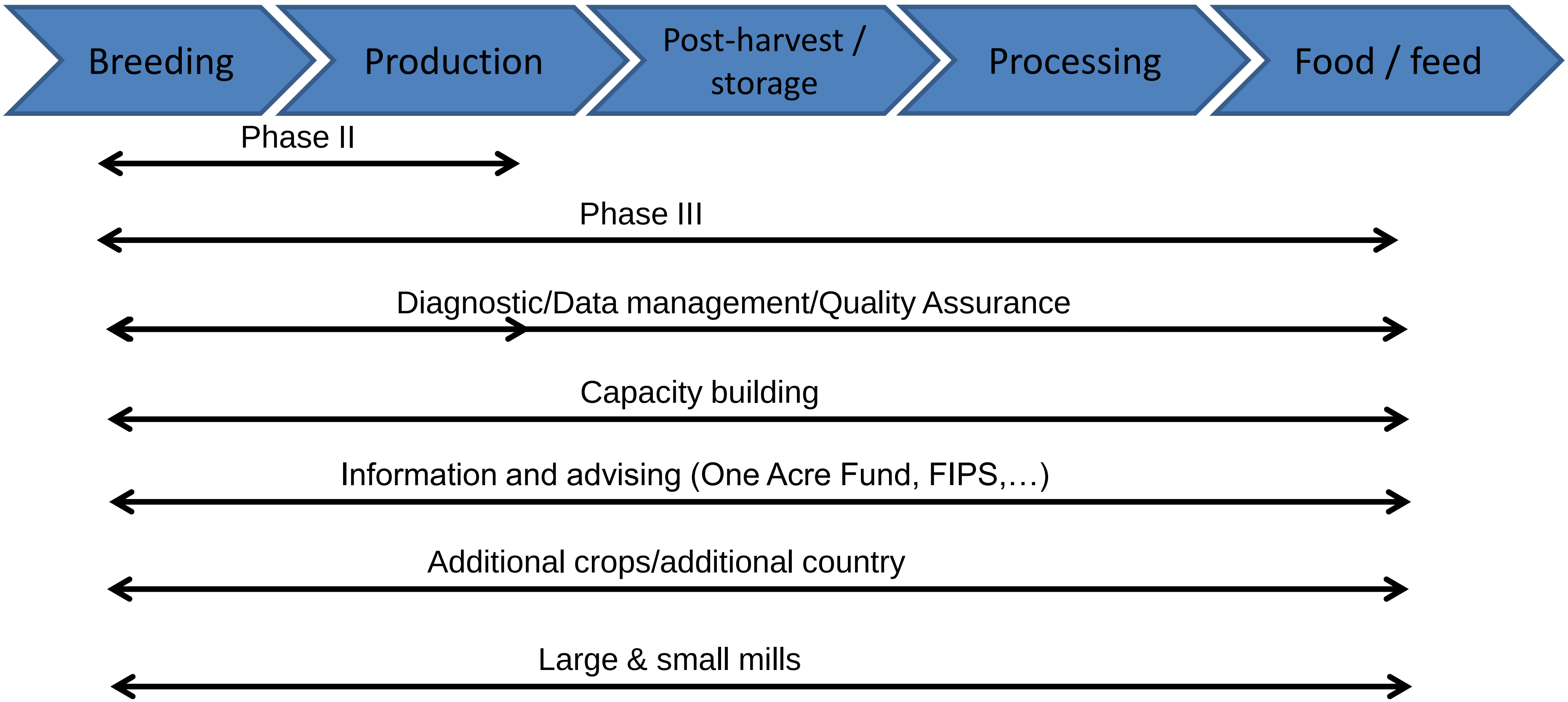
Uptake of improved varieties, Kenya & Tanzania: 10.6 million

Kenya Cereal Millers Association – diagnostics: $\leq$10 million

Extension work with subsistence farmers 175,000 ppl

Estimated direct impact (phase III): ~20 million people

Aflatoxin value-chain



Food chain analysis for strategic targeting of interventions

Varieties – risk mapping - diagnostics