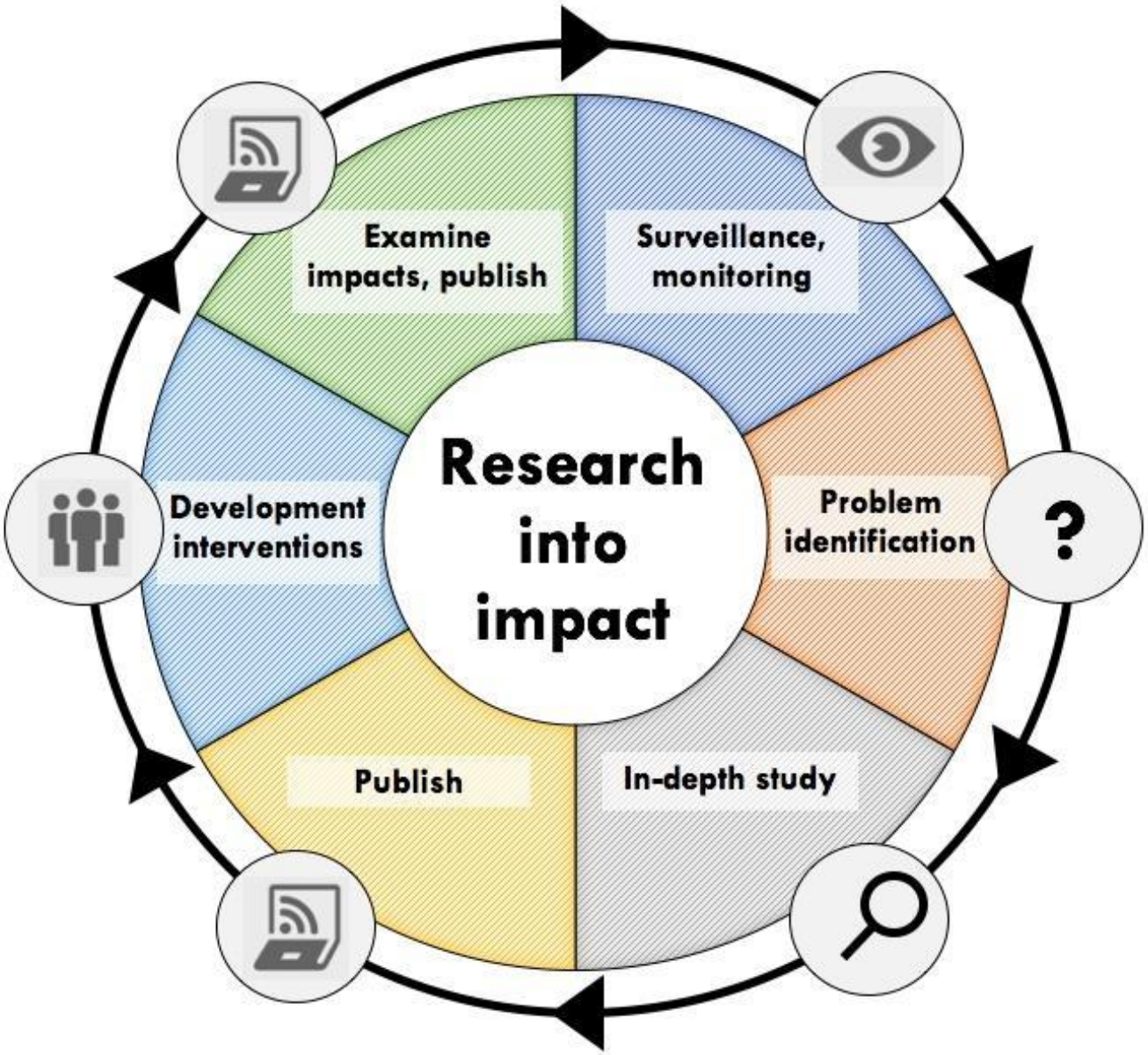
Building a Laos – CIMMYT Partnership:

Overview of global research programs, opportunities, and confronting Fall Armyworm

Timothy J. Krupnik, Brendan Brown, Horst Weyerhaeuser, Prasanna Boddupalli
… and many, many colleagues …

CIMMYT

CGIAR


Research into impact
Examine impacts, publish
Surveillance, monitoring
Problem identification
In-depth study
Publish
Development interventions
?

CIMMYT is a member of the CGIAR

- One of 15 independent, international, non-profit agricultural research organizations that make up the CGIAR.
- The CGIAR home to almost 10,000 scientists, technicians and staff working with national partners and development organizations for a food-secure future.

CGIAR

Centers

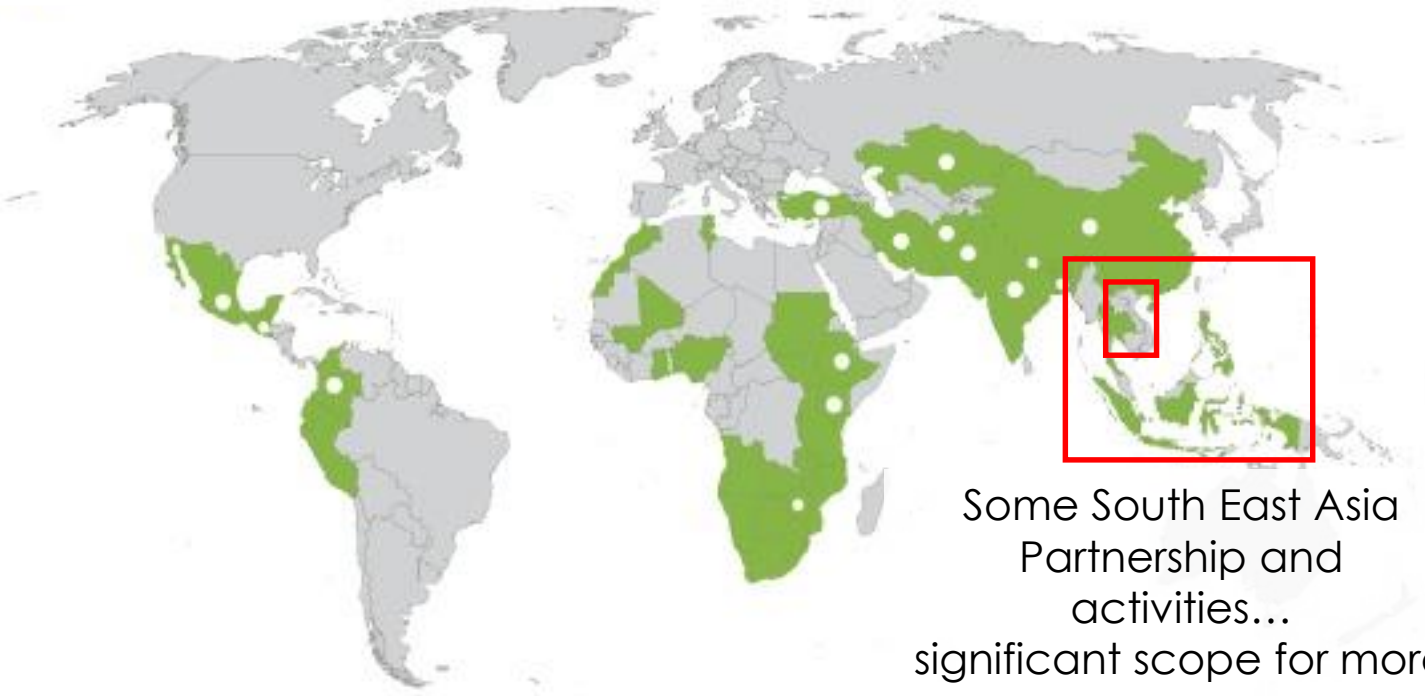
1. AfricaRice
2. Bioversity International
3. Center for International Forestry Research (CIFOR)
4. International Center for Agricultural Research in the Dry Areas (ICARDA)
5. International Center for Tropical Agriculture (CIAT)
6. International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
7. International Food Policy Research Institute (IFPRI)
8. International Institute of Tropical Agriculture (IITA)
9. International Livestock Research Institute (ILRI)
10. **International Maize and Wheat Improvement Center (CIMMYT)**
11. International Potato Center (CIP)
12. International Rice Research Institute (IRRI)
13. International Water Management Institute (IWMI)
14. World Agroforestry Center (ICRAF)
15. WorldFish

Partnerships around the world

1,580 staff from over 50 countries

Country offices:

- Afghanistan
- Bangladesh
- China
- Colombia
- Ethiopia
- Guatemala
- India
- Iran
- Kazakhstan
- Kenya
- Mexico
- Nepal
- Pakistan
- Turkey
- Zimbabwe



Some South East Asia Partnership and activities…
significant scope for more

Applied research for development projects in > 40 countries globally

- Impact through partnerships
- Scoping in South East Asia:
  - Where and how we can effectively contribute to existing programs and partnerships ?
- Not dominated by production goals alone:
  - Environmental sustainability
  - Biologically diverse & integrated farming systems
  - Social equity and justice
  - Profitable farming systems
  - Livelihood alternatives

Crucial need for viable alternatives that contribute to rural livelihoods while conserving biodiversity

Fall Armyworm Activity

The shaded areas of this map represent countries with new or ongoing Fall Armyworm activity.

Map: CIMMYT, August 2018

CIMMYT's core research programs

Genetic Resources Program

- Gene bank (150K+ ancestral maize genotypes)
- Seed health and distribution
- Biometrics

Maize and Wheat Programs

- Breeding and improved germplasm
- Molecular markers and phenotyping
- Seed systems

Sustainable Intensification Program

- Farming systems agronomy
- Participatory integration of technologies & institutions
- Multi-scale farming systems research
- Partnerships for scaling and impact

Socioeconomics Program

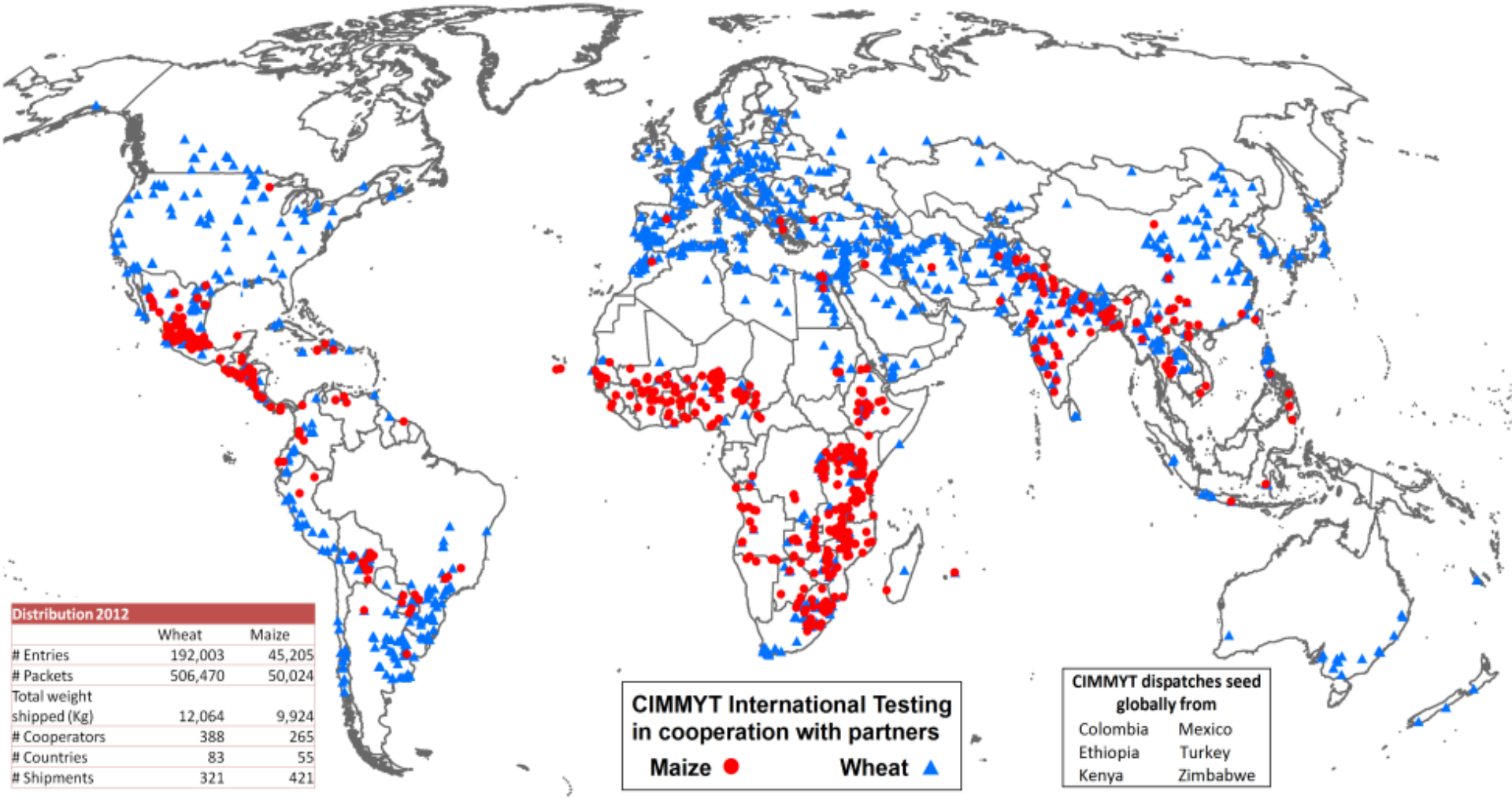
- Foresight and targeting R4D
- Gender and social inclusion
- Value chain analysis
- Impact assessment, innovation systems

Remote sensing and GIS

Big Data Analytics

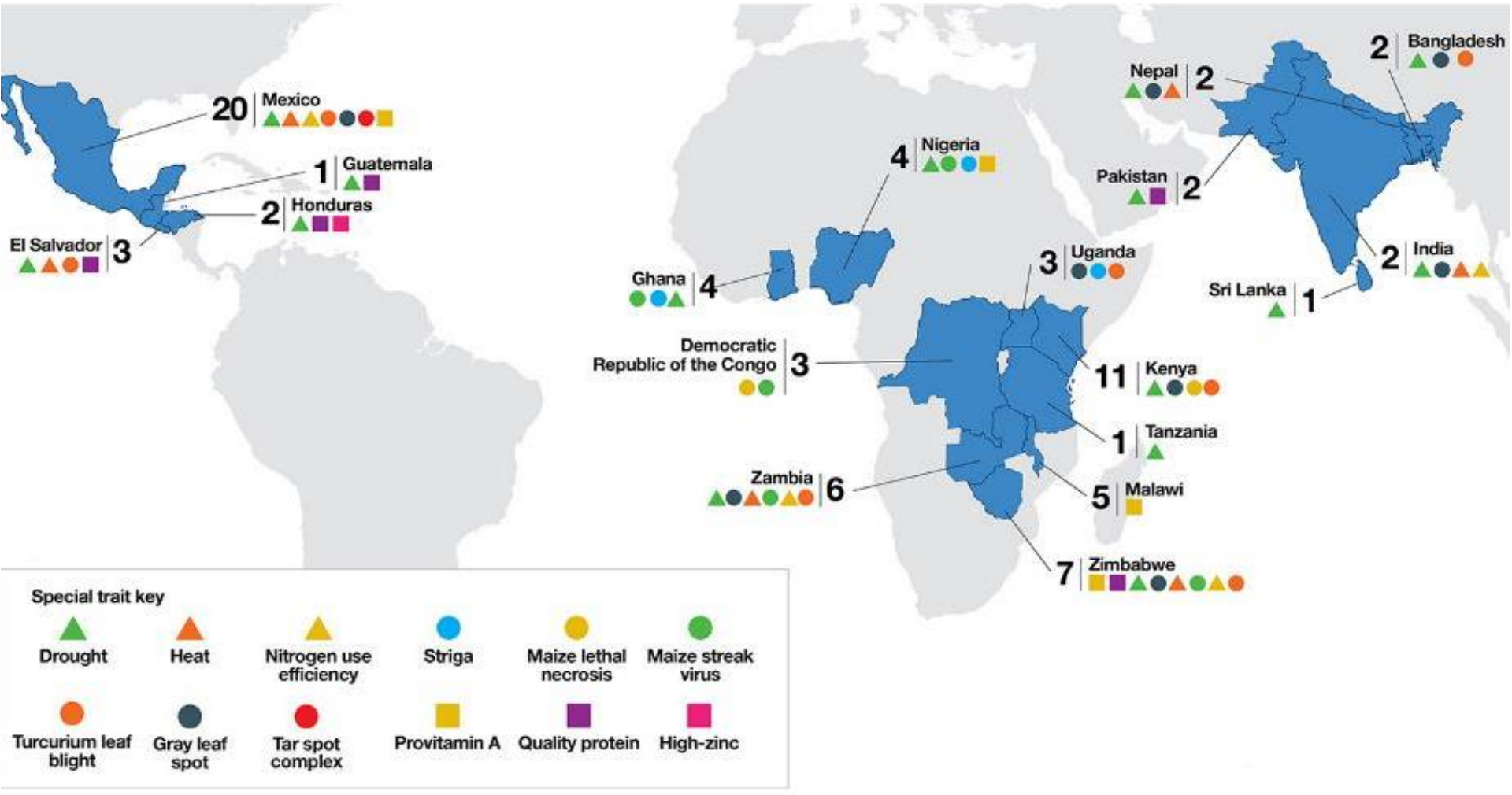
Training and capacity development

Largest public sector breeding program in the world



Distribution 2012	Wheat	Maize
# Entries	192,003	45,205
# Packets	506,470	50,024
Total weight shipped (Kg)	12,064	9,924
# Cooperators	388	265
# Countries	83	55
# Shipments	321	421

Largest public sector breeding program in the world



79 varieties – sub-Saharan Africa: 44 (EA: 18; SA: 18; WA: 8); Latin America: 26; Asia: 9. CIMMYT-derived: 71; IITA-derived: 8

Principles of Sustainable and Ecological Intensification

Yield Increase

Accessible, reduced costs

Reduced resource use

Profitable and inclusive

GHGs

Pollution

Diversity and esilience

Contents lists available at SciVerse ScienceDirect

Agriculture, Ecosystems and Environment

journal homepage: www.elsevier.com/locate/agee

Optimizing intensive cereal-based cropping systems addressing current and future drivers of agricultural change in the northwestern Indo-Gangetic Plains of India

Mahesh K. Gathala[a,e], Virender Kumar[a,b], P.C. Sharma[c], Yashpal S. Saharawat[a,d], H.S. Jat[c], Mainpal Singh[c], Amit Kumar[c], M.L. Jat[b], E. Humphreys[f], D.K. Sharma[c], Sheetal Sharma[a], J.K. Ladha[a,*]

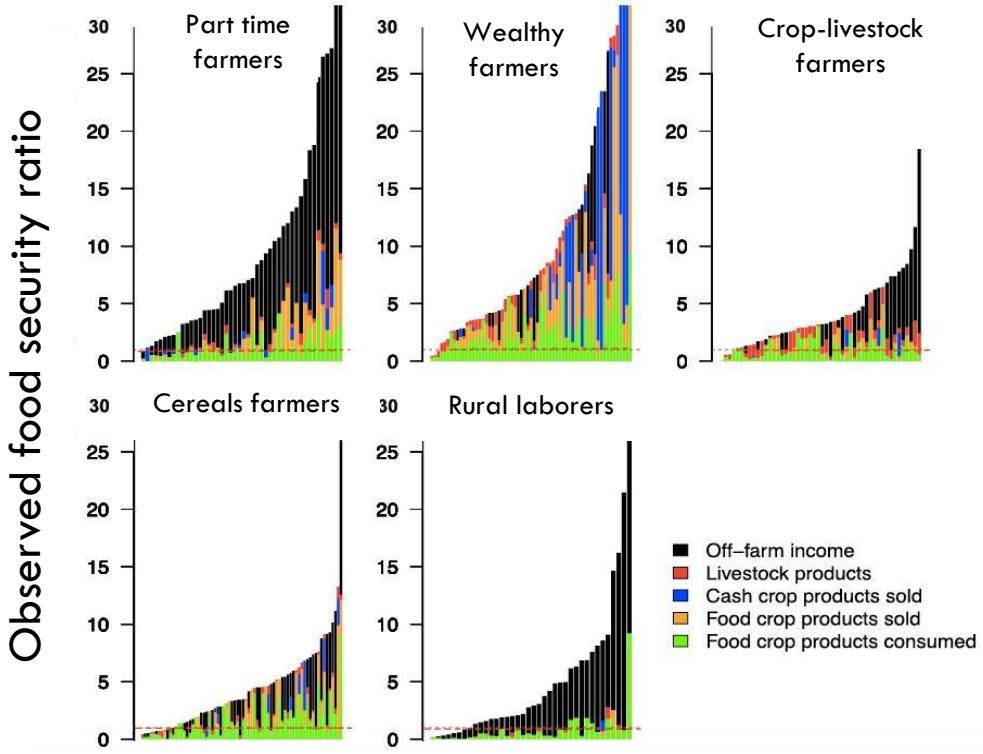
Scale-appropriate farm mechanization

Low intensity, high drudgery → Appropriate mechanization ← High intensity, low efficiency

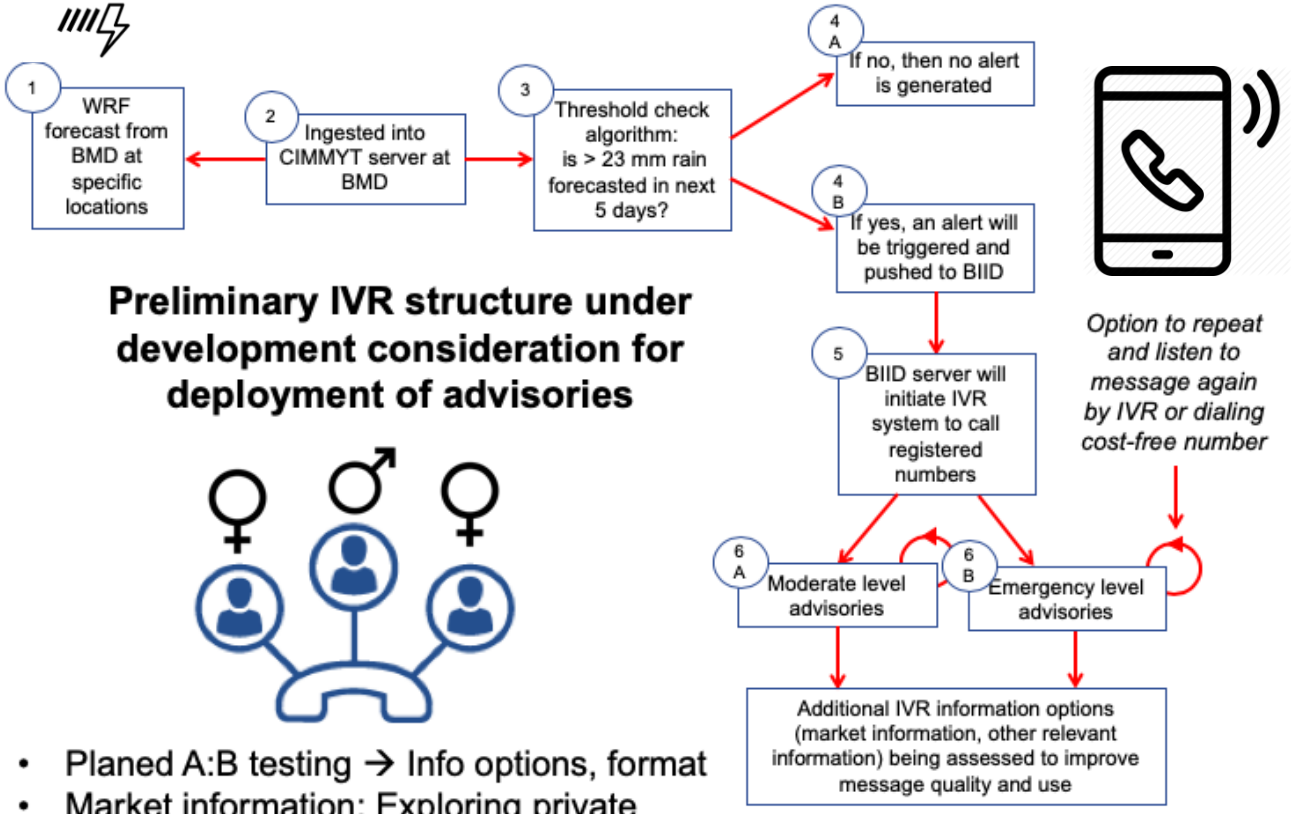
Multi-scale farming systems research and modeling

Ex-ante assessment of food security with climate-smart agriculture



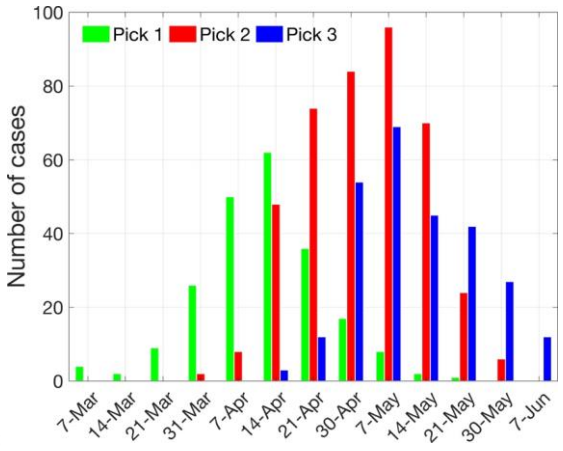


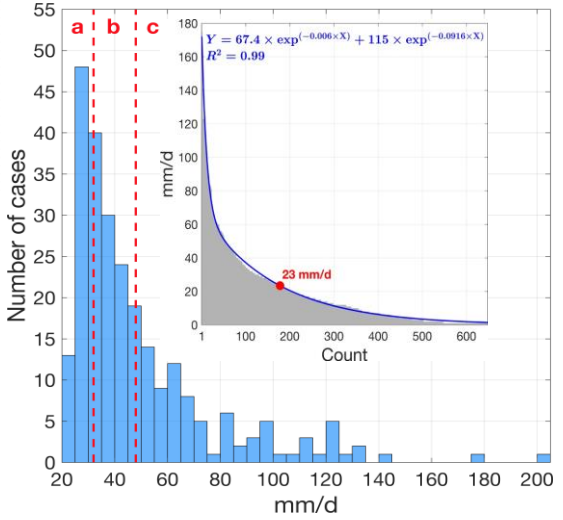
Designing appropriate and demand-driven crop advisory systems



Preliminary IVR structure under development consideration for deployment of advisories

- Planed A:B testing → Info options, format
- Market information: Exploring private sector investment to sustain system post-project





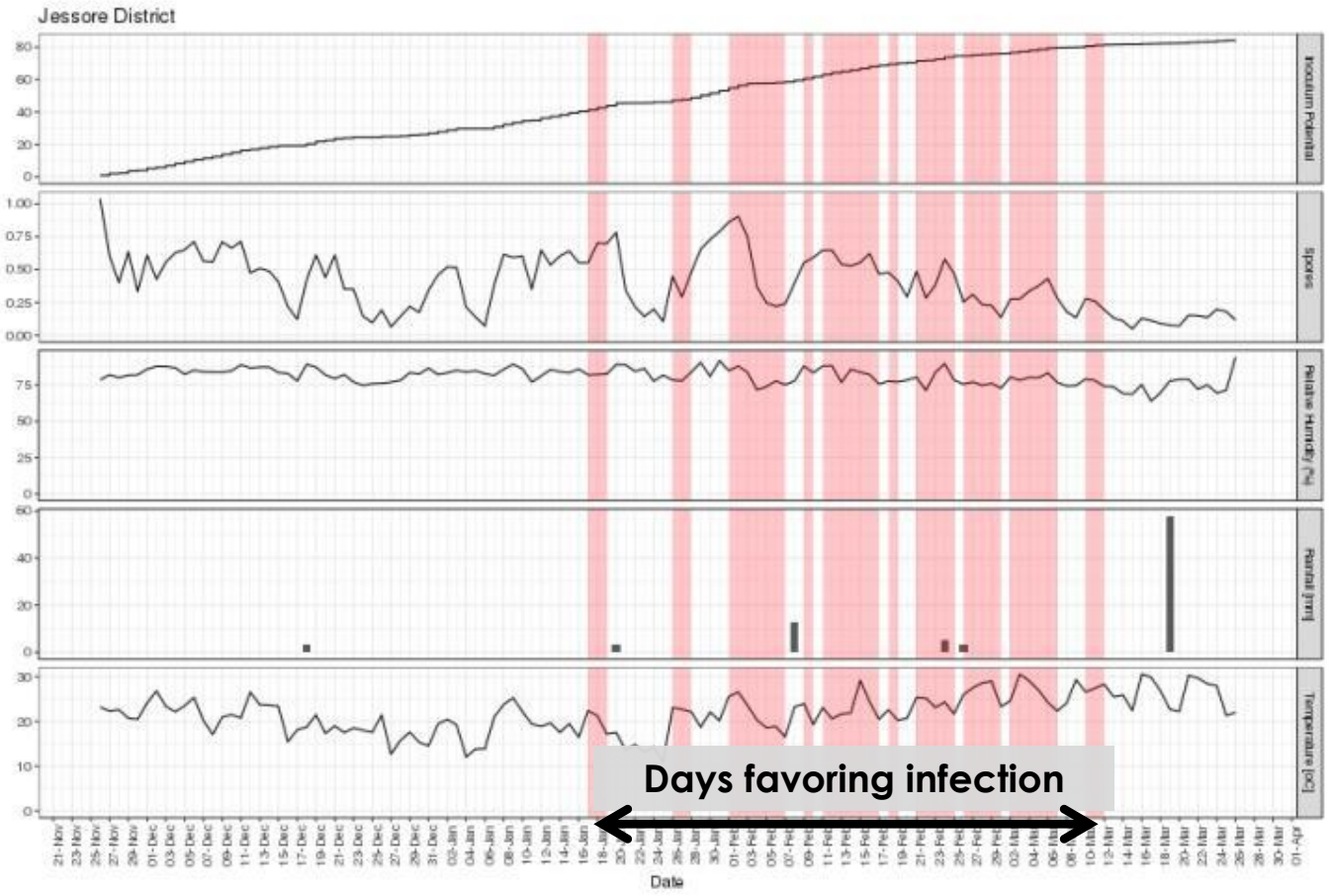
Analysis: C. Montes

Weather forecasting and disease modeling to mitigate wheat blast

Weather based wheat blast outbreak risk early warning + advisory system

Driven by weather forecast models

- Temp. forecast
- Precip. forecast
- RH forecast
- Spore cloud model
- Inoculum build-up model



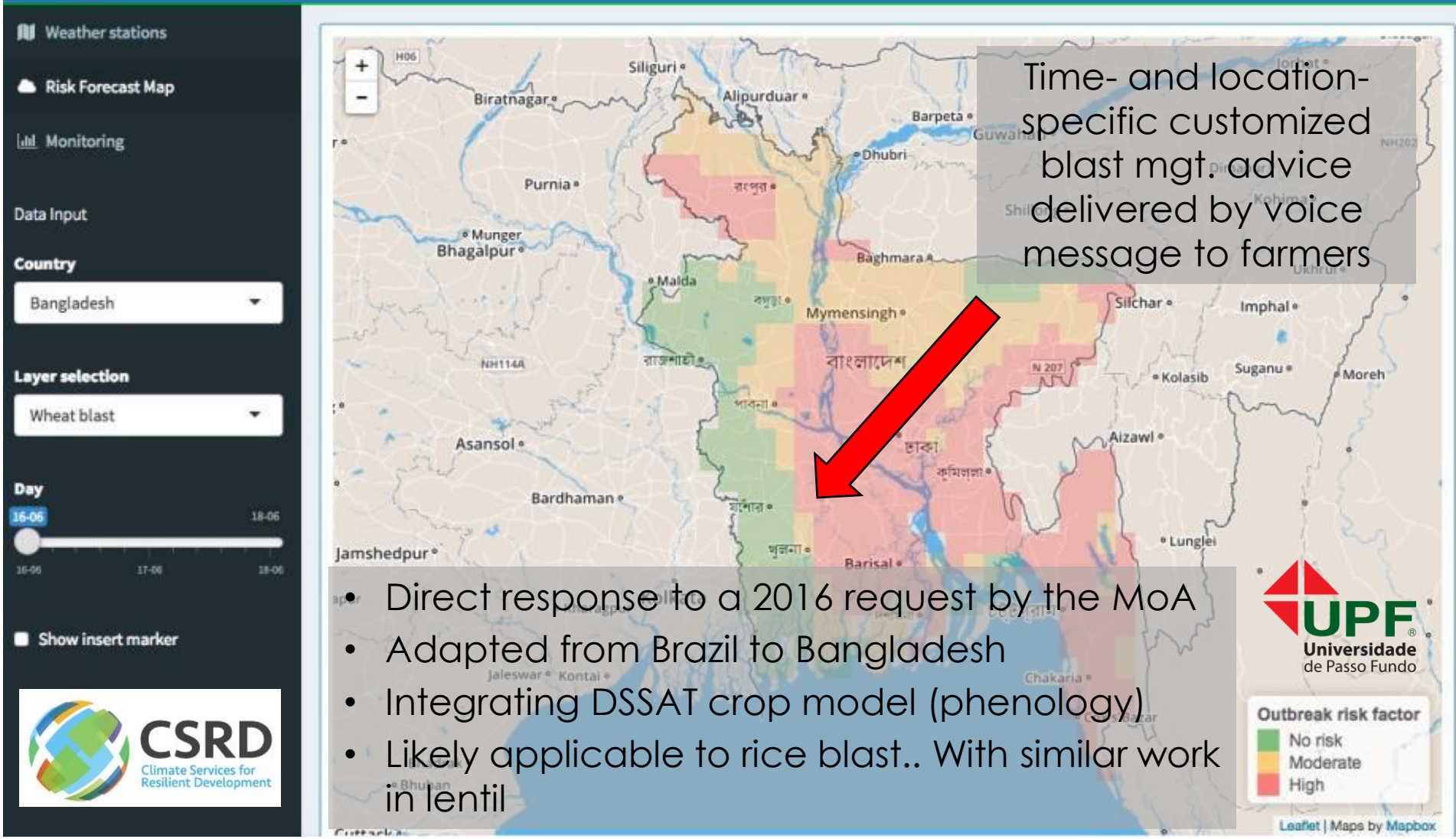
CSRD Climate Services for Resilient Development

Collaboration with the University Passo Fundo, Brazil

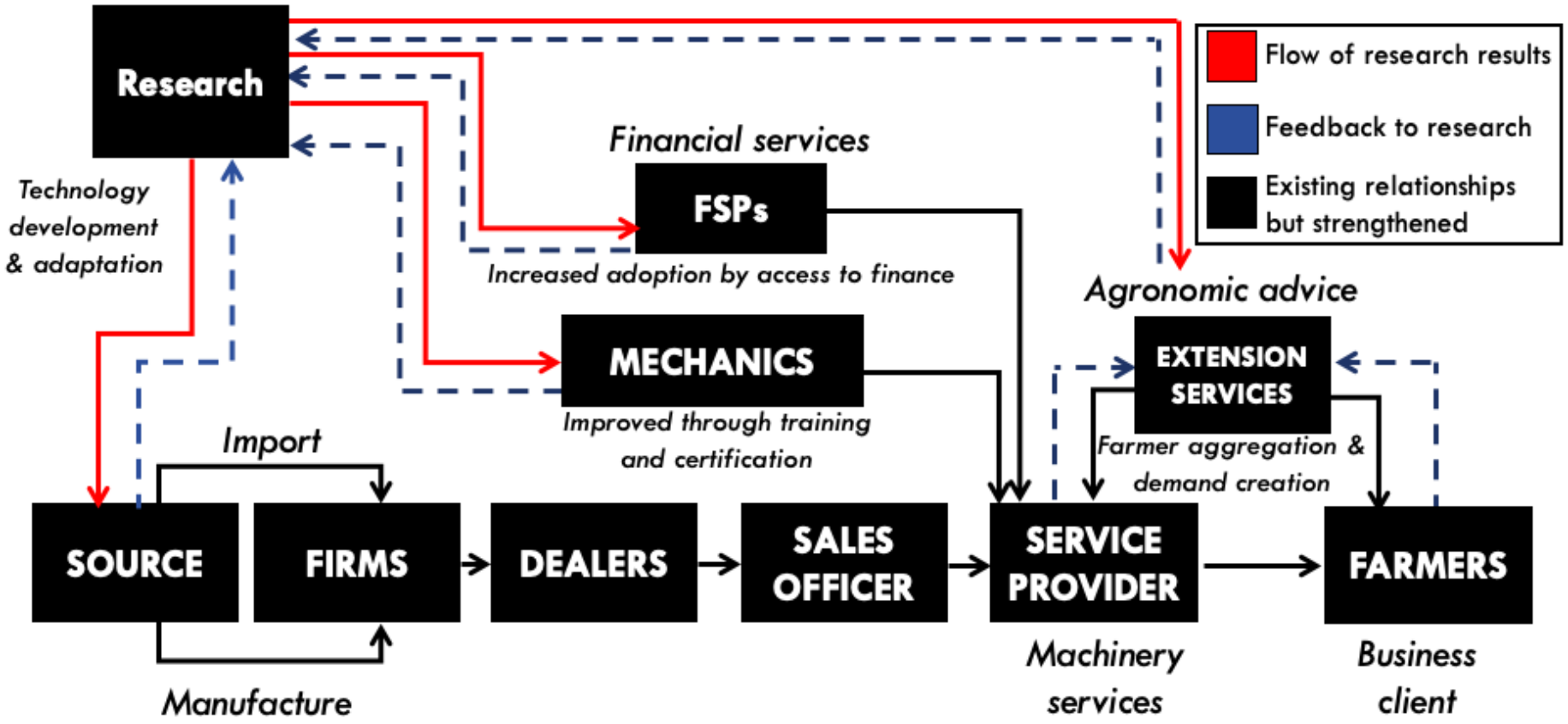
CGIAR Platform for Big Data in Agriculture

Wheat blast outbreak early warning advisory system

Geographically explicit blast outbreak warnings using 5-day weather forecasts



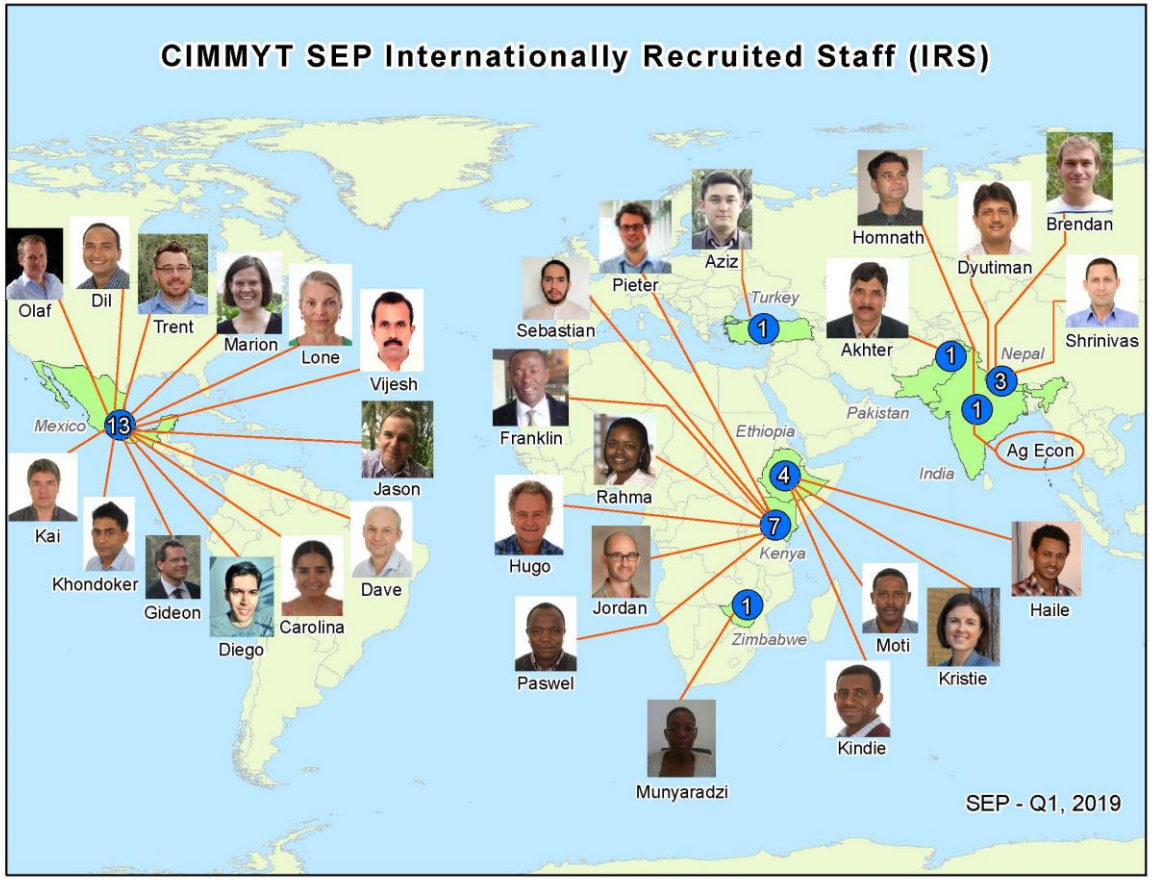
Aligning value chains for scaling and development impact



- Manufacture improvement + imports + supply + sales
- 3,340 service providers, 213,000 farmers, > 100,000 ha
- >$6 million of private sector investment in five years
- 25% of new machinery service providers enter market without contact from CIMMYT

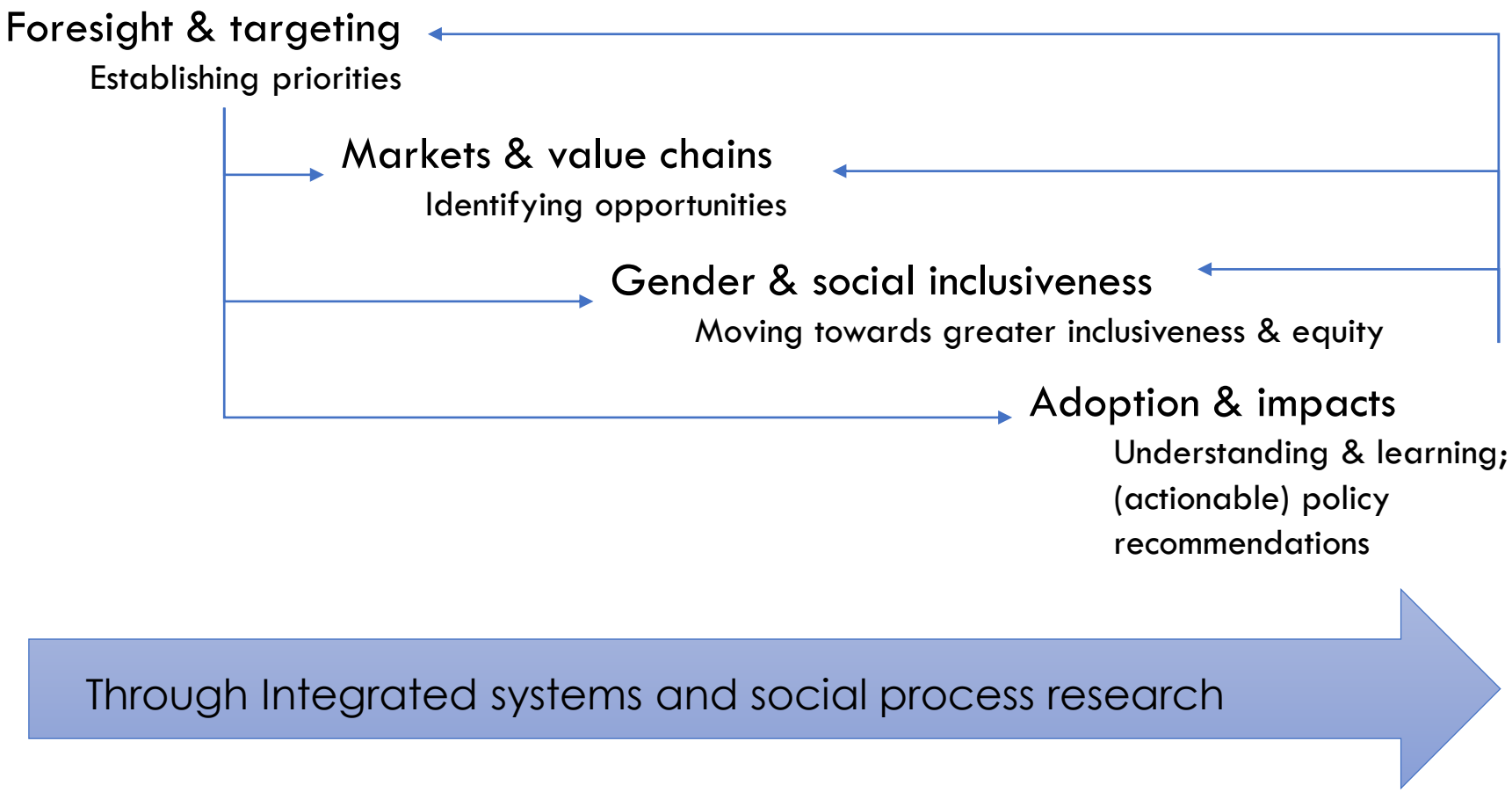
The CIMMYT Socioeconomics Program

- Diverse research (not just economists!)
- Collaborates with all CIMMYT programs & CRPs
- Aims to:
  - Improve use of scarce R4D resources through targeting
  - Accelerate the uptake of wheat & maize innovations
  - Enhances their impact and social inclusiveness for poor producers & consumers

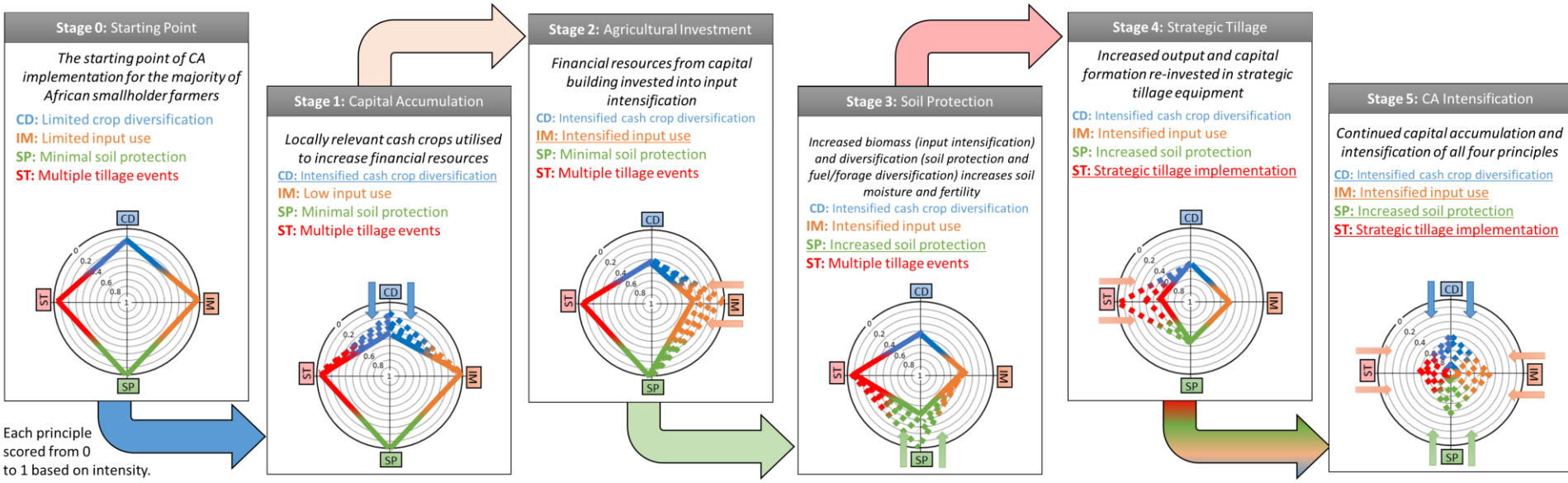


- Has 30 scientific staff strategically placed around the world

What the Socioeconomics program does

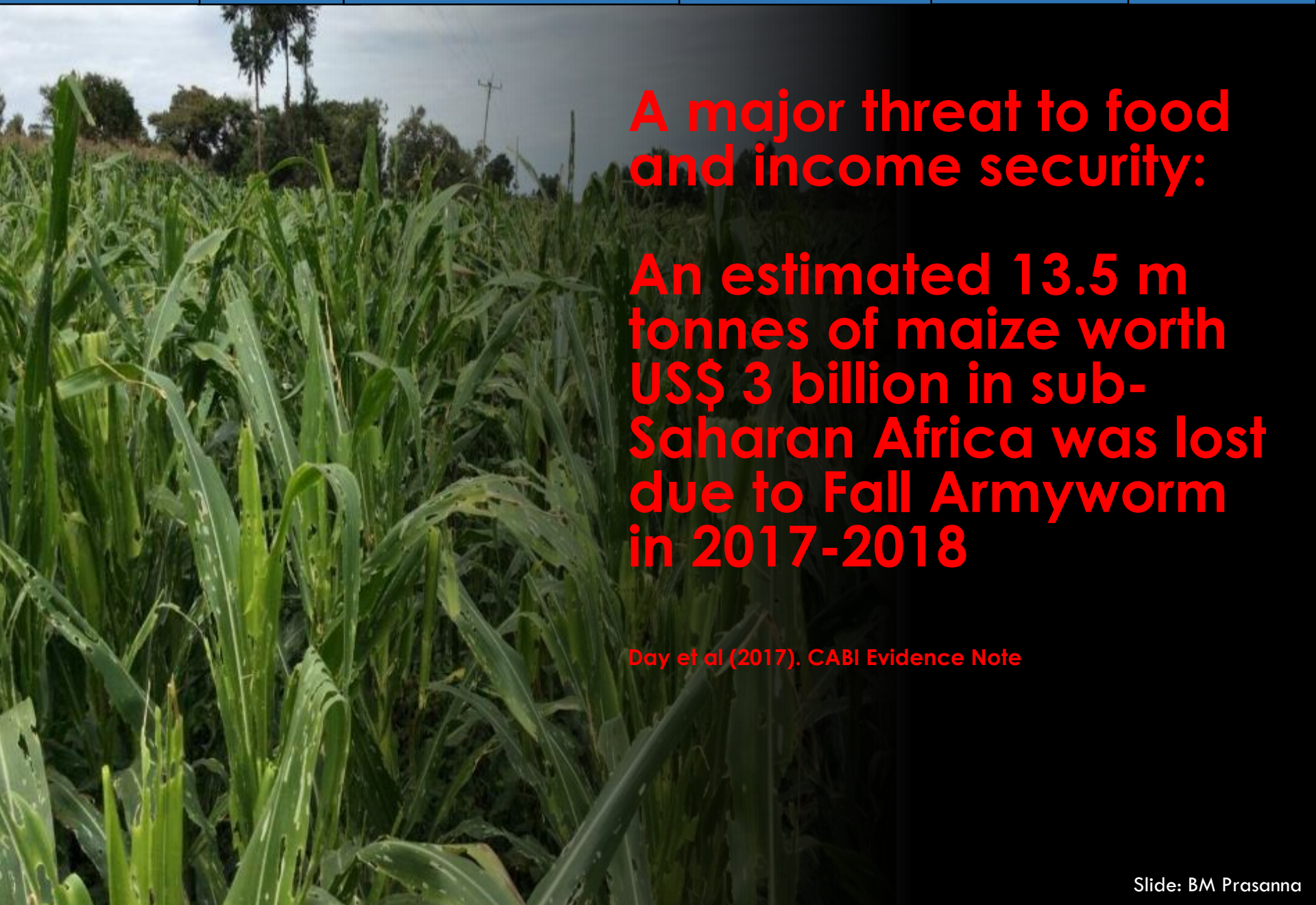


Developing Participatory Impact Pathways for Sustainable Agricultural Development



Brown, B., Nuberg, I., Llewellyn, R. (2018) Pathways to intensify the utilisation of conservation agriculture by African smallholder farmers. *Renewable Agriculture and Food Systems.* (In press)

https://doi.org/10.1017/S1742170518000108



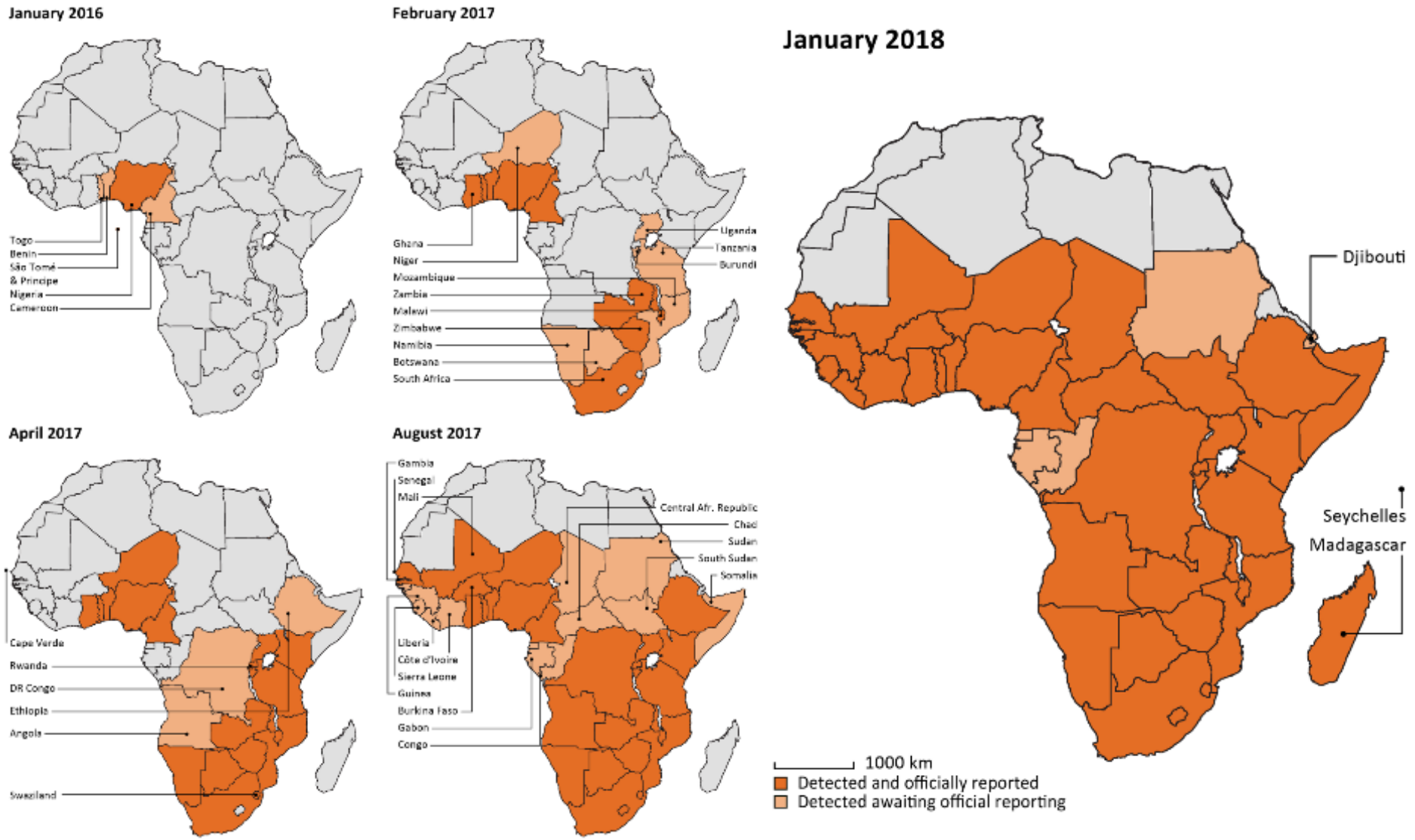
A major threat to food and income security:

An estimated 13.5 m tonnes of maize worth US$ 3 billion in sub-Saharan Africa was lost due to Fall Armyworm in 2017-2018

Day et al (2017). CABI Evidence Note

Slide: BM Prasanna

Rapid invasion across in Africa



Established in South Asia in mid-2018

What is Fall Armyworm and why is it a threat ?

Fall Armyworm is a pest that feeds on **80 types** of crops and plants, but prefers maize.

Fall Armyworm was found for the first time in Asia in 2018 in India.

It has now spread throughout many parts of India and has entered Bangladesh.

Scientists expect this pest will continue to spread throughout Asia.

Knowing how to identify Fall Armyworm is key to the fight against this pest. This guide provides simple information on how you can identify Fall Army worm at different ages.

FEED the FUTURE
The U.S. Government's Global Hunger & Food Security Initiative

Fall Armyworm in Africa:

A GUIDE FOR INTEGRATED PEST MANAGEMENT

First Edition

USAID FROM THE AMERICAN PEOPLE | CIMMYT International Maize and Wheat Improvement Center | CGIAR RESEARCH PROGRAM ON Maize

Fresh vs. old feeding damage

Crop damage affected by:

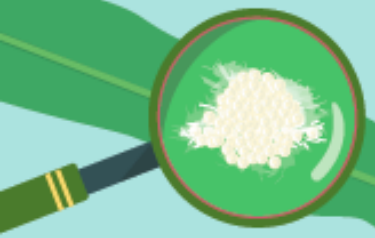
1. Environmental conditions
2. Stage of the crop during the attack
3. Host plant tolerance (maize can to some extent recover)
   - Damage can look severe (don't overly panic)
   - Yield loss severe, but can be patchy
   - Questions on overall yield loss (farmer vs. measured losses)
4. Management (not only control) requires knowledge of pest biology and ecology, population pressure, and economics of crop production

Slide concepts courtesy of CABI

How can I identify Fall Armyworm?

Egg masses

Egg masses are very small and white, and are often found on the underside of leaves.



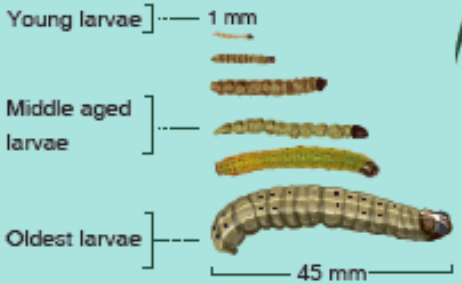
Hatching from eggs

When the eggs are ready to hatch, they are a similar color as cigarette ash.

Young Fall Armyworms

Hundreds of small Fall Armyworms with black heads will crawl out of hatched egg masses.

Growing Fall Armyworm



Older Fall Armyworm

Older Fall Armyworms can have a white

mark on their heads

They also have **four large dots** in a square on the end of their body.

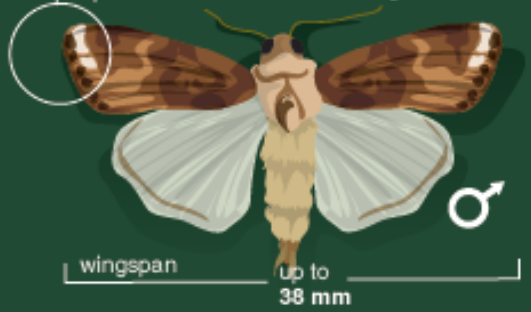
Pupae are red-brown color

Red - brown colored Fall Armyworm pupae can be found in the soil before Fall Armyworm turns into an adult.

You may also find cocoons 2 to 8 cm deep in the soil that look like this.

Adult moth

Adult male moths have a white spot at the end of their wings.



Female moths are less colorful and do not have a white stripe on their wings

The Cereal Systems Initiative for South Asia (CSISA) was established in 2009. The project is led by the International Maize and Wheat Improvement Center

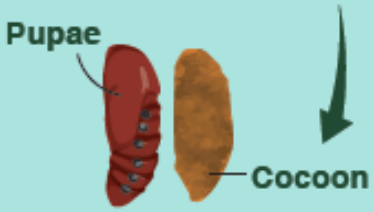
Fall Armyworm Life Cycle

Fall Armyworm generations last between around 33 to 63 days depending on the temperature

1. Adult female Fall Armyworm moths lay between 100 to 2,000 eggs.

2. After hatching from eggs, Fall Armyworm larvae will feed on maize for between 14 to 22 days. It eats leaves, stems, or on older plants, may tunnel directly into the maize cob.

3. When larvae are full grown, Fall Armyworm drops off the maize plant and digs into the soil to pupate for between one and two weeks.

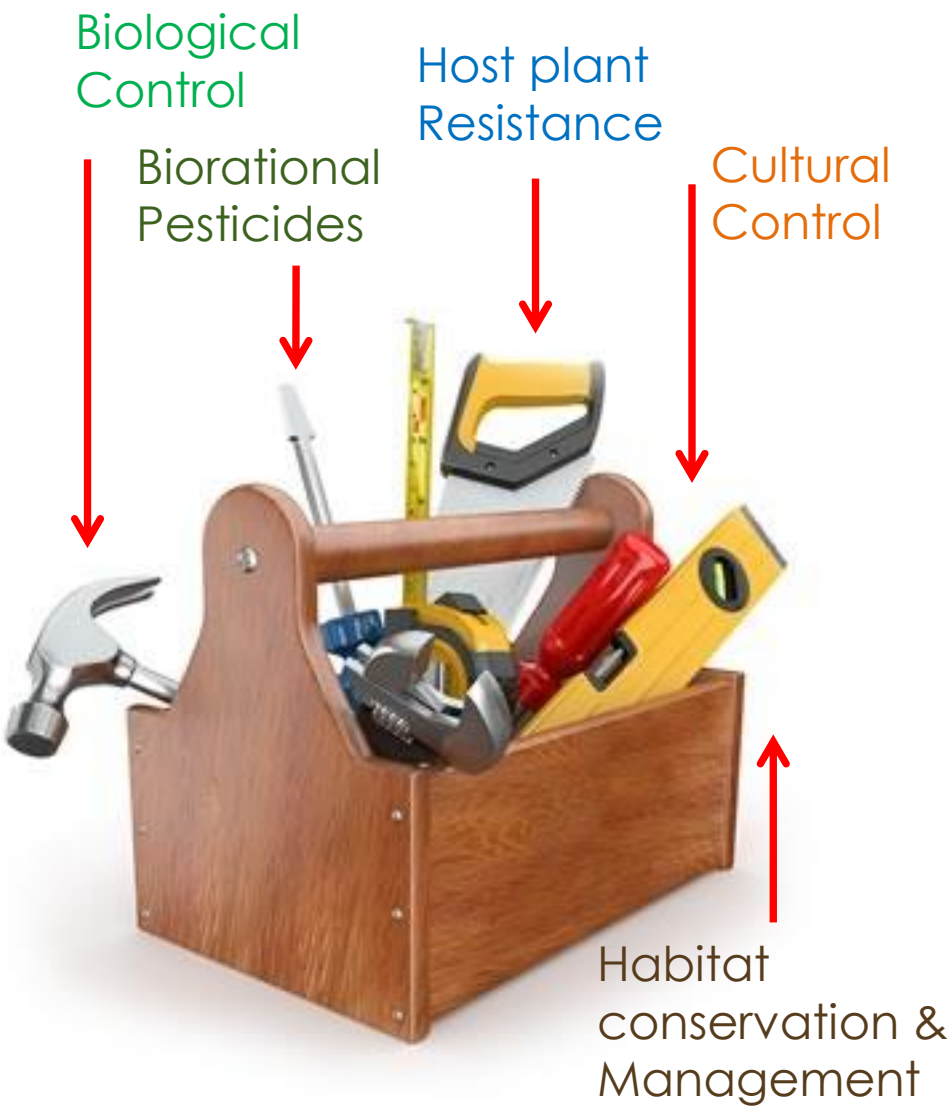


4. Fall Armyworm will complete pupation and have a faster life cycle in warmer climates.

5. The adult moth lives as an adult for 10 or more days, and is blown by the wind as it migrates to new fields. It lays eggs for 3-4 days while it is an adult.

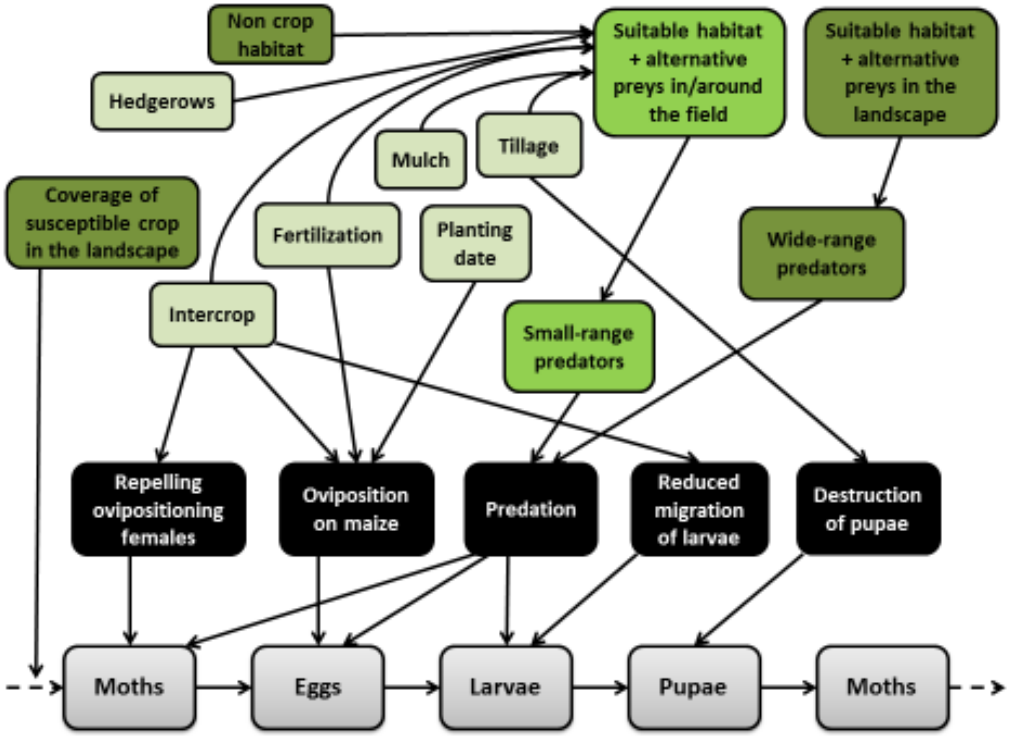
6. Adult moths can be blown by the wind and can migrate hundreds of kilometers before they lay eggs and die.

No single tool will be completely effective against Fall Armyworm: Integrated Pest Management (IPM) is needed



Agroecological management of FAW

- Builds on increased **diversity** and Host-Natural Enemy relationships
  - Encourage ants, spiders, beetles, etc.
- Controls the pest at different **stages** and using different mechanisms (reduces evolution of resistance)
- Options available at the **field, farm and landscape** level



Baudron et al. 2017 unpublished

Parasitoids, biological controls, bio-pesticides

- *Telenomus remus* Nixon (Hym.: Platygastridae)
- FAW co-evolved parasitoid, effective in the Americas

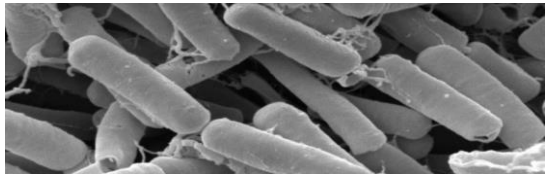
- *Chelonus insularis* Cresson (Hym.: Braconidae)
- FAW co-evolved parasitoid

- *Cotesia marginiventris* (Cresson) (Hym.: Braconidae)
- FAW co-evolved parasitoid
- Less effective in presence of sprays

- *Trichogramma Egg Parasitoid*

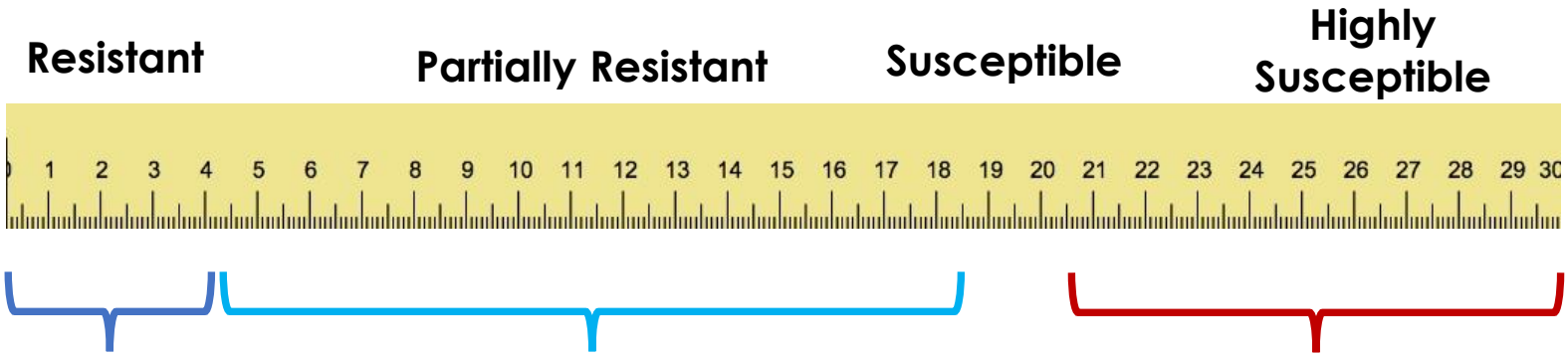
- *Spodoptera frugiperda* multiple nucleopoly-hedrovirus (SfMNPV)
- Host-specific, long persistence, low non-target risks

- *Commercial product released in Americas: Fawligen (AgBiTech), CartuchoVIT*
- *Production of own biopesticides at smallholder level*



- *Bt options*

Native genetic resistance to FAW, even if partial, is important for multiple reasons



Bt maize
(single gene; high selection pressure on insect)

Conventional / Native genetic resistance
(polygenic; low selection pressure on the insect)

Almost all commercial maize varieties in Africa, likely in Asia

Early scouting and action is crucial

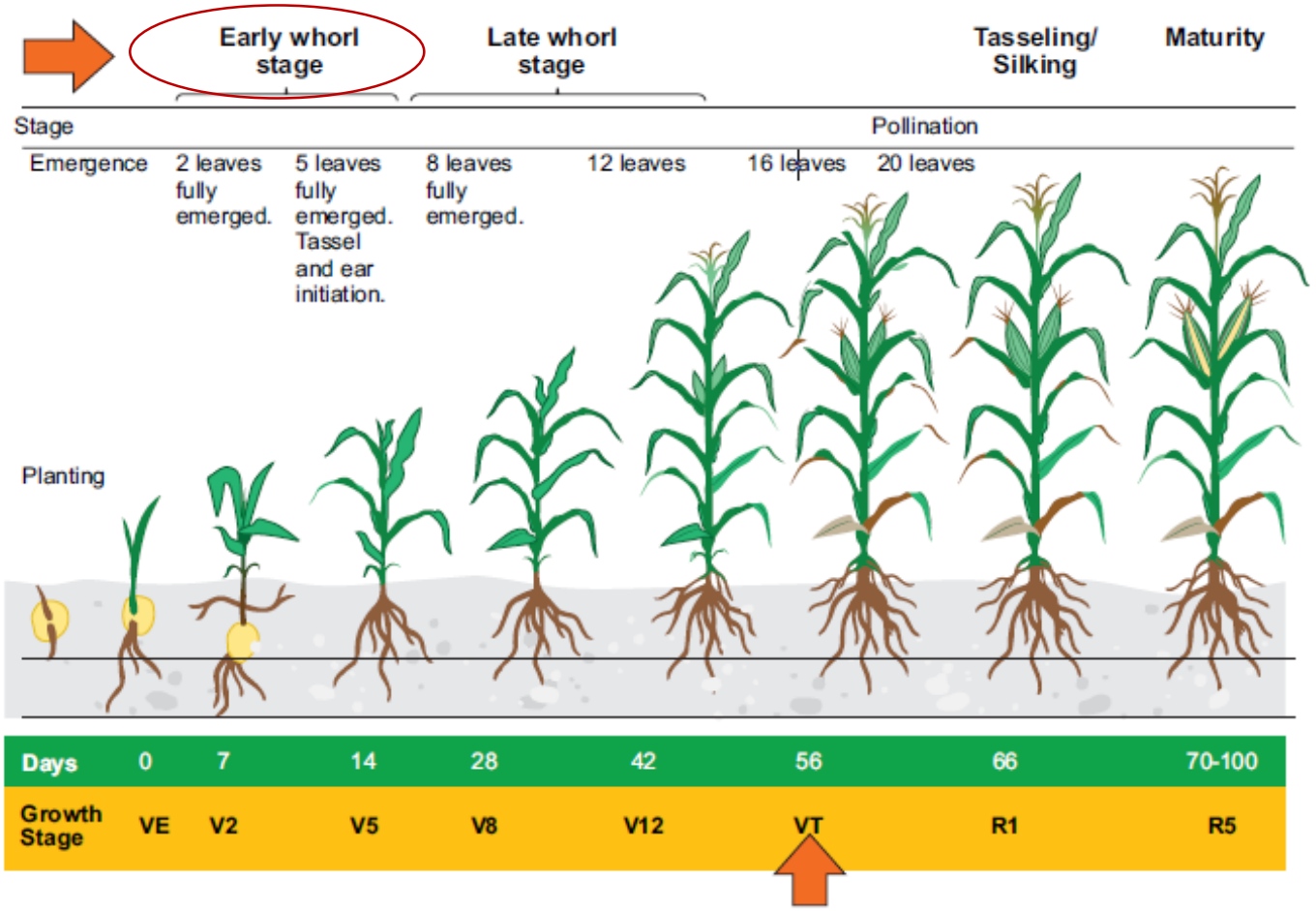
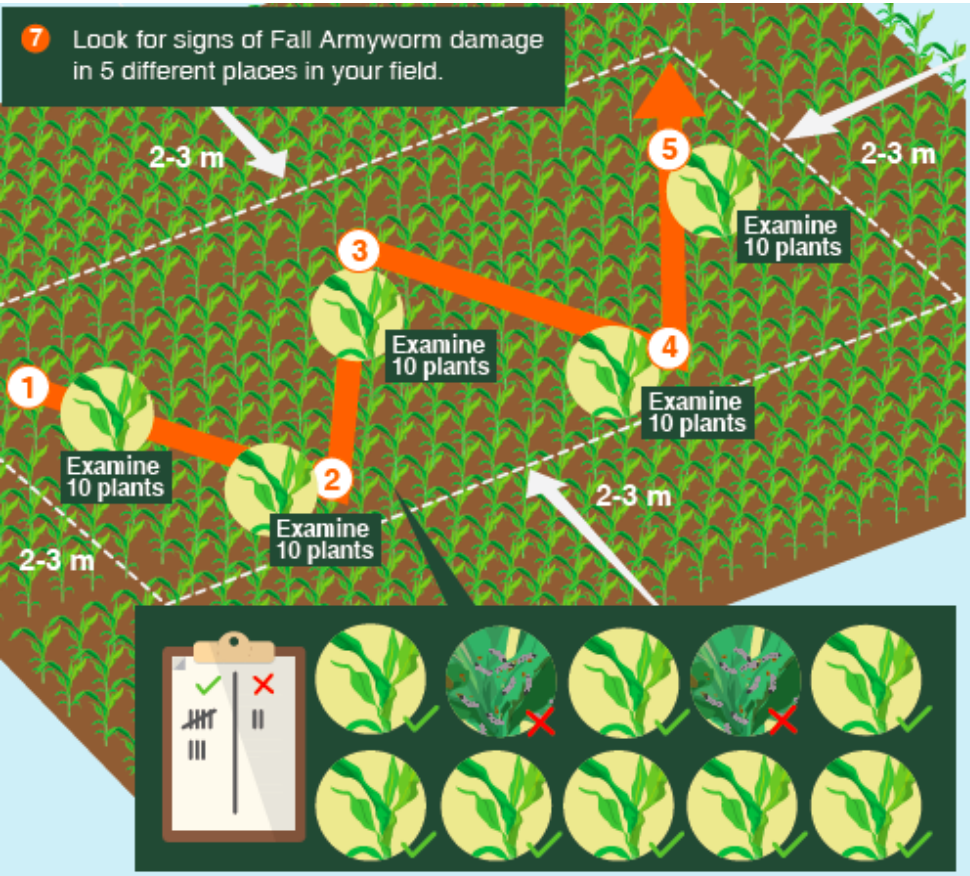


Figure 6. Maize growth stages (Modified from Clarrie Beckingham, 2007, https://www.dpi.nsw.gov.au/agriculture/horticulture/vegetables/commodity-growing-guides/sweet-corn). Orange arrows indicate critical stages to consider.

Source: USAID-CIMMYT FAW IPM Manual, First Edition, Jan 2018

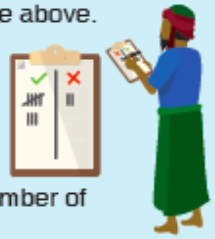
7 Look for signs of Fall Armyworm damage in 5 different places in your field.



8 Stop in 5 places that are not on the sides of the field as shown in the image above.

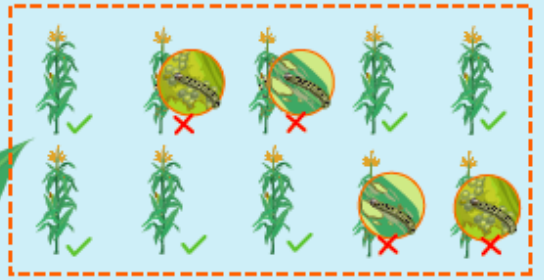
9 In each of the 5 places in your field, carefully examine 10 plants for signs of new Fall Armyworm damage. Next, count up the total number of plants out of 50 that have signs of new damage.

10 Write down how many plants have Damage. Also record the number of plants that do not.



If **more than 10 out of 50** young plants out have signs of fresh Fall Armyworm damage, consult with an extension agent or CIMMYT for pest management advice.

11 When maize is older, examine the top three leaves or cobs for signs of Fall Armyworm damage.



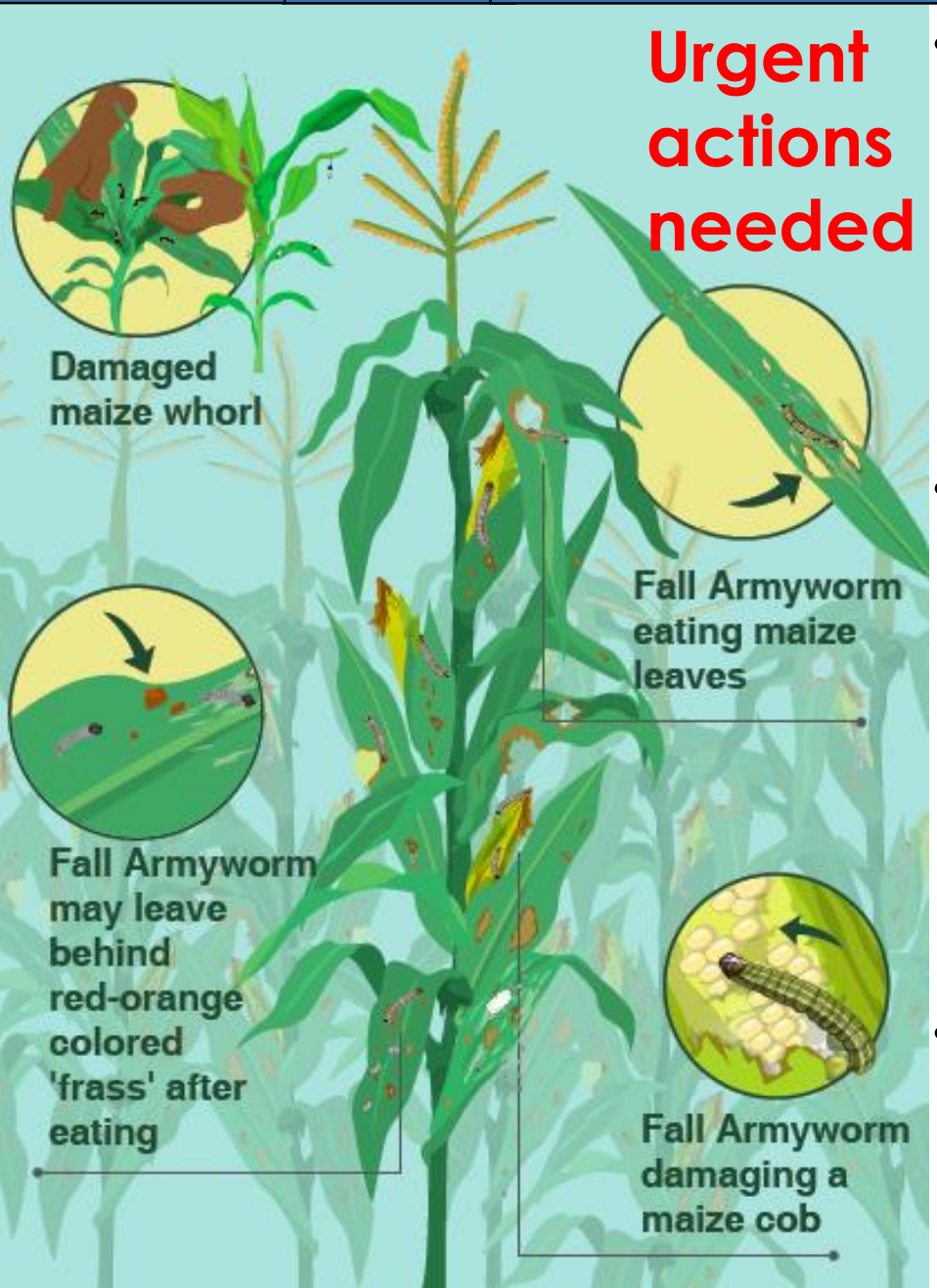
If **more than 20 out of 50** older plants have counted have fresh Fall Armyworm damage, consult with an extension agent or CIMMYT. Be sure to only count plants with new damage.

12 If you have found enough Fall Armyworm damage in your field, consult with an extension agent for advice.

More than 10
young plants out of 50 plants surveyed.

More than 20
older plants out of 50 plants surveyed.

13 Ask the extension agent if it you have enough Fall Armyworm damage to justify use of insecticides. Only use insecticides as a last option.If rain is forecasted in the coming days, spraying may not be needed. But if you do choose to spray, only use insecticides that minimize environmental damage and risk to human health.

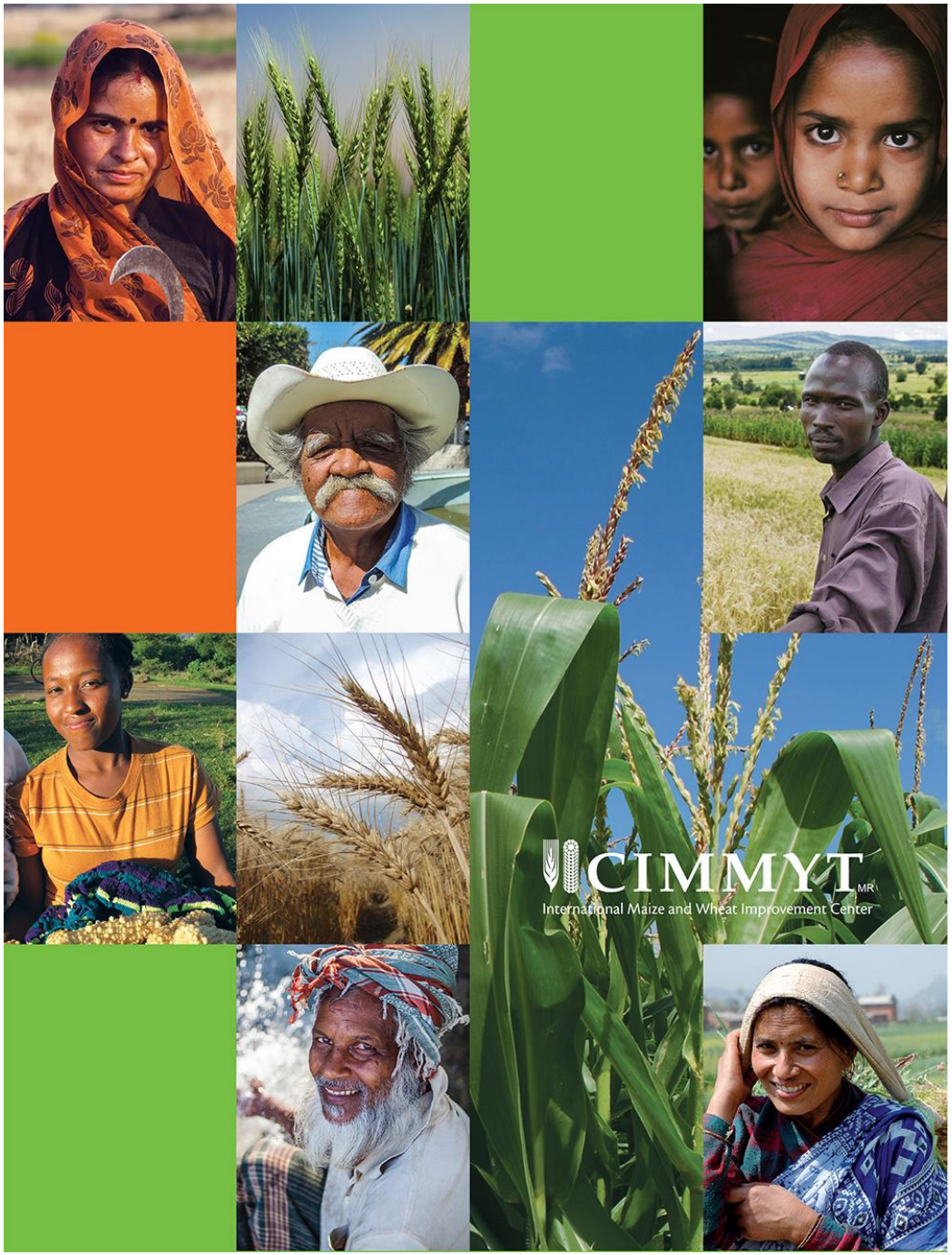


- **Awareness & training campaign**
  - Farmers (IPM options)
  - Input dealers (least toxic options)
  - Extension and dev. projects (training of trainers and deployment)
  - Additional non-maize livelihood options
- **Evidence-based management**
  - Monitoring (pheromone traps, crowd sourcing)
  - Data dashboards
  - Provincial alert systems
  - Validating IPM options (environmental, social & financial appropriateness)
  - Lower toxicity insecticide screening (reduced non-target effects)
- **Capacity development**
  - Provincial workshops
  - Study exchanges
  - Interactions with S. and S.E. Asian regional research institutions

Opportunities for Laos – CIMMYT partnership

- Emergency + longer term response to Fall Armyworm
- Technical support to partners
- Research capacity development and training (including exchanges)
- Farming systems and livelihood diversification (Partial transition out of maize)
- Scale-appropriate farm mechanization
- Climate information services
- Technology targeting and out-scaling
- Social inclusion and gender analysis
- Innovation systems, value chains

We are here to learn from you, and identify where CIMMYT might be of service and assistance



Thank you!

Any questions?

t.krupnik@cgiar.org