

# Accelerating agricultural development

## *The role of improved seed & seed systems*

Martin Kropff, Director General, CIMMYT





## CIMMYT's mission

Maize and wheat science for improved livelihoods.



## CGIAR's vision

Transforming food systems for affordable, sufficient and healthy diets produced withing planetary boundaries



# CIMMYT around the world

1,300 staff from over 50 countries

## 13 offices

Afghanistan

Bangladesh

China

Colombia

Ethiopia

India

Kazakhstan

Kenya

**Mexico**

Nepal

Pakistan

Turkey

Zimbabwe



With >300 partners!



Projects in over 40 countries



# Three converging challenges:

*climate change, population growth, limited natural resources*

*A perfect storm*



More



Less



Better



# Feeding the world:

## + 40% Maize and Wheat needed by 2050

MAIZE PROVIDES

**15-56%** OF

**TOTAL CALORIE INTAKE**

in Sub-Saharan Africa, Latin America and Asia



PREFERRED

STAPLE FOOD TO

**900** million people

LIVING ON LESS THAN \$2 A DAY



Global  
production  
in 2016

**1026**  
million  
metric tons

WHEAT IS THE LARGEST  
PRIMARY COMMODITY

GLOBAL PRODUCTION IS OVER  
**735** million metric tons



WHEAT PROVIDES **18%** OF OUR  
TOTAL AVAILABLE CALORIES



**2.5 billion** people  
in **89** countries



# CIMMYT's Return on Investment



Annual benefits of US \$3.5 billion for wheat and US \$1 billion for maize.



50% of maize and wheat in the developing world is based on CIMMYT varieties.



Trained over 12,000 agricultural experts and scientists.

## Zero Hunger

SUSTAINABLE  
DEVELOPMENT  
GOALS

1 NO POVERTY



2 ZERO HUNGER



3 GOOD HEALTH AND WELL-BEING



5 GENDER EQUALITY



6 CLEAN WATER AND SANITATION



8 DECENT WORK AND ECONOMIC GROWTH



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



13 CLIMATE ACTION



15 LIFE ON LAND



17 PARTNERSHIPS FOR THE GOALS

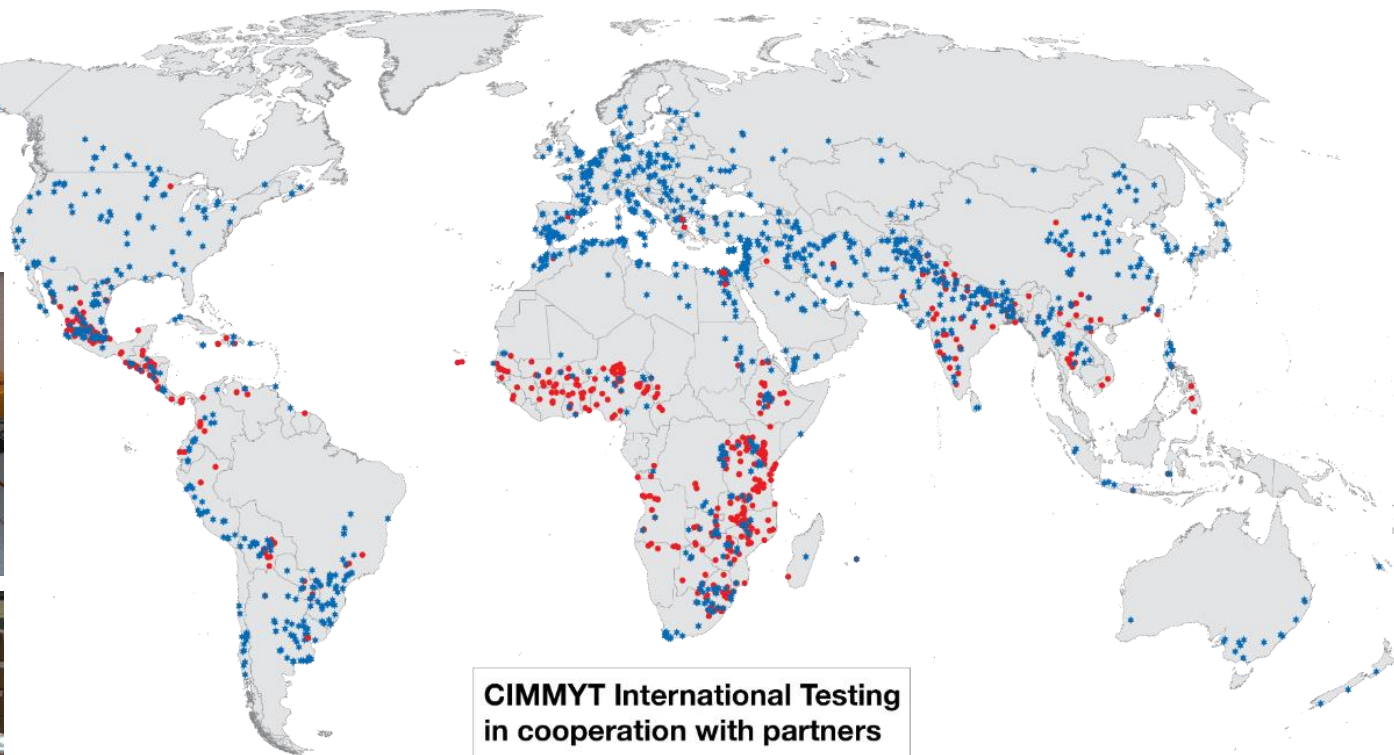


# Improving productivity, resilience and livelihoods through strong seed systems



# CIMMYT's global seed distribution network

**1,500** maize and wheat shipments every year, each containing over **500,000** individual seed packets



CIMMYT International Testing  
in cooperation with partners

Maize



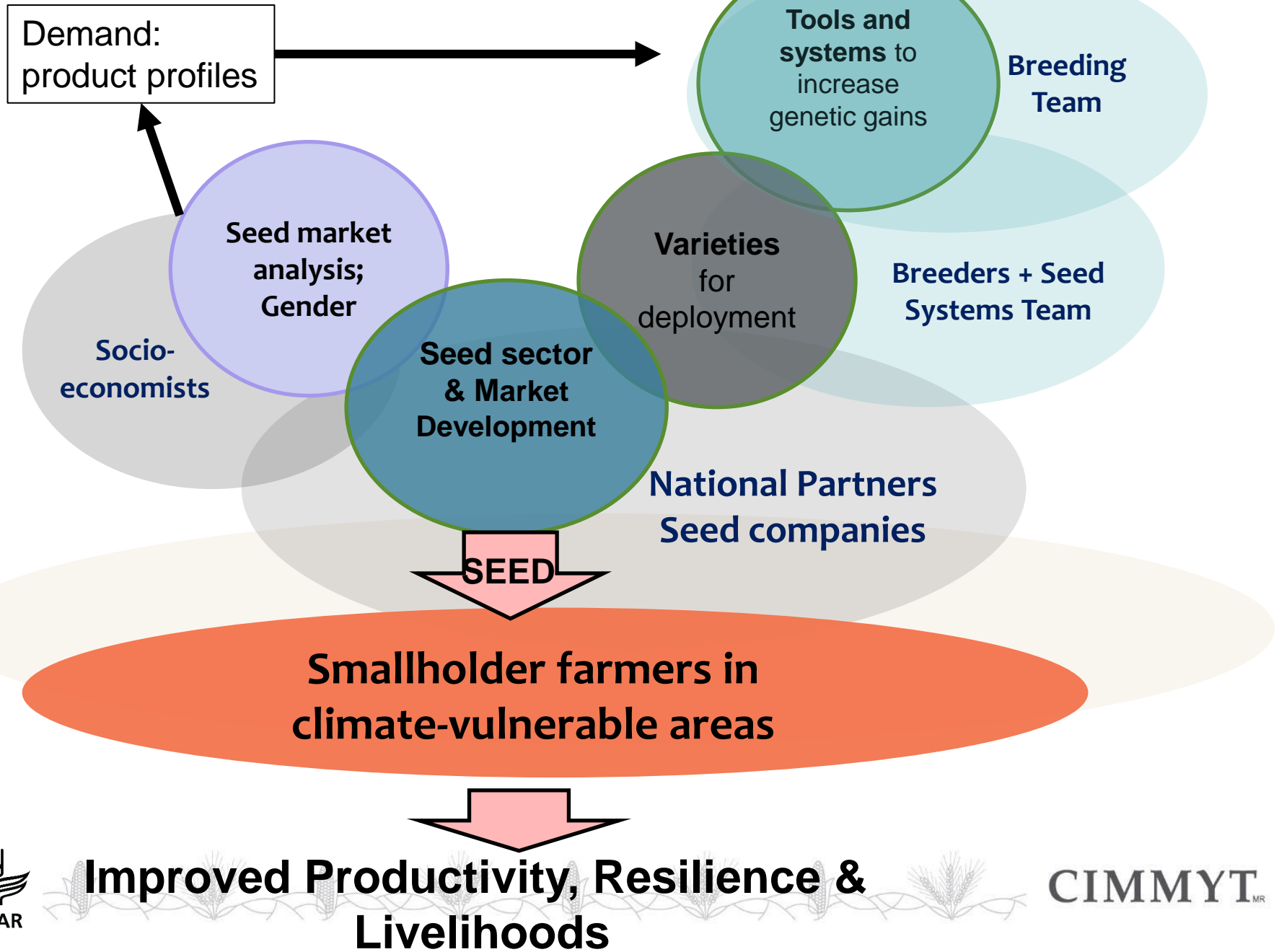
Wheat



The **CGIAR** provides **80%** of  
**public germplasm** to the world.



## Seeds as a solution



# Seed Value Chain

Demand:  
product profiles

Breeding & Multi-location  
Testing of New Products

Variety Development

CIMMYT  
NARS

Regional On-Farm Trials  
Stage-gate Advancement

On-farm Testing  
Product Advancement

CIMMYT  
NARS  
Seed Companies

Data; NPTs

National Performance Trials  
Varietal Release

NARS  
Seed Companies

Seed Production  
QA/QC

Seed Production &  
Processing

Demos; Field Days;  
Farmer Awareness

Product Promotion

Seed  
Companies

Market Segmentation  
Territory Planning

Product Distribution & Sales

Agro-  
dealers

Crop Advisory Services

**FARMERS**

Extension

# Seed Solutions: better and resilient varieties

- Increased yield
- Tolerance to drought, heat and other stressors
- Disease and pest resistance
- Biofortification: zinc, iron, protein, Provitamin A
- Nitrogen-use efficiency



Margaret from Zimbabwe

# Improved seed: the core input for increasing yield

- Availability of quality seed of varieties with high genetic value enhances crop productivity.
- Improved varieties: crucial for poverty alleviation.
- Formal and local/farmer seed systems.
- NB: The use of agricultural inputs without the use of quality seed may not result in high productivity.



Seed system: varietal development and release, maintenance breeding and production of various classes of seeds.



# Ultimate goal: to deliver plant breeding improvements to farmers' fields



*Sylvia Horemans (right) and a warehouse supervisor (left) inspect seeds at Kamano Seeds, Zambia.*

- Seeds of improved varieties must be multiplied at large scale to be available to farmers for cultivation, with genetic purity maintained.
- Varietal turnover & seed replacement are essential to optimal performance: requires both the continued development of varieties, and maintenance of seed of superior varieties in genetically pure state.

# Wheat seed systems

- Seed purity can be maintained relatively easily.
- Production requires large seed volumes due to relatively high seed rates (100-120 kg/ha)
- Low profit margins keep large private sectors away from the seed industry in developing countries.
- In CIMMYT target countries, 80-98% of seed is farmers saved or exchanged farmer-to farmer.
- Gov't seed sectors and small private companies are the main seed providers for seed replacement.



# Improved varieties have tangible outcomes on productivity

*e.g. South Asia*

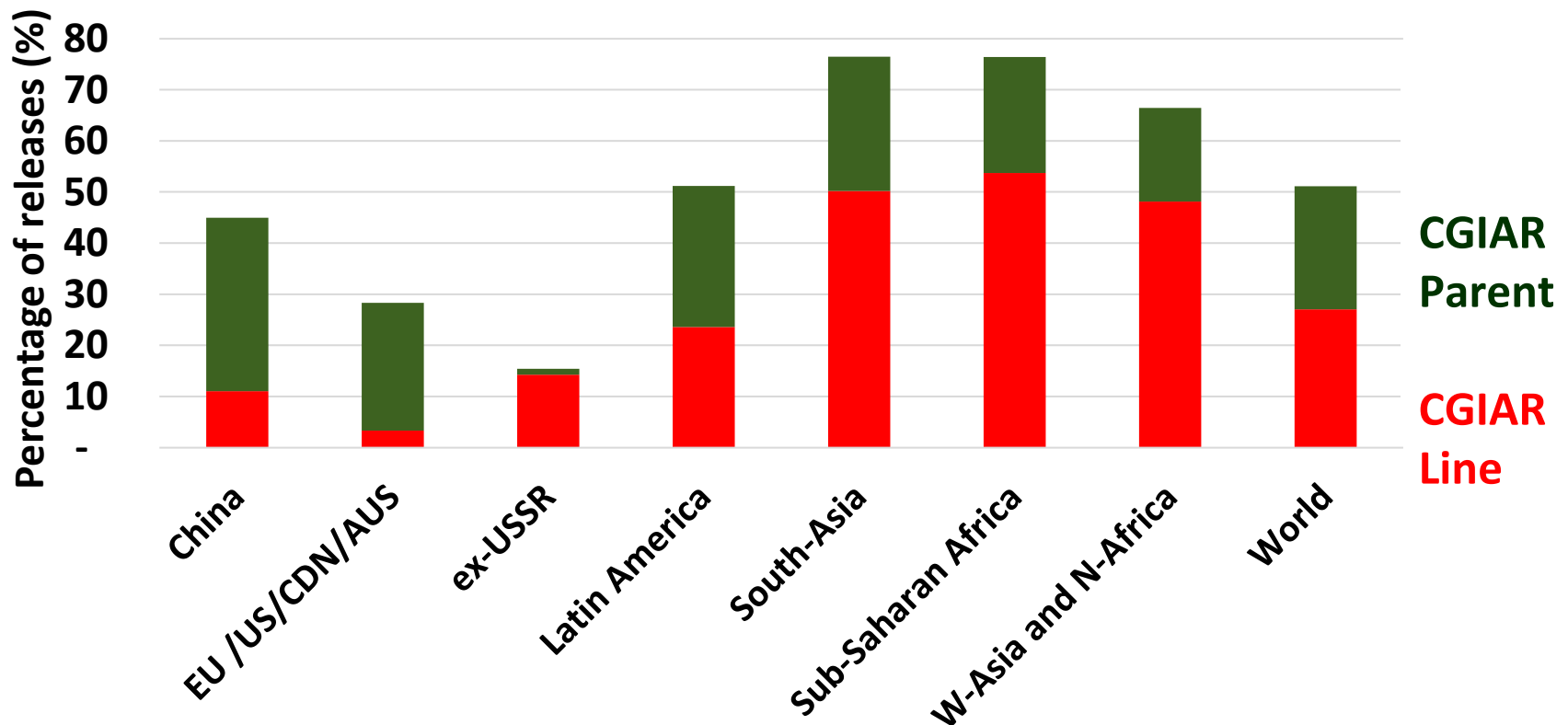
Wheat dynamics in SAARC Nations (1961-62 to 2017-18)

Country	Area change	Production change	Yield change
Afghanistan	-6%	+88%	+99%
Bangladesh	+633%	+3934%	+450%
India	+118%	+726%	+279%
Nepal	+569%	+1292%	+108%
Pakistan	+93%	+599%	+262%



# CGIAR wheat breeding delivers impact to farmers as improved varieties

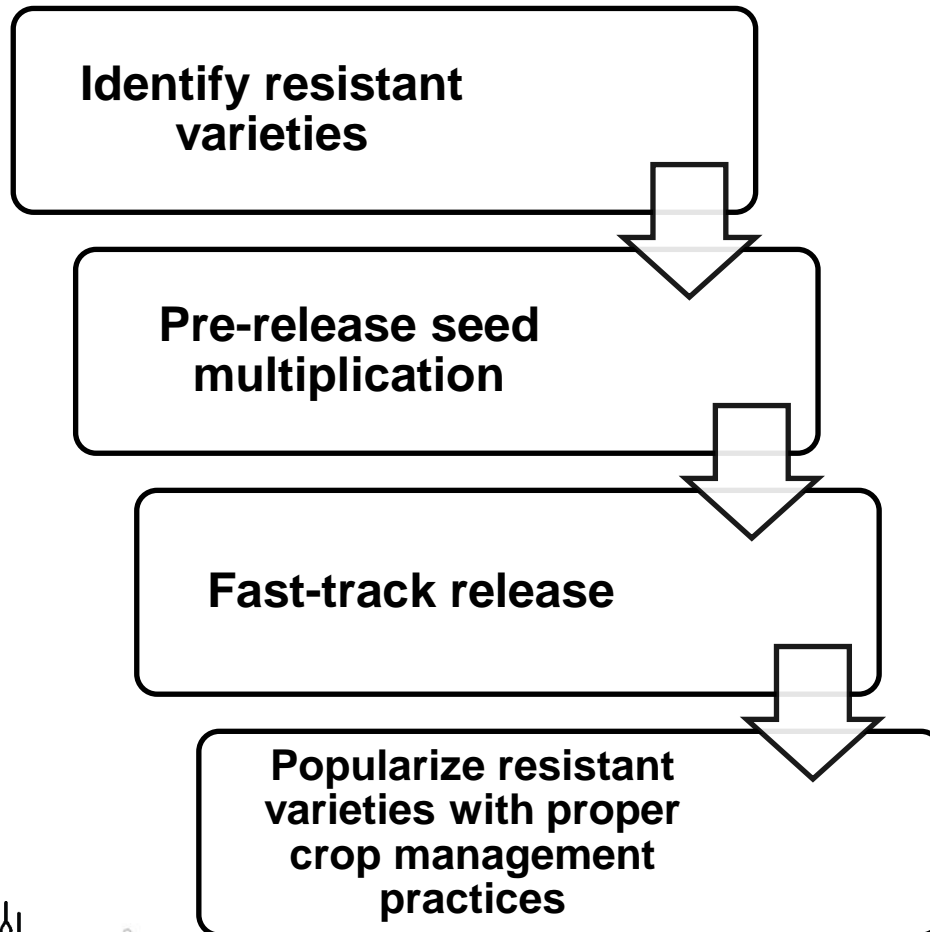
Percent of Spring bread wheat releases derived from CGIAR by region and origin 1994-2014





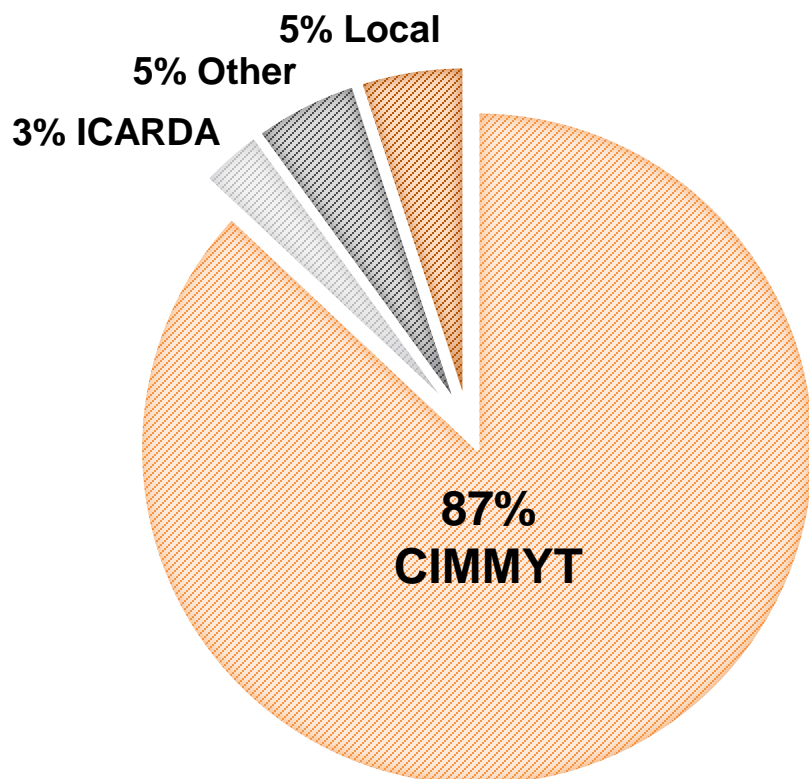
# Seed enables rapid-response to new disease threats

*E.g. Response to Ug99 and wheat blast*



# Widespread adoption of CIMMYT wheat material - Ethiopia

## Ethiopia DNA fingerprinting

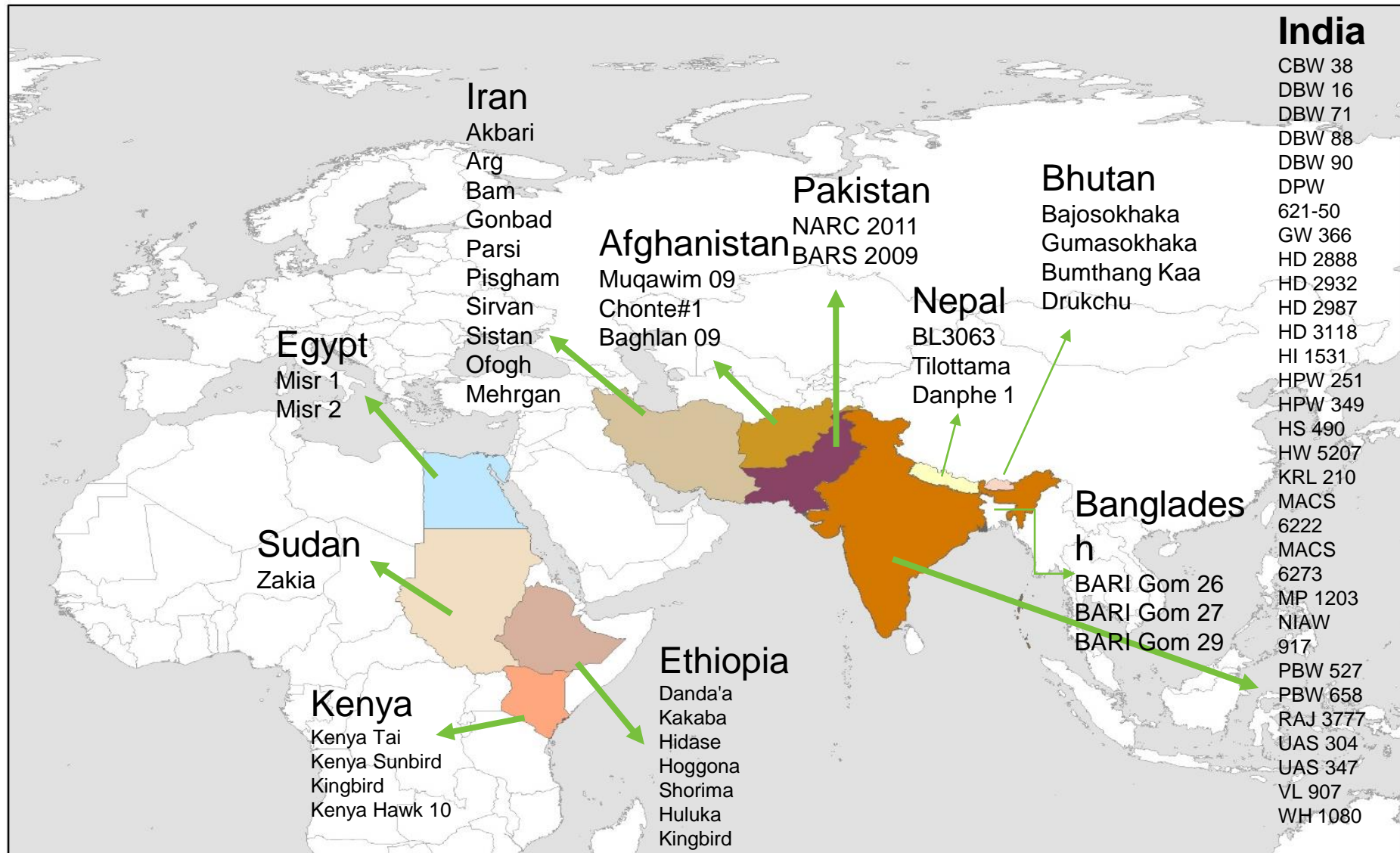


- Ethiopia produces ~5 million tonnes/year
- In 2016/17:
  - Recently released varieties (post 2005) occupied 61% of the wheat area sampled.
  - 43% of the area sampled planted to varieties released since 2010.
- A substantial decline in average area weighted varietal age for bread wheat - from 15 years in 2014/15 to 11 years 2018/19.

Results based on 4000 samples from farmers field sampled in 2016-17 season. Full results in Hodson *et al.* (2020) Scientific Reports 10: 18532  
Funded by Bill & Melinda Gates Foundation

# Achieving rapid seed response

*E.g. Response to Ug99*





# *Maize Seed Systems: From varietal releases to impacts*

**Products that meet diverse demands of farmers, besides seed companies**

**More rapid scaling and wider adoption of stress-tolerant varieties**

**Not just quantity, but quality!**

**Faster replacement of obsolete and climate-vulnerable varieties**





# A dedicated cadre of Maize Seed Systems Specialists @CIMMYT

- Seed production research
- Regional On-farm Trials in partnership with NARS and seed companies: assess farmers demand
- Breeder's and pre-basic seed supply to commercial partners
- Technical backstopping of partners on market segmentation, territory planning, varietal turnover, gender mainstreaming, and QA/QC
- Catalysing and tracking adoption and impacts of our varieties





# International Maize Improvement Consortium (IMIC) in Africa and Asia

## IMIC-Asia (since 2011)



## IMIC-Africa (since May 2018)





# On-farm genetic gain



Contents lists available at ScienceDirect

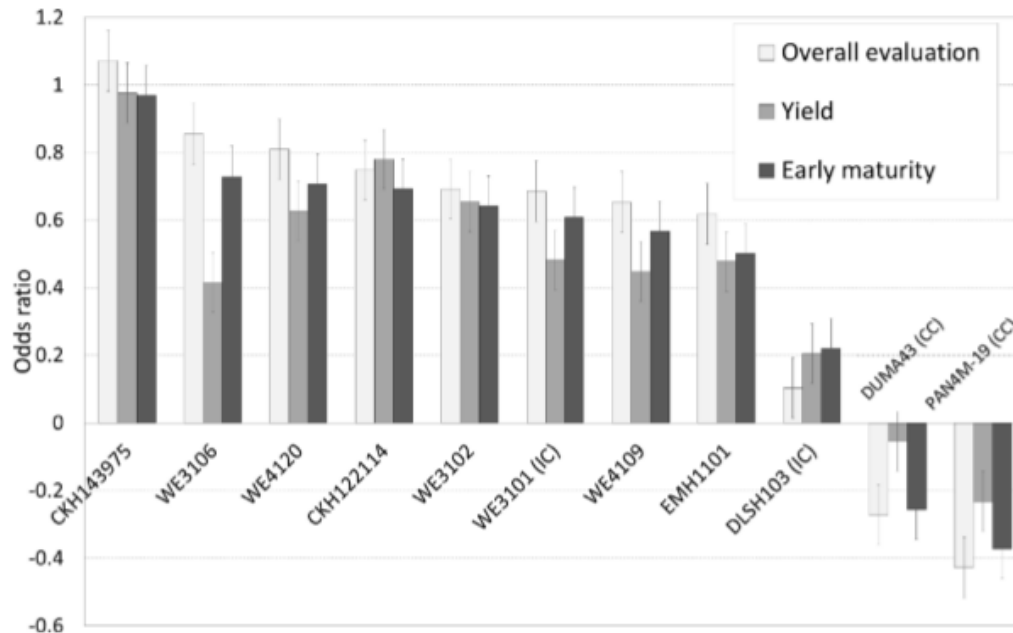
Field Crops Research

journal homepage: [www.elsevier.com/locate/fcr](http://www.elsevier.com/locate/fcr)



## On-farm performance and farmers' participatory assessment of new stress-tolerant maize hybrids in Eastern Africa

Mosisa Worku<sup>a</sup>, Hugo De Groote<sup>a,\*</sup>, Bernard Munyua<sup>a</sup>, Dan Makumbi<sup>a</sup>, Fidelis Owino<sup>a</sup>, Jose Crossa<sup>b</sup>, Yoseph Beyene<sup>a</sup>, Stephen Mugo<sup>a</sup>, McDonald Jumbo<sup>a</sup>, Godfrey Asea<sup>c</sup>, Charles Mutinda<sup>d</sup>, Daniel Bomet Kwemoi<sup>c</sup>, Vincent Woyengo<sup>e</sup>, Michael Olsen<sup>a</sup>, Boddupalli M. Prasanna<sup>a</sup>



Farmer participatory evaluation of early-to-intermediate variety performance





# CGIAR-related Stress Tolerant Maize in Sub-Saharan Africa

**1**

**111,713 MT**

Est. volume of certified STM seed produced



>100 SME's

**2**

**5.03m HECTARES**

Est. area planted with STMA varieties



Weighted average age 10 years

**3**

**ADOPTION**

of new varieties by 8.67m households



**4**

**52.27m**

Est. number of beneficiaries of STM varieties



**CIMMYT**<sup>MR</sup>

Source: B.M. Prasanna (CIMMYT)



# Seed Solutions: rapid response to threats

- Select for/ Build in Host Plant Resistance
- New technologies: e.g. gene editing, double haploid maize

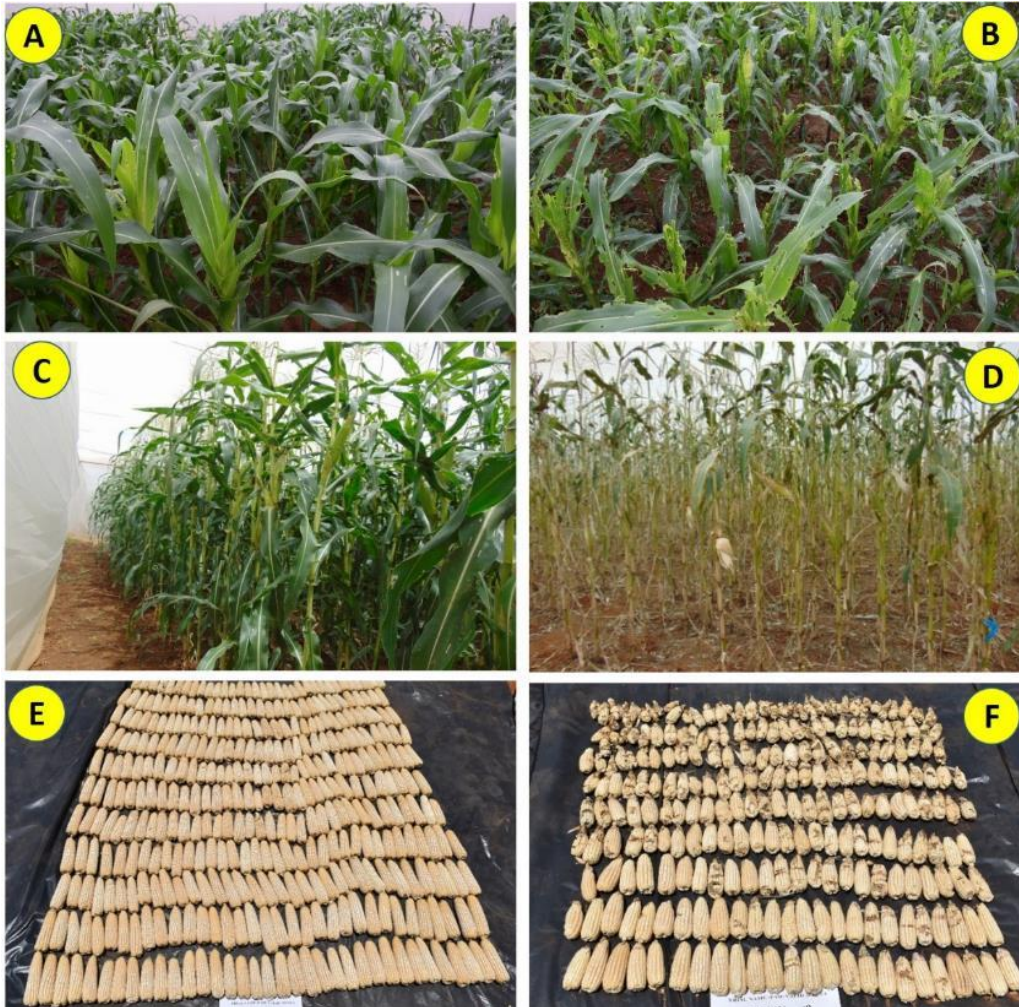


**Fall Armyworm**



**Maize Lethal Necrosis**

# FAW-tolerant Maize Hybrids from CIMMYT



Three FAW-tolerant elite maize hybrids developed by CIMMYT – **FAWTH2001**, **FAWTH2002 & FAWTH2003** – announced in Dec 2020.

<https://www.cimmyt.org/news/announcing-cimmyt-derived-fall-armyworm-tolerant-elite-maize-hybrids-for-eastern-and-southern-africa/>

These hybrids will be released in countries across Africa (through our NARS partners) after National Performance Trials (NPTs) in 2021.

# Bottlenecks along the seed value chain

- **What bottlenecks exist?** Organizational, Production side, Demand-side, Marketing
- These have different impacts on seed producers (by size of company and country)
- **Enabling policies and multi-institutional synergies needed for:**
  - Faster release of varieties across borders in similar agro-ecologies
  - More efficient seed production and processing capacities
  - Access to credit by small/local seed companies
  - QA/QC implementation
  - Liberalizing seed trade





# Meeting farmer demands

In addition to productivity & quality, a farmer needs varieties with many traits (with no access to plant protectives)





# Thank you

Dr Martin Kropff

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