

# Mainstreaming biofortification in maize and wheat

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# Maize and wheat: what the world eats



PREFERRED  
**STAPLE FOOD TO**  
**2.5 billion** people  
in **89** countries



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

PREFERRED  
**STAPLE FOOD TO**  
**900 million** people

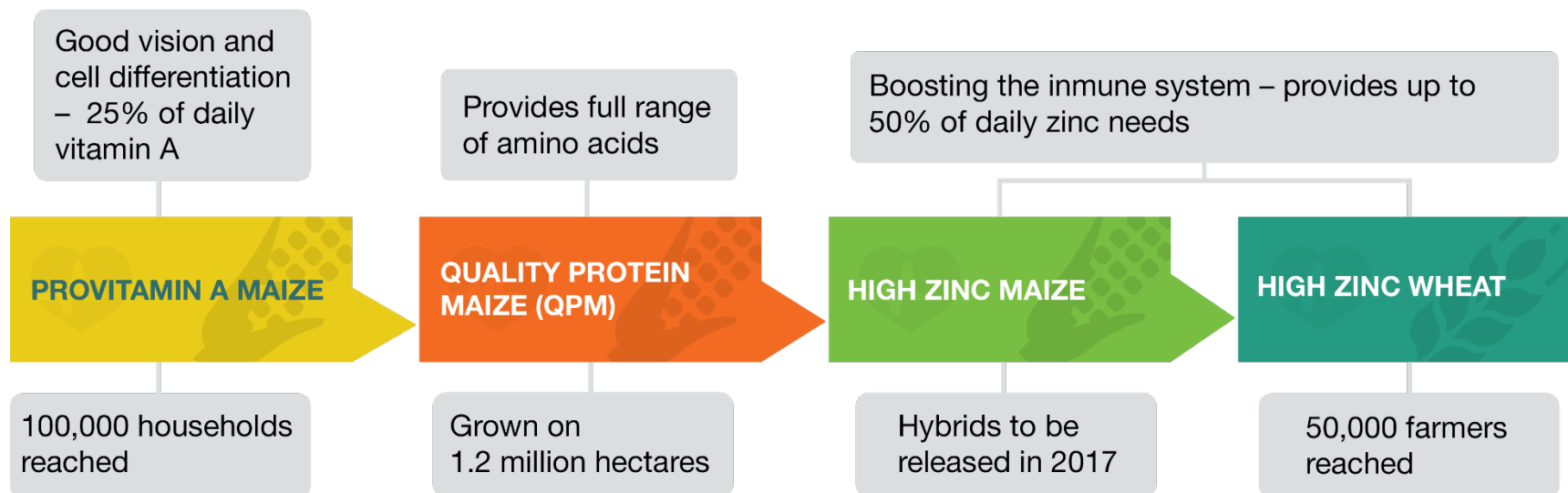
LIVING ON LESS THAN \$2 A DAY



MAIZE PROVIDES **15-56%** OF  
**TOTAL CALORIE INTAKE**  
in Sub-Saharan Africa, Latin America and Asia



# Biofortification – progress so far



# MAIZE



**CIMMYT**<sub>MR</sub>



# Provitamin A-enriched Maize

**1500** tons of  
seed of provitamin A  
enriched certified seed  
produced per year

Number of **households**  
**growing pro-vitamin A**  
**maize** in Africa in 2013:  
**100,000**

Total number of pro-vitamin  
A varieties released: **4** in  
**Malawi**, **3** in **Zambia** and **1**  
in **Zimbabwe**



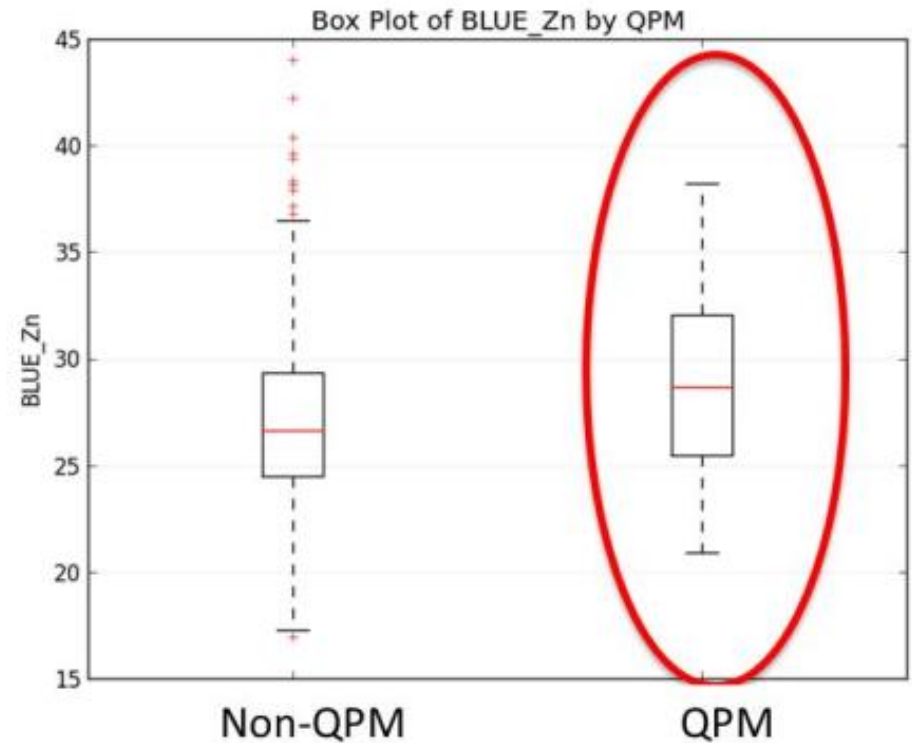
# Impact: QPM

- QPM is estimated to be grown on about **1.2 million hectares worldwide**
- 2010 meta analysis from 5 countries showed consumption of QPM instead of conventional maize leads to a **12% increase in the rate of growth in weight and a 9% increase in the rate of growth in height in infants and young children with mild to moderate undernutrition** from populations in which maize is the major staple food.
- Use for animal feed - China



# Impact: High Zn

- High Zn 3-6 hybrids and additional OPVs to be released in Guatemala, Colombia and Nicaragua in 2017
- Not all QPM are high in Zn, but CIMMYT has identified good sources of High Zn in QPM background





# Constraints

1. Cultural preferences - orange vs. white maize, different consumption patterns and market situations – need to work in a targeted manner with both public and private sector partners.
2. Compromise for other traits.
3. Risk of little genetic diversity – one pathogen could wipe out all varieties.
4. Best lines for nutritional traits are often agronomically inferior – biofortification programs are playing catch up.
5. Lag in grain yield compared to existing white hybrids – more investment has gone into white maize.



# Priorities for mainstreaming

- Still need explore best way to mainstream biofortification:
  - Needs are different in different regions
  - Mainstreaming can take different forms
  - Zinc, iron and proVA are nutritionally related
- “Bridging” breeding program applying all available tools to introgress combinations of traits
- Would require an investment of at least 4-5 million USD per year in only SSA over a 10 year period.



# WHEAT



**CIMMYT<sub>MR</sub>**

# From genetic resources to farmers' fields in less than 10 years



**Zn-Shakti' PVS variety:** Extra-early with +14 ppm Zn (40% increase) adopted by >40000 farmers in NEPZ



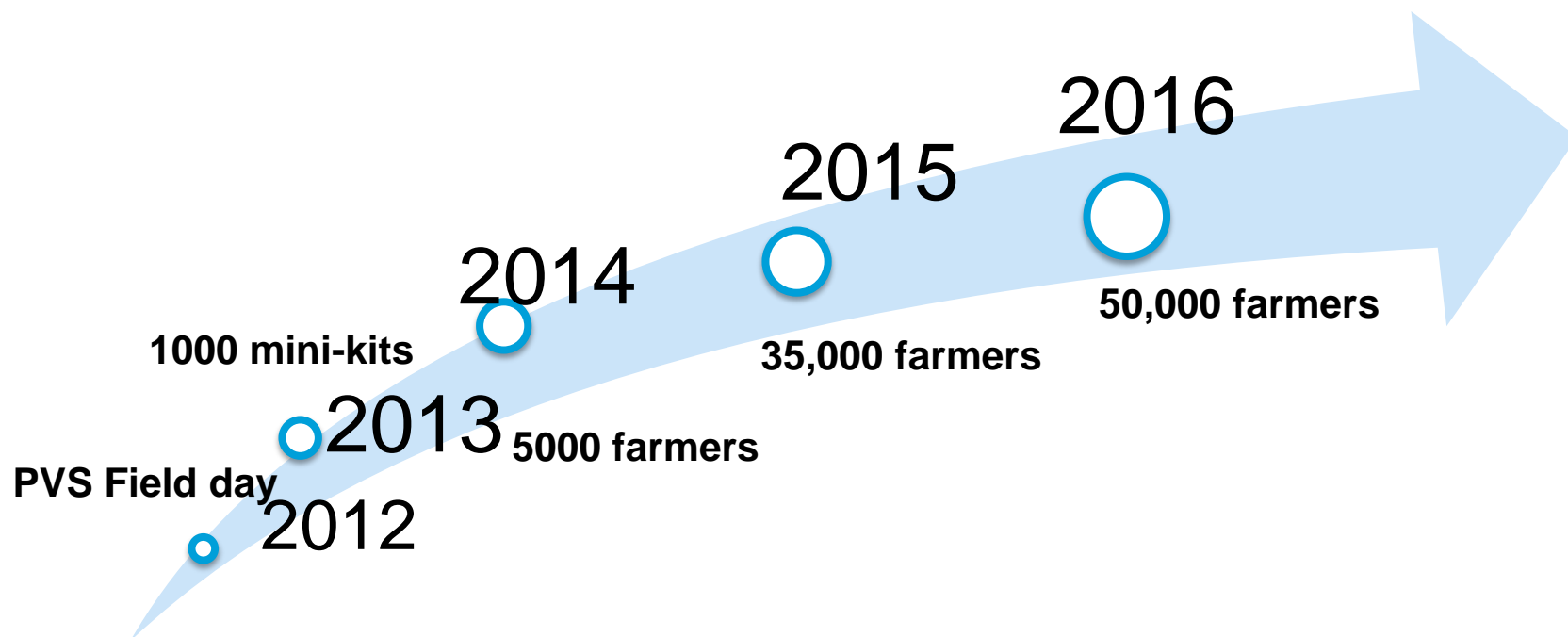
**Zincol 2016:** 1<sup>st</sup> high zinc wheat in Pakistan with +6 ppm Zn = 2000 tons of seed to be sown in 2016-17



**Two sister Mayil lines** (+6 ppm Zn) identified in 2016 for release in NWPZ of India in 2017



# High Zn Wheat Delivery progress & target in South Asia

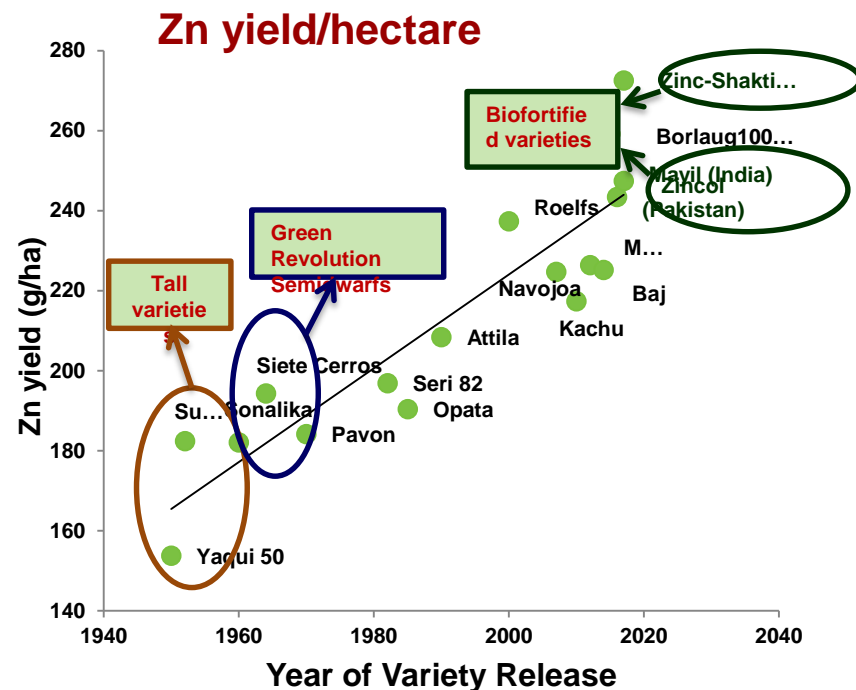
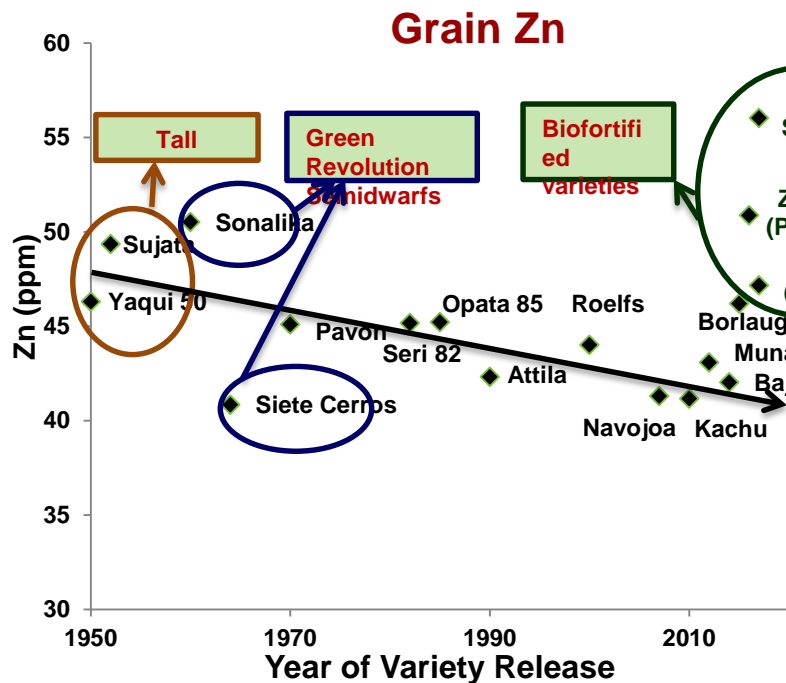


	2014	2015	2016	2017	2018
Area (ha)	2000	40,000	60,000	150,000	350,000
Farming HH	5000	35,000	75,000	250,000	500,000



# Zn in tall, semidwarf and 'biofortified' wheat varieties

(mean 2013-14, 2014-15 & 2015-16 seasons in Zn-enriched fields at Ciudad Obregon, Mexico)



- Grain Zn concentration shows declining trend over year of breeding, however
- Zn yield/hectare shows increasing trend over year of breeding; i.e. newer varieties harvest more Zn from soil
- Biofortified varieties combine high grain Zn with high Zn yield/hectare



# Constraints

- Early generations selections on individual plants level not possible, grains from small-plots can be useful if obtained from soil with more uniform Zn content/availability. - this limits the total number of plots that can be sown and harvested (as small plots and yield trial plots).
- Need appropriate testing program in target countries e.g. high zinc lines in Obregon might not be high in India)
- Continuous funding focused on improving grain micronutrients - funding for Wheat H+ has gone down



# Priorities for mainstreaming

- Maintaining annual genetic gains of 1% to 1.5% in grain yield (& other traits) needs additional funding of 30% increase
- Major increase in costs for main-streaming are for:
  - Increased land for growing plots (advanced lines and yield trials) in Zn homogenized soil.
  - Increased scientific, technical capacity and machines (XRF).
  - Upscaling phenotyping for disease resistance and other traits.
  - Molecular markers development for combining multiple QTLs.
  - Working on genomic selection approaches- prediction of crosses and selecting lines with multiple traits.



# Thank you for your support!

