



# Biofortification: How to Reach 1 Billion Consumers with Micronutrient-Dense Crops

Howarth Bouis

Founding Director and Interim CEO, HarvestPlus

June 10, 2019

---

[HarvestPlus@cgiar.org](mailto:HarvestPlus@cgiar.org) • [www.HarvestPlus.org](http://www.HarvestPlus.org)



## Dietary Diversity

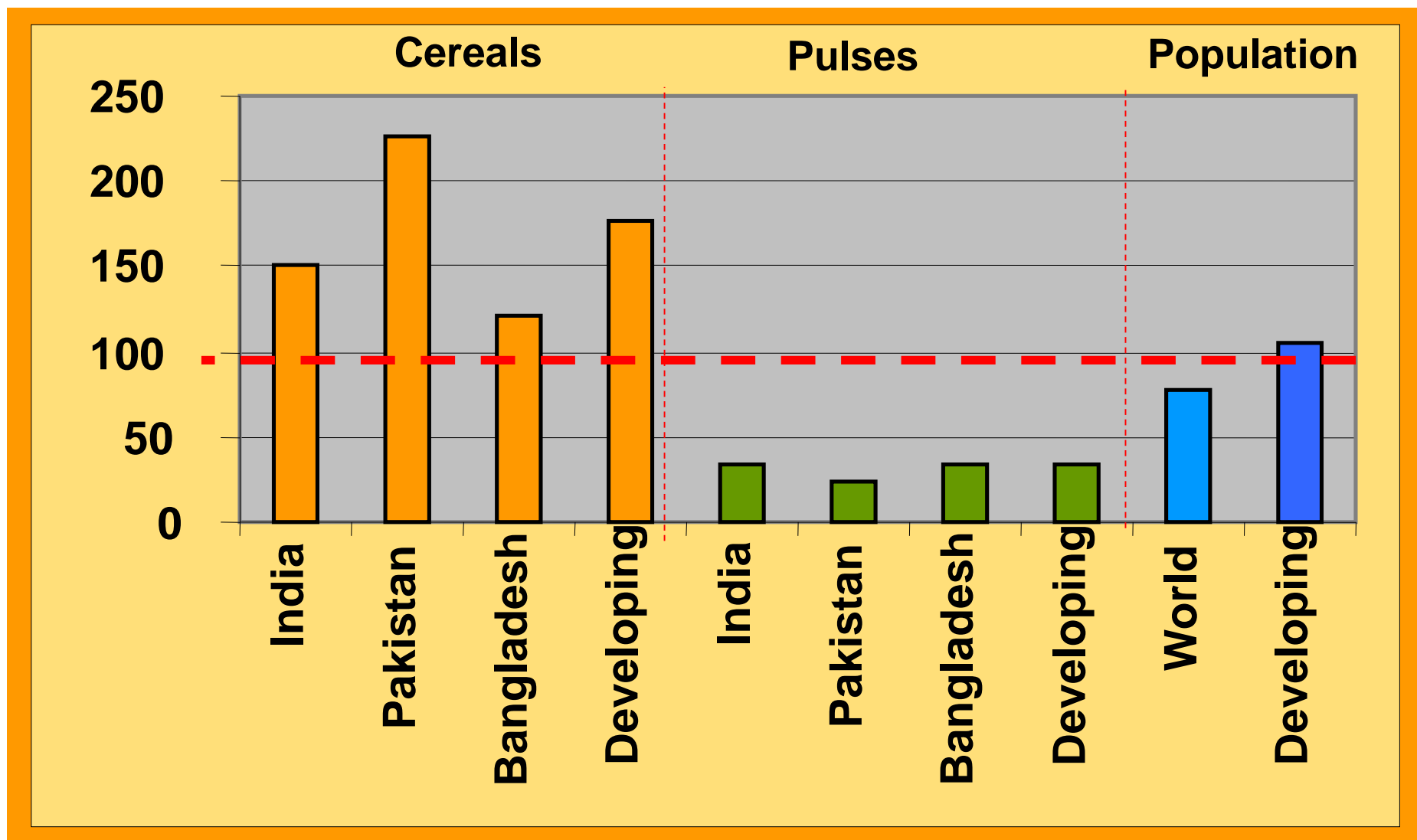
---

Why are Mineral  
and Vitamin  
Deficiencies Such  
A Significant  
Public Health  
Problem?



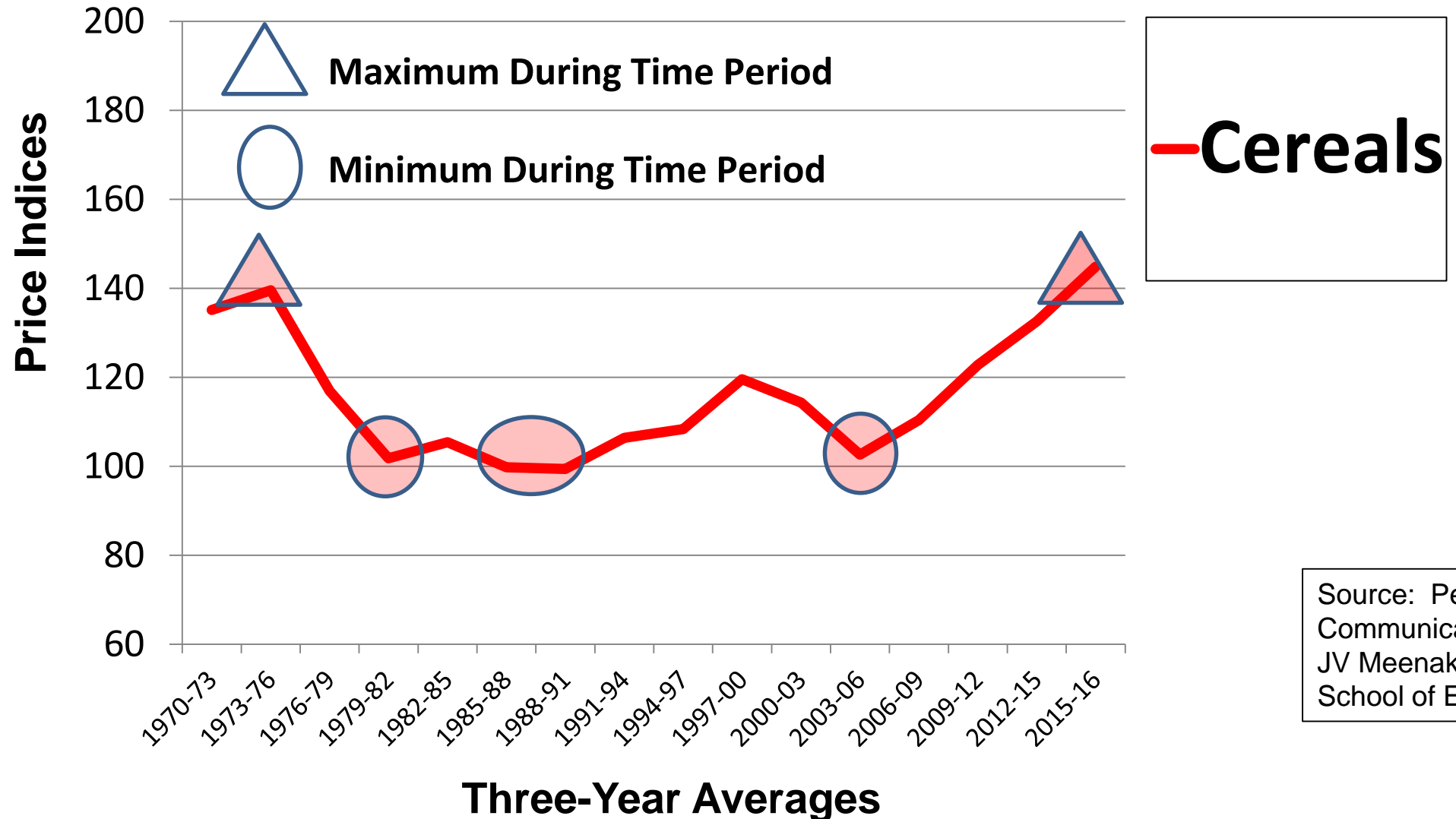


## Percent Changes in Cereal and Pulse Production and in Population Between 1965 and 1999



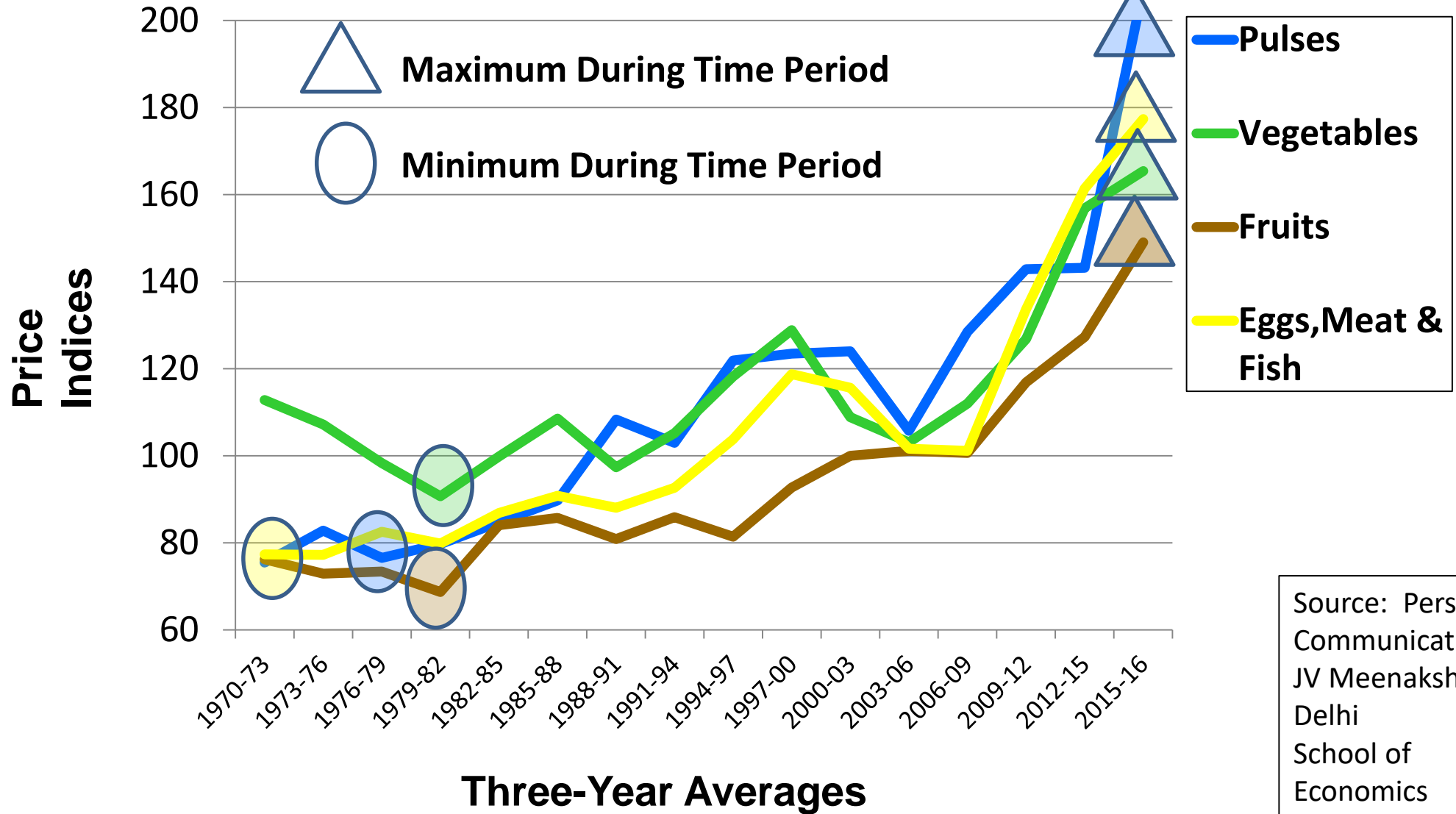


# Price Indices By Food Group for India, 1970-2016, Deflated by Non-Food Price Index



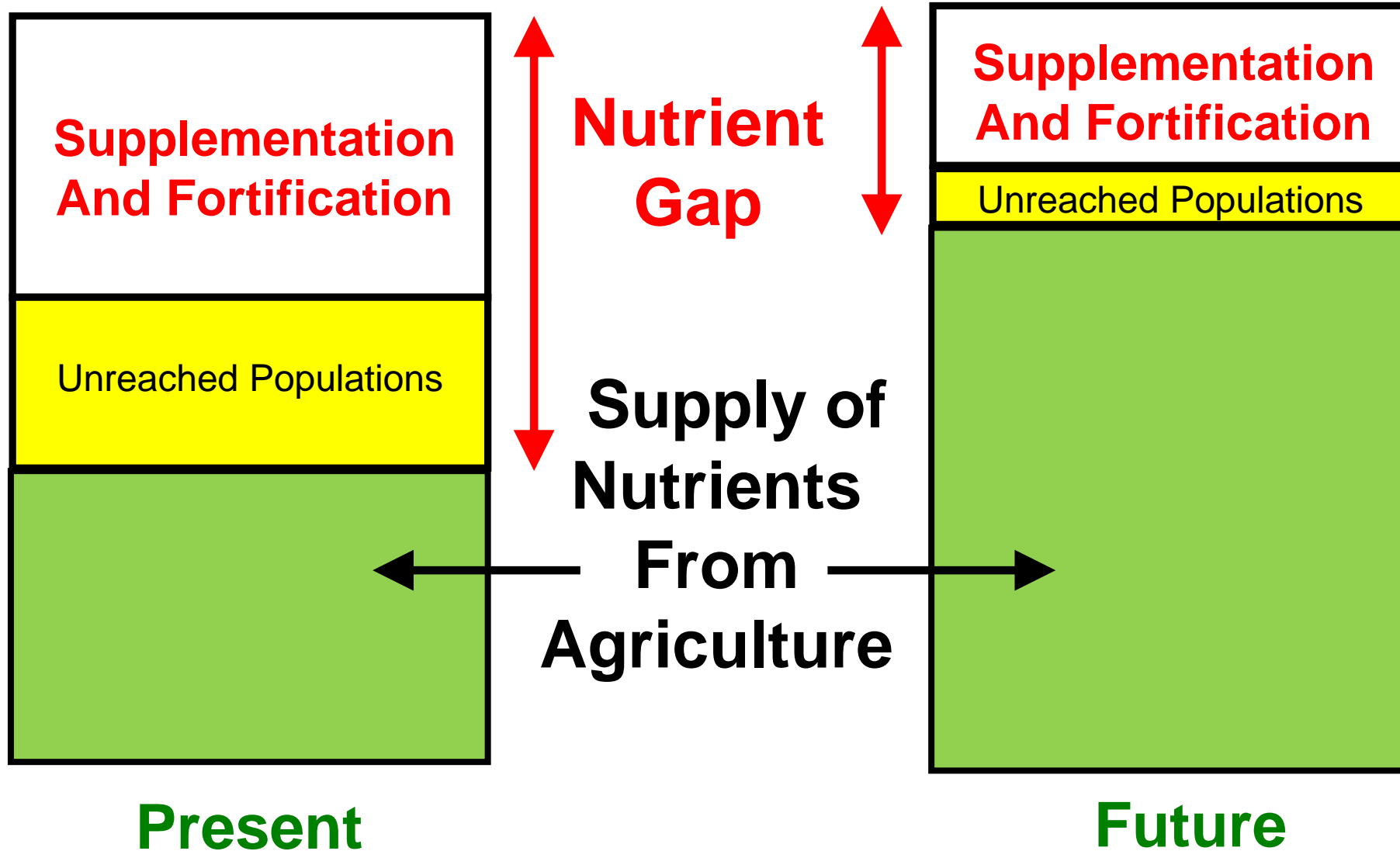


# Price Indices By Food Group for India, 1970-2016, Deflated by Non-Food Price Index





# A Primary Role of Agriculture Is To Provide Nutrients for Healthy Populations







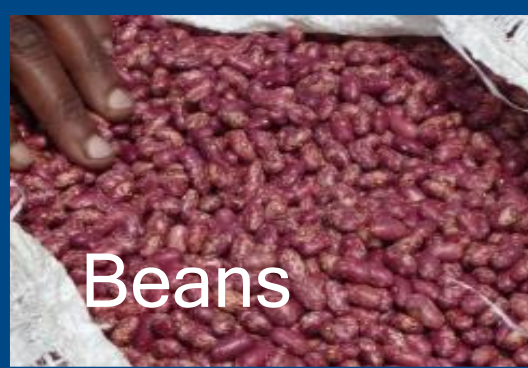
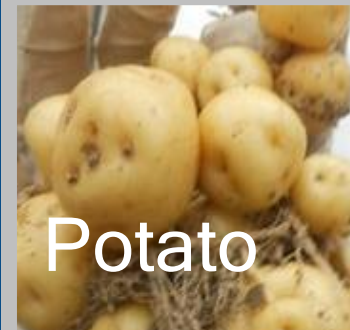
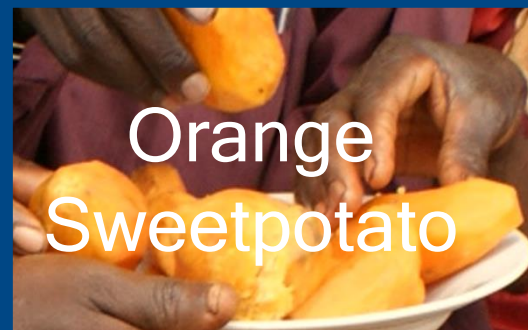
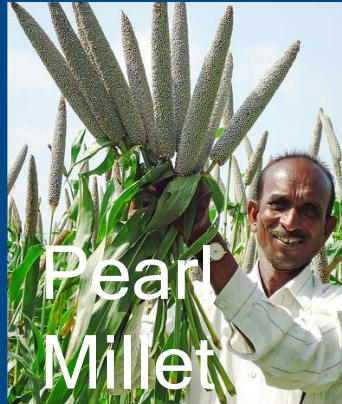
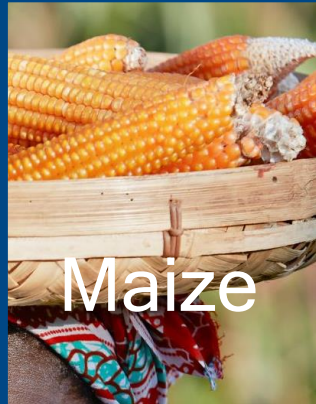
## Per Capita Energy Intakes per Day for Jessore, Bangladesh

	Lower Income	Middle Income	Higher Income
Food Staples	1816	1848	1876
Non-Staple Plant Food	339	427	474
Fish and Animal Foods	47	59	92
All Food Groups	2201	2334	2442





# Biofortified Crops - Reaching over 30 Million





# Over 340 Biofortified Varieties Released

- Biofortified crops released in 30+ countries. Testing underway





## Cost-effective: Central, One Time Investment

---






## Excerpt From UNICEF Brochure

**8 BILLION**  
VITAMIN A CAPSULES



 each silhouette represents  
100 million capsules

 **Government of Canada** **Gouvernement du Canada**

Thanks to a donation programme financed by the Government of Canada and implemented through the Micronutrient Initiative, UNICEF has received more than 8 billion capsules since 1998, which, when combined with programme financing, have been critical to maintaining strong Vitamin A supplementation programmes.

**4 MILLION**

The Micronutrient Initiative estimates that more than 4 million deaths have been averted during this time.

Cost Per Vitamin A Capsule \$US 0.50-1.25 World Bank (2007)



# Biofortification is Climate-Smart

---

- Biofortified crops piggyback on crop varieties that are bred for desirable attributes which include resistance to climate change effects such as tolerance to heat, drought, flooding

## Examples:



Heat and drought  
tolerant iron beans



Drought tolerant  
vitamin A maize

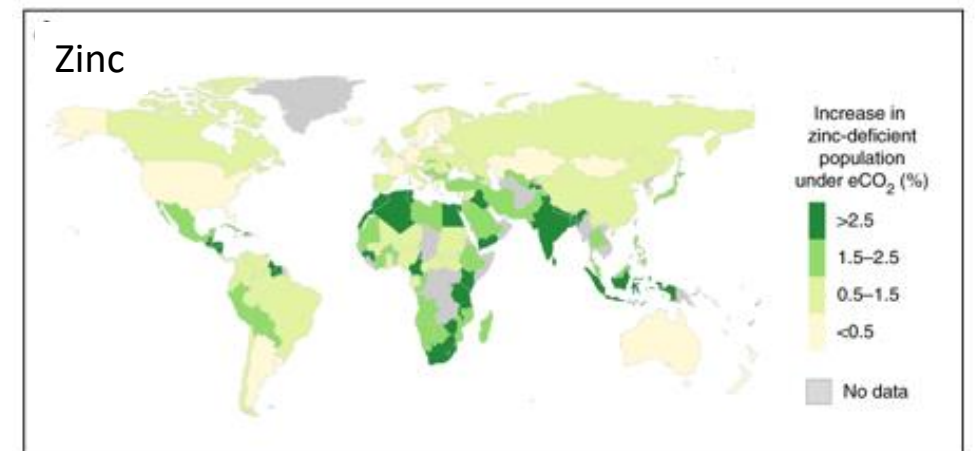
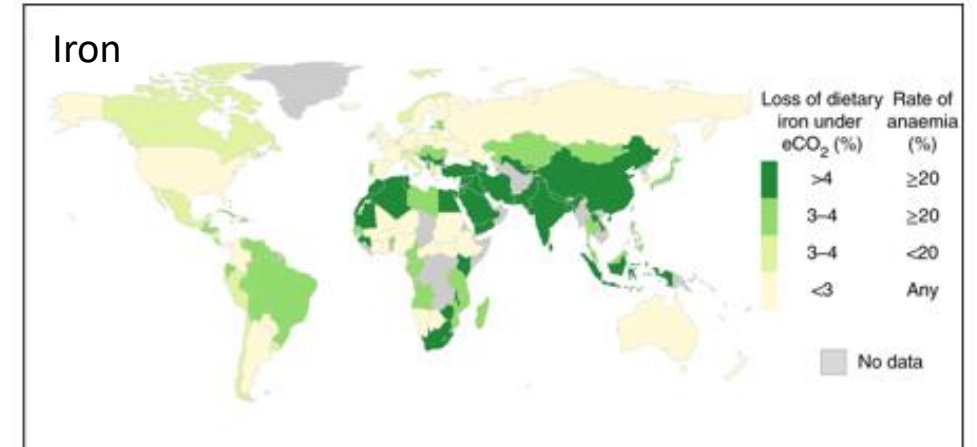


Flood/Submergence  
tolerant zinc rice



# Negative Impact of CO<sub>2</sub> Emissions on Nutritional Value

- **Rising CO<sub>2</sub> levels will likely cause plants to lose nutritional value**
  - Under rising CO<sub>2</sub> levels, many food crops have iron and zinc contents that are reduced by 3-17% compared with current conditions
  - Elevated CO<sub>2</sub> could cause an additional 175 million people to be zinc deficient
  - 1.4 billion women of childbearing age and children under 5 live in countries with greater than 20% of anemia prevalence and would lose >4% of dietary iron



Risk of inadequate nutrient intake from elevated atmospheric CO<sub>2</sub> concentrations of 550 ppm. (Smith and Myers 2018).



## Nutrition Contribution

---

- Biofortified crops, as consumed, provide *an extra* 40% of estimated average requirement each day – substituting one-for-one the biofortified variety for the existing non-biofortified variety.





# Human Nutrition Efficacy Trials

---

Fourteen Efficacy Trials either completed or in process

- High iron crops ✓ +
  - Meta-analysis completed for beans and pearl millet
- High vitamin A crops ✓
  - Multiple efficacy trials completed for sweetpotato, maize, and cassava
- High zinc crops
  - Bioavailability studies positive, one efficacy trial completed, others in data analysis stage

















# Functional Outcomes

---

- Efficacy trials with vitamin A, iron, and zinc biofortified crops have also shown improved functional outcomes:
  - Improved cognitive function (iron)
  - Better work performance (iron)
  - Reduced morbidity (zinc and provitamin A)
  - Better sight adaptation to darkness (provitamin A)

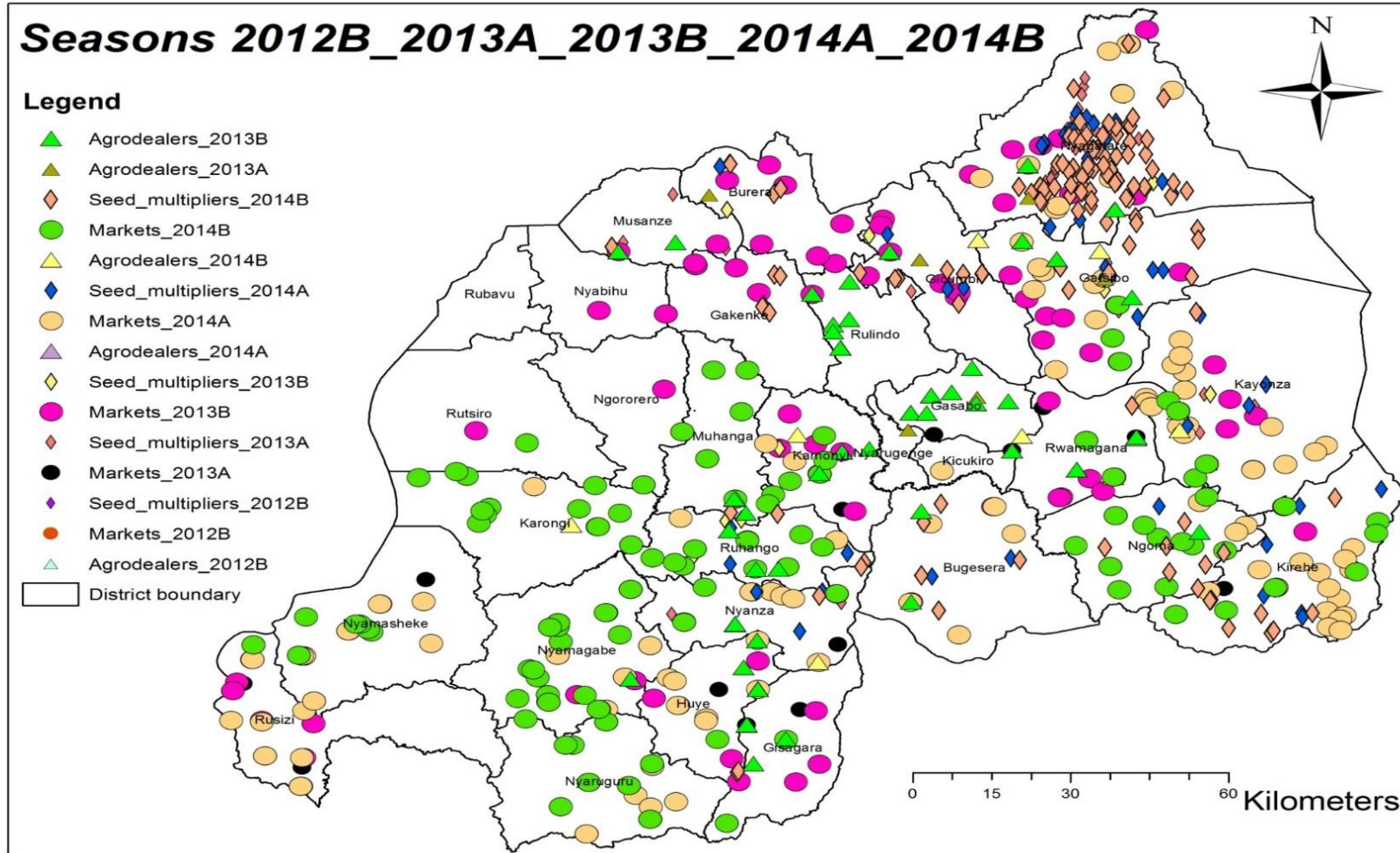


# Ten Bean Varieties Released in Rwanda

 <b>AGRONOMIC PROPERTIES OF IRON BEAN</b> 						
Names	Pictures	Type	Yield potential	Adaptation	Iron content	Maturity
RWV 3316		Climber	4 t/ha	High altitude	91,6ppm	110 Days
RWV 3006		Climber	3.8 t/ha	High altitude	91,7ppm	110 Days
MAC 44		Climber	3.5 t/ha	Mid to low altitude	78 ppm	87 Days
RWR 2245		Bush	2.5 t/ha	Mid to low altitude	75 ppm	87 Days
RWR 2154		Bush	2.5 t/ha	Mid to low altitude	75 ppm	87 Days
RWV 1129		Climber	3.5 t/ha	Mid to high altitude	81 ppm	110 Days
Cab2		Climber	3 t/ha	High altitude	94,8 ppm	115 Days
RWV 3317		Climber	4 t/ha	High altitude	74 ppm	110 Days
RWV 2887		Climber	3.5 t/ha	Mid to high altitude	93,7 ppm	106 Days
MAC 42		Climber	3.5 t/ha	Mid to high altitude	91 ppm	81 Days



# Rwanda: Location of Combined Activities in 2014





# Results Of Nationally Representative Farm Survey

---

## Rwanda 2015 Season B Bean Production

Percentage of Farmers Planting Iron Beans At Least Once	30%
Iron Beans As Percentage of Total Bean Production	16%
Yield Advantage of Climbing Iron Beans	+22%
Yield Advantage of Bush Iron Beans	+17%
Added Value of Production of Climbing Iron Beans	+\$78/hectare
Added Value of Production of Bush Iron Beans	+\$57/hectare



# Cumulative Production & Health Benefits

---

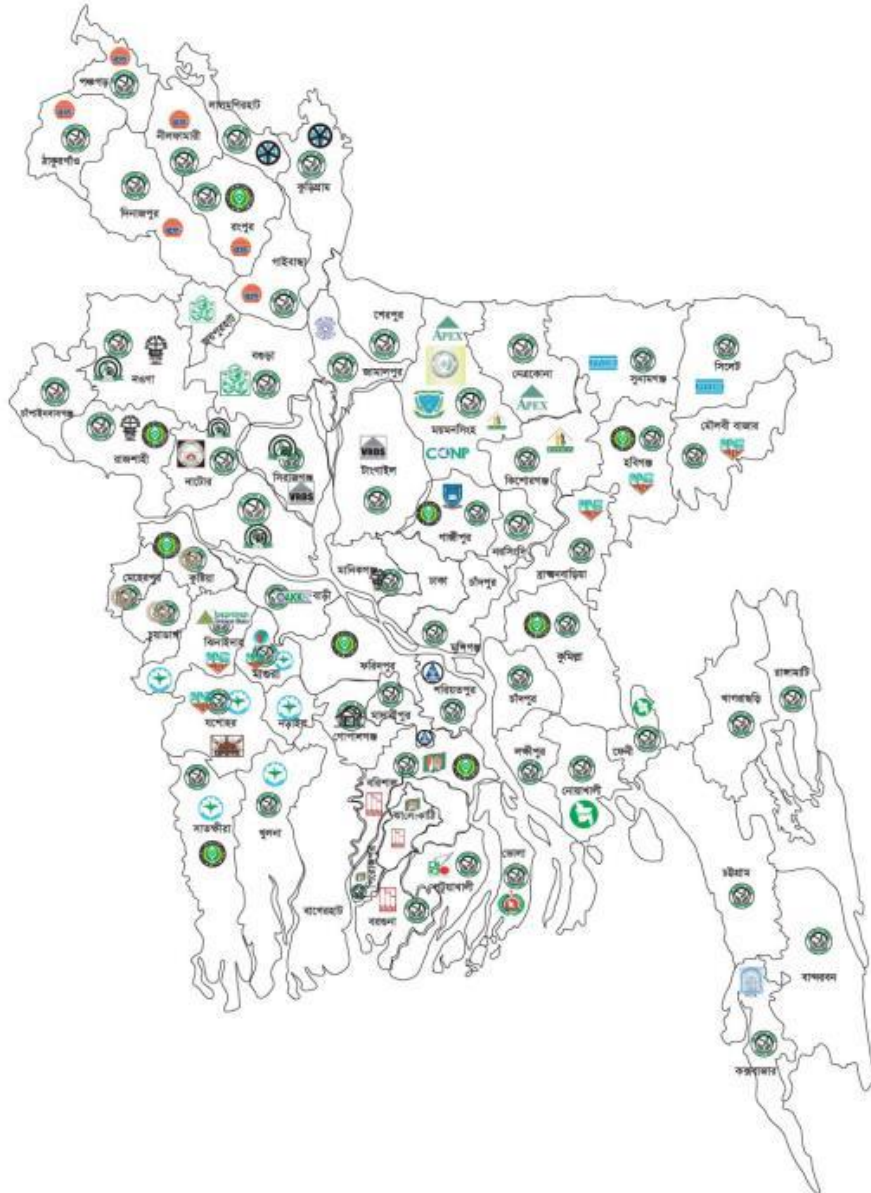
## Iron Beans in Rwanda (\$million)

<b>Observed 2010-2018</b>	
Extra Bean Production	\$19.8
Reduced Iron Deficiency (4,939 DALYs Saved)	\$4.9
<b>Simulated Pessimistic 2010-2025 (no change in 2018 production)</b>	
Extra Bean Production	\$61.6
Reduced Iron Deficiency (16,151 DALYs Saved)	\$16.2
<b>Simulated Optimistic 2010-2025 (2025 production increases to 40%)</b>	
Bean Production	\$83.8
Reduced Iron Deficiency (22,280 DALYs Saved)	\$22.3



# HarvestPlus in Bangladesh

---



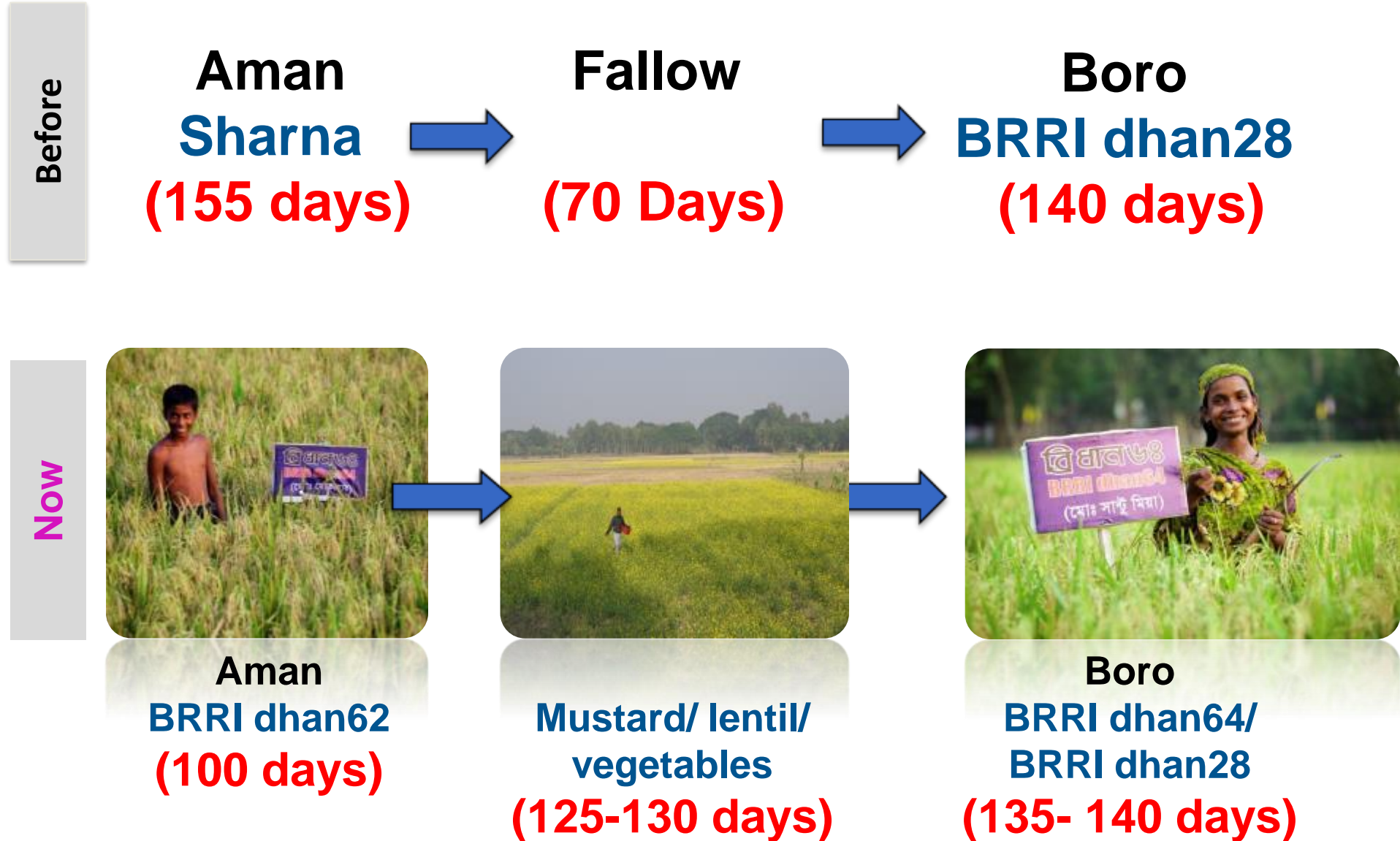
**GO- 5**

**NGO- 25**

**PS- 2 associations  
(300 seed  
companies)**



# Additional Crop in Cropping Pattern





# Harvest Plus and Partners are Catalyzing Robust Supply Chains







# Vitmain A Sweetpotato Puree - No refrigeration

---

Preservative free OFSP puree





# Vitamin A Maize Marketing in Zambia





# Vitamin A Cassava Marketing in Nigeria





PROFESSOR  
**TORBERT'S**

ORANGE CORN

This corn has a story, find  
out more & order online at  
**ProfessorTorberts.com**

Want to talk? Contact us at:  
[Hello@professortorberts.com](mailto:Hello@professortorberts.com)





## Mainstreaming Through Key Stakeholders

---

- Public agricultural research (CGIAR, NARS)
- Seed Companies (SeedCo in Africa)
- Food Companies (exploratory)
- International financial institutions (World Bank, IFAD)
- Multi-lateral agencies (World Food Program, Codex)
- National governments (Brazil, China, India)
- International NGOs (World Vision, GAIN)

## Stay Connected!

 [www.harvestplus.org](http://www.harvestplus.org)

 [harvestplus@cgiar.org](mailto:harvestplus@cgiar.org)



**HarvestPlus**  
Better Crops • Better Nutrition





# Questions?

---

