HarvestPlus
Better Crops • Better Nutrition

CENTRO INTERNACIONAL DE LA PAPA
CIP
A member of the CGIAR Consortium

International Potato Center

Biofortification Overview

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CGIAR

Overview

1. Global Situation
2. The Process of Biofortification
3. Estimated Average Requirements (EARs).
4. Breeding - Nutrition Targets.
5. HarvestPlus – Global Convenor of Biofortification

Micronutrient Deficiencies 2 Billion People!

Vitamin A deficiency

- Supplements reduced child ***mortality*** by 23%.
- 375,000 children go blind each year; compromised immunity.

Iron deficiency

- ***Impaired cognitive abilities*** that cannot be reversed.
- 82% of children < 2 years in India are anemic; anemia also contributes to maternal mortality.

Zinc deficiency

Increased ***incidence/severity Diarrhoea/pneumonia; stunting.***

- 2 billion people at risk; 450,000 deaths per year.

Biofortification – The Process

- Continuous process of crop breeding to improve yields and resistance to pests, diseases, and climate.
- Innovation for Health; adding nutrition as a desirable breeding trait.
- New varieties developed in CG centres, then transferred to countries.
- National Agricultural Research Services (NARS) conduct:
  - crossing/adaptive breeding.
  - test for 2 - 3 years in different terrains, soils, and climates.

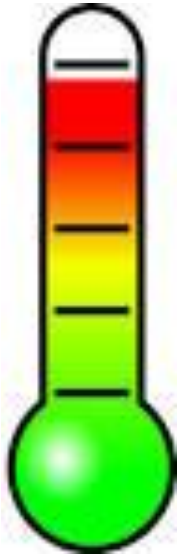
Biofortification Methods

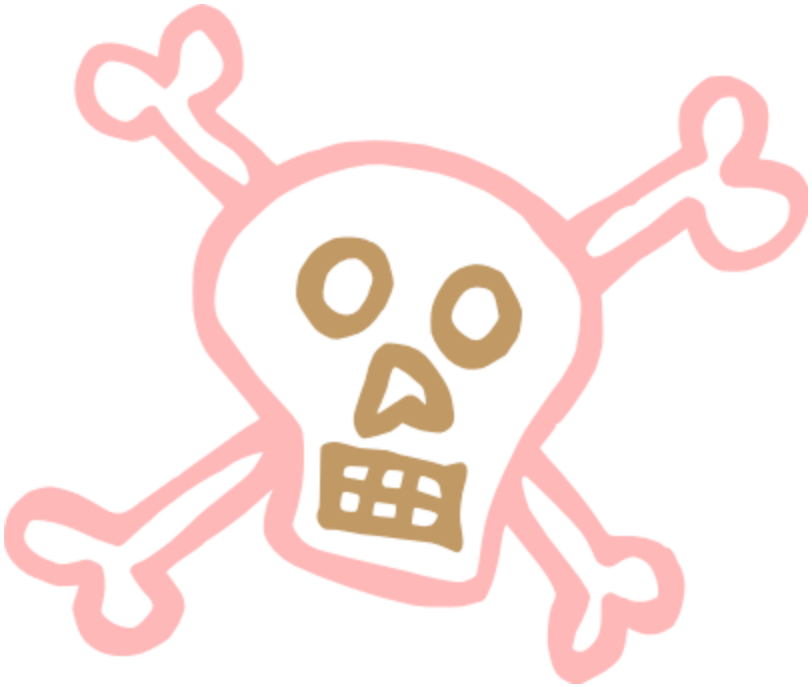
1. **Conventional Breeding**

2. Genetic Modification (Biotechnology, modern biotechnology, gene technology, recombinant DNA technology, or genetic engineering)

3. Foliar Application (Zinc Fertiliser Spraying)

Global Warning!





1. Biofortification is **NOT** GM!
2. Biofortified crops do not pose a threat to World-Domination!
3. Please read 1; above; again!

Crops for Africa & Release Dates

2007

Orange Sweet Potato

Vitamin A

(Uganda, Mozambique, and elsewhere)

Crops are high-yielding and possess other required traits.

Crops for Africa & Release Dates

2011	2012	2012
		
Cassava	**Beans**	**Maize**
Vitamin A	Iron (Zinc)	Vitamin A
(Nigeria	(Rwanda	(Nigeria
DR Congo)	DR Congo)	Zambia)

Crops are high-yielding and possess other required traits.

Crops for Asia & Release Dates

2012

Pearl Millet

Iron (Zinc)

(India)

2013

Rice

Zinc

(Bangladesh India)

2013

Wheat

Zinc

(India Pakistan)

Crops are high-yielding and possess other required traits.

Other Biofortified Crops

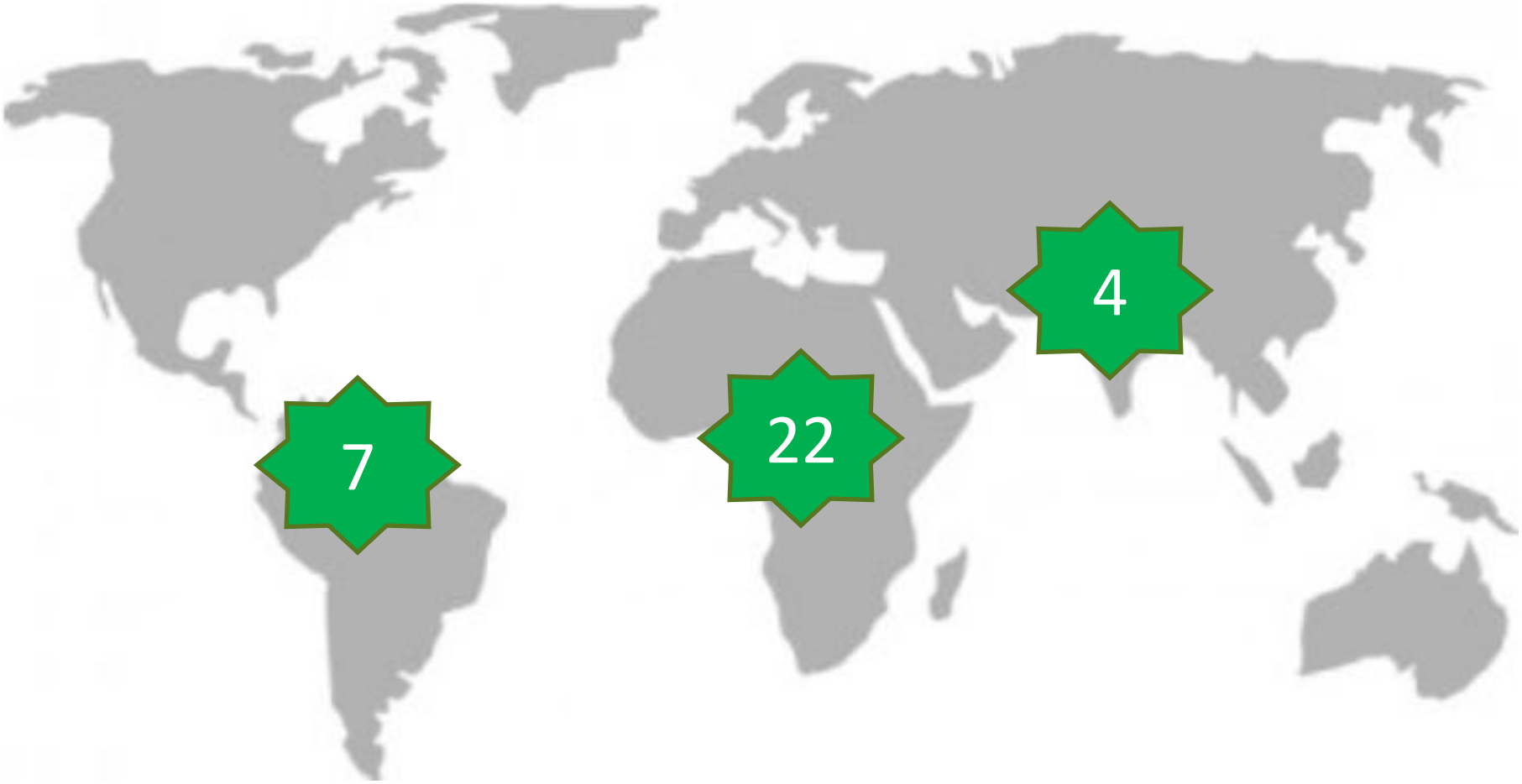
Potato	**Lentil**	**Sorghum**	**Banana/Plantain**	**Cowpea**
Iron	Iron, Zinc	Iron, Zinc	Vitamin A	Iron, Zinc



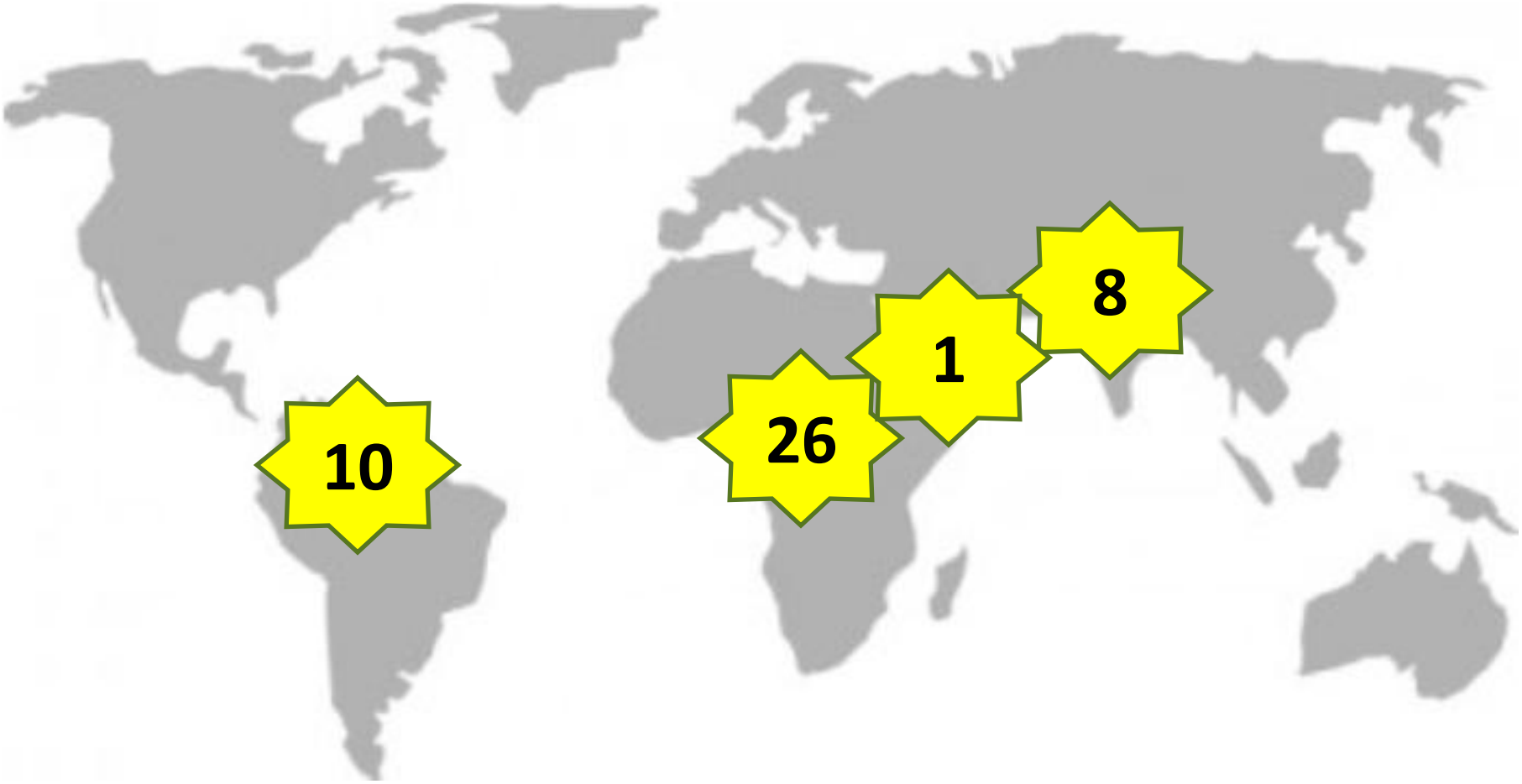


Crops are high-yielding and possess other required traits.

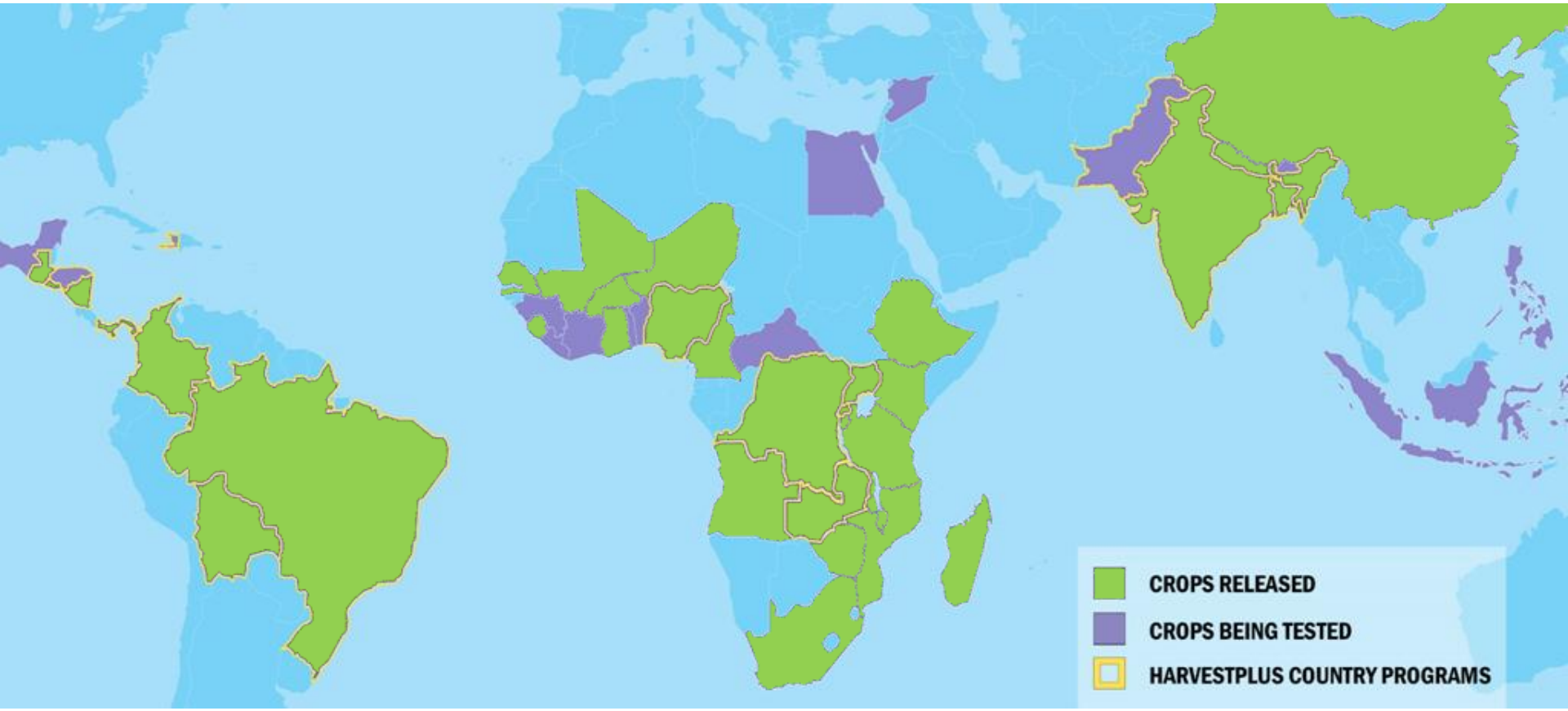
Biofortification - Released



Biofortification - Testing



Biofortified Crops – Released/Testing



Biofortification – The Evidence

- Careful breeding increases nutrient levels without reducing yields.
- Extra nutrients in crops improve micronutrient status.
- Farmers are growing biofortified crops, and consumers are avidly eating them.
- Biofortification is cost-effective, centralised, and a once-only investment. Continually improved varieties are still needed.

When is a Crop Biofortified?


Breeding Research
Nutrition Research
Delivery to Farmers

"Estimated Average Requirement" (EAR) Drives Breeding Targets

Initial Nutrient Concentration – Raw Food

% Nutrient Retained After Harvest
(Storage / Processing / Cooking)

Amount of food consumed

% nutrient absorbed -> utilized (bioavailable)

Contribution to Nutritional Sufficiency
(30-50% EAR)

Breeding Targets - Woman of Reproductive age

(Non-pregnant, Non- Lactating)

Crop	Food Eaten (g/day)	X	"Additional nutrient concentration (µg/g)"	X	Nutrient Retained after storage & processing (%)	X	Absorbed Proportion (%)	=	Nutrient Absorbed (µg/day)	Daily requirement (µg)
Maize & Cassava	400	X	15.0	X	50	X	8.0	=	240	**Vit. A = 500**
Beans	200	X	44.0	X	90	X	5.0	=	396	**Iron = 1460**
Rice & Wheat	400	X	8.0	X	90	X	25.0	=	720	**Zinc = 1860**

Boring Maths!

Nutrient **Absorbed** = **% EAR**

Nutrient **Required** (Estimated Average Requirement)

For:

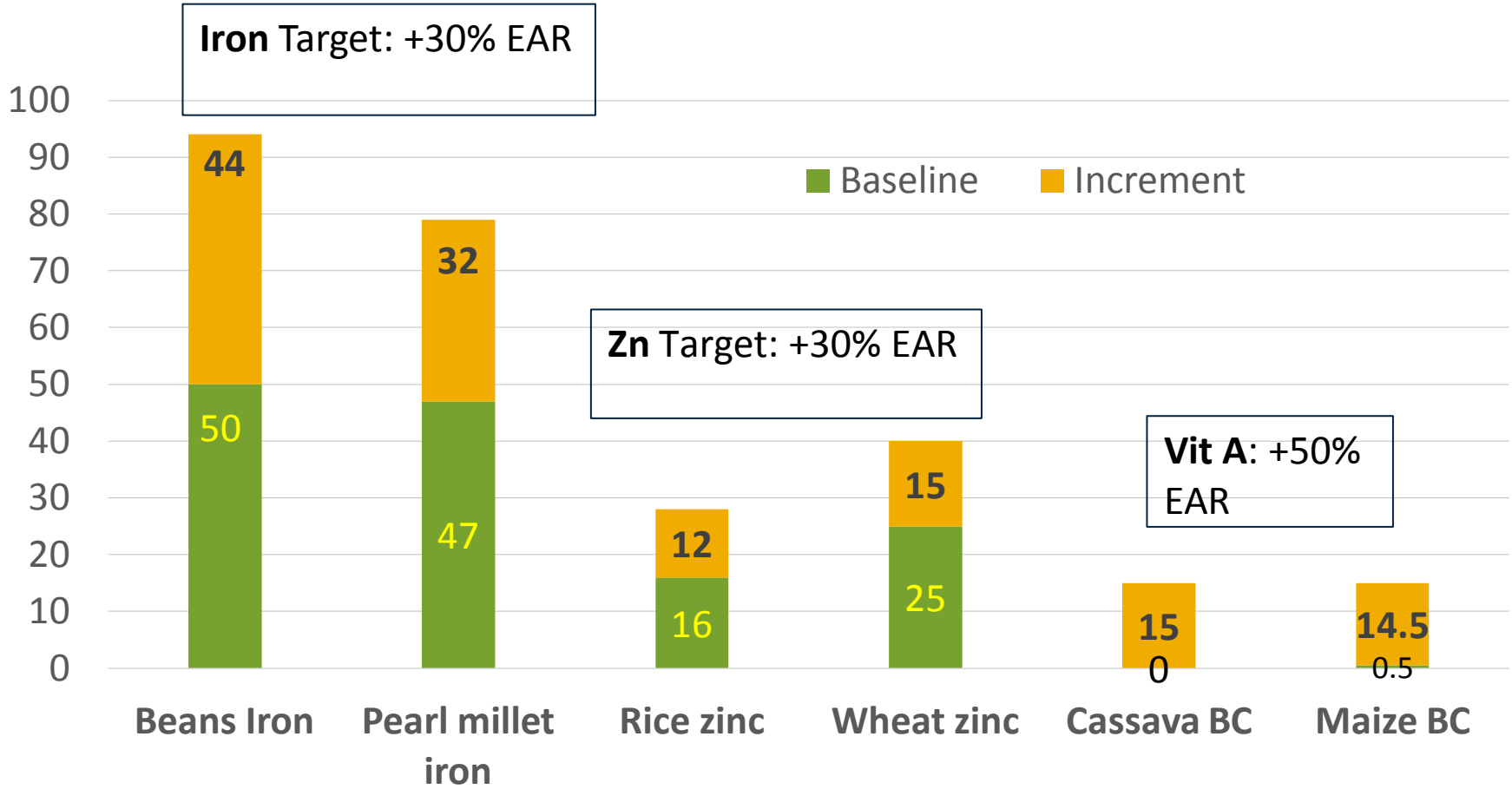
Vit A = **48%**

Fe = **27%**

Zn = **39%**

Nutrient Target Levels by Crop (µg/g)

(Estimated Average Requirement [EAR] for Non-Pregnant / Non-Lactating Women)



Micronutrient Target by Crop (PPM)

Crop	Genetic Variation (Max Discovered)	Average (Non-Biofortified)	Target Increment	HarvestPlus Nutrition Target
Iron Bean	125	50	44	94
Iron Pearl Millet	130	47	30	77
Zinc Rice	30	16	15	**28***
Zinc Wheat	70	25	15	40*
PVA Cassava	15	0.5	15	15.5
PVA Sweet Potato	300+	2	28	30
PVA Maize	15	0.5	15	15.5

* Target not optimal but achievable with conventional plant breeding techniques.

Frequently Asked Questions

- **Not Genetically Modified.**
- Cannot “overdose!”
- Supports, (not undermines), bio-diversity and varied diets.
- Does not just “make bad food better.”
- “Visible” versus “Invisible” traits affecting consumer acceptance.

HarvestPlus

global convenor of biofortification

HarvestPlus Phase 3 Strategic Priorities

Scale up delivery in target countries and expand delivery to new countries

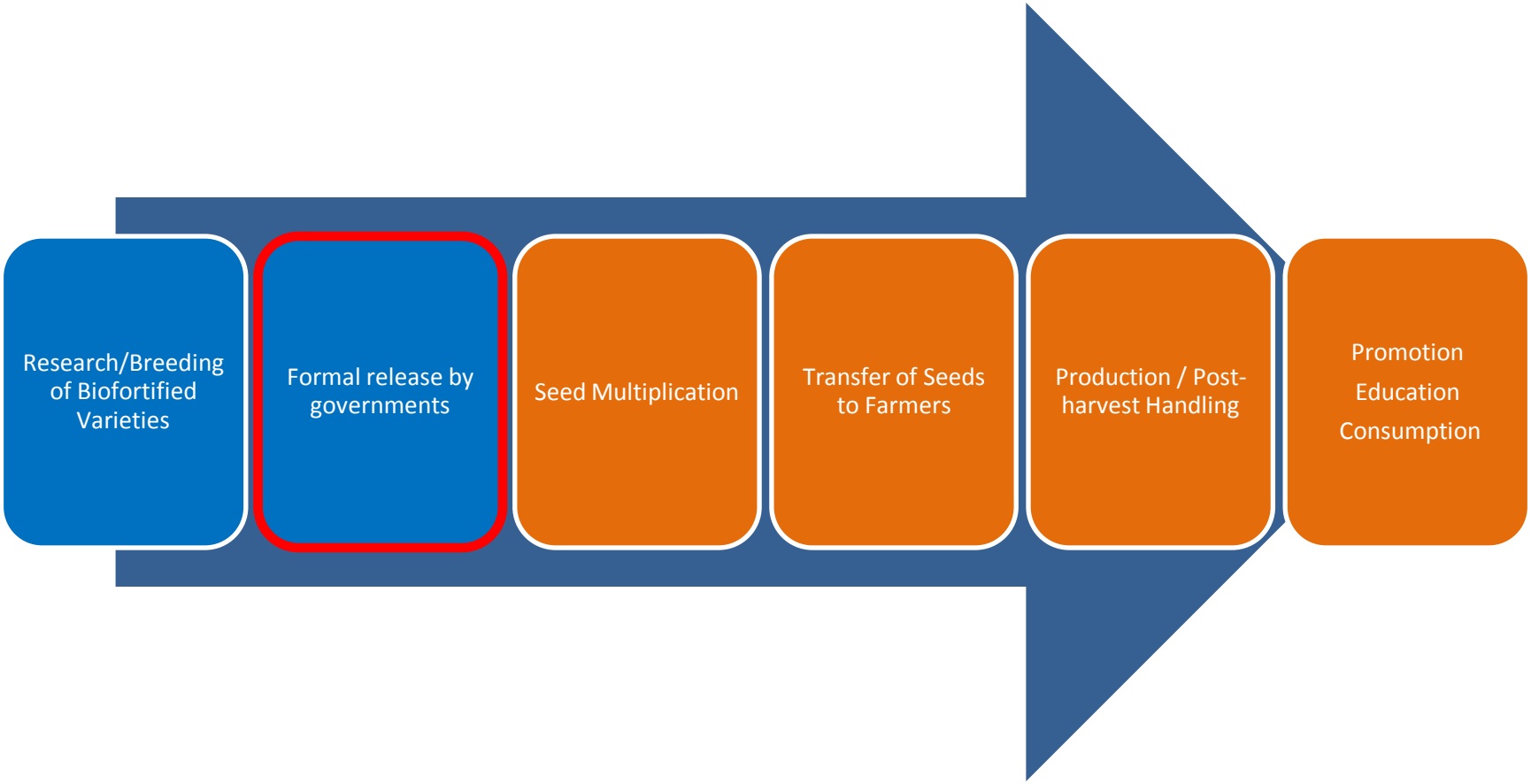
Target Countries

- Implement country level business plans
- Food Basket Approach

Partner Countries

- Scale up delivery of prioritized crops <u>through partnerships</u>
- Develop & deploy technical assistance to support partnerships

Breeding to Consumption



HarvestPlus - Breeding

HarvestPlus **funds** breeding of biofortified crops in:

CG Centres – IITA, CIAT, CIP, CIMMYT, IRRI, ICRISAT

NARS – many countries

Universities

Annual budget going to breeding – 10 million

Country Approach

One crop …

Food Basket …

Partners for Scaling

- Scaling Up and Out with Lessons Learned
- Commercialisation (where possible) and thus sustainability
- Advocacy – bottom to top

HarvestPlus - Africa

Target Country	Crops
Nigeria	**VA Cassava**, VA Maize, Sorghum, Pearl Millet (OFSP)
DRC	**High Fe Beans, VA Cassava**, VA Maize, OFSP
Rwanda:	**High Fe Beans**, VA Maize (OFSP)
Uganda	**OFSP**, High Fe Beans, VA Maize, VA Cassava, Pearl Millet
Zambia	**VA Maize** (High Fe Beans, OFSP)

Seed Multiplication

- NARS provide access to released seed / stems /vines for multiplication.
- Multiplied and distributed via:
  - Seed companies.
  - CBO / farmer groups.
  - Government agencies.

Seed Quality Control

- Capacity-building needed with Multipliers.
- Different seed quality available:
  - “Quality-Declared” seed.
  - “Certified” seed.
  - “Truthfully Declared” seed (India)

Getting Seeds to Farmers

- Delivered by commercial and non-commercial sources:
  - Seed companies.
  - Agro Dealers.
  - Farmer to Farmer.
  - Project / NGOs.
  - Government systems.

Encouraging Production

- Creating demand for Biofortified Seeds with Farmers by:
  - Extension staff training.
  - Farmer training.
  - Lead mothers and clinics.
  - Nutrition messaging, integrated with agronomic and marketing messages / training.

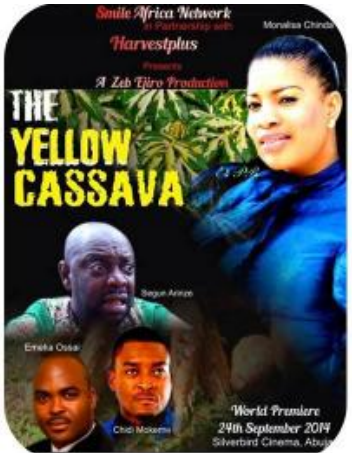
Partnerships for scaling-up

Reaching urban consumers !

Promoting Consumption

- Innovative campaigns are needed to encourage production and consumption by target community.
- Many tested methods: Radio Dramas, print (and other media), Community Theatre, consumer tasting / cooking demonstrations.

Consumer tasting sessions with Orange Sweet Potato in Uganda



HarvestPlus / Nollywood collaboration on Yellow Cassava in Nigeria

HarvestPlus joint roadshow with afroPop, rap, R&B musicians to promote iron beans in Rwanda

Thank You!

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