HarvestPlus
Better Crops • Better Nutrition

Smallholder Farmers and Biofortification:

Improving Access to Nutritious, Healthy Food and Enriching Food Systems

HarvestPlus@cgiar.org • www.HarvestPlus.org

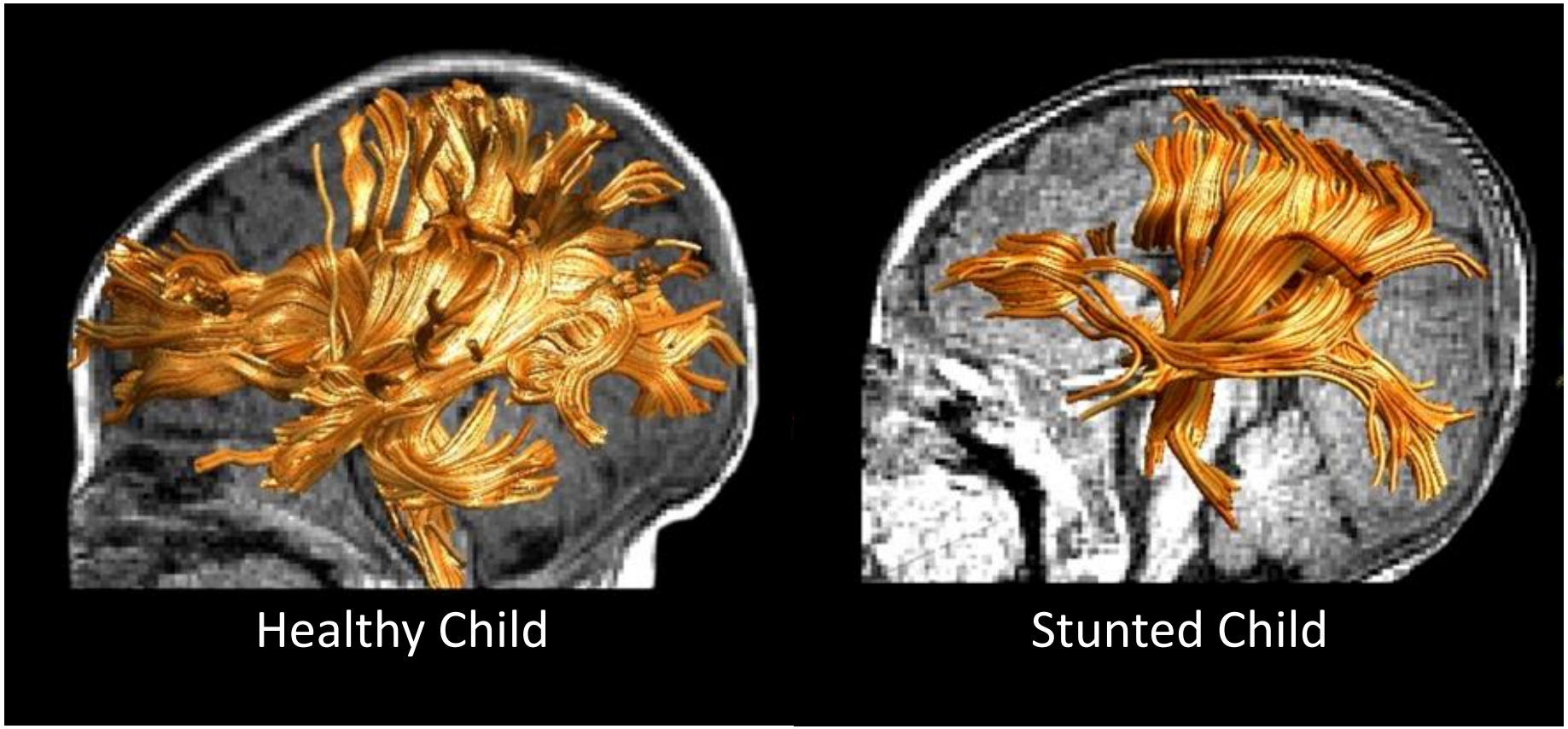
CGIAR RESEARCH PROGRAM ON Agriculture for Nutrition and Health
Led by IFPRI

The Scale of Hidden Hunger

2 billion people lack
access to safe, nutritious
and sufficient food

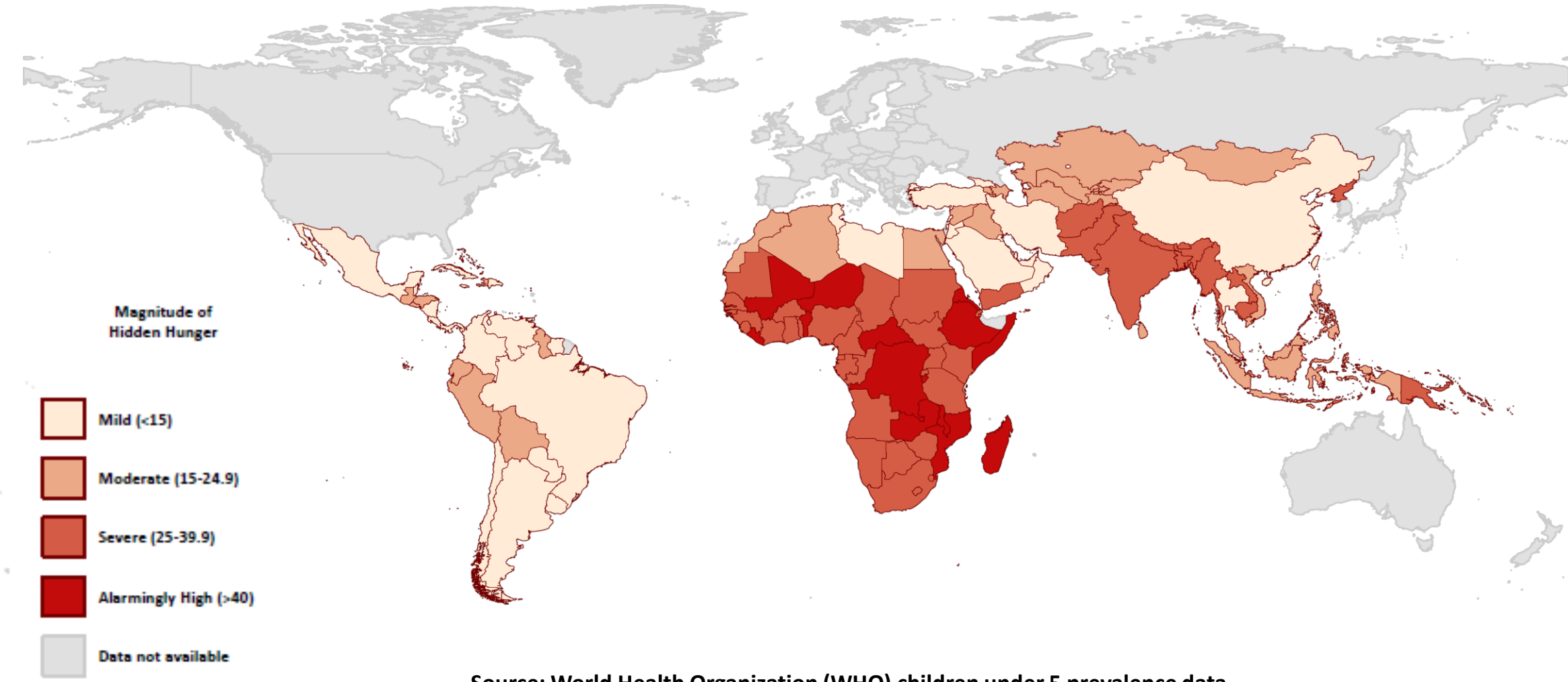
Globally, **one in four children**
are physically and cognitively stunted
due to poor nutrition

The Costs of Hidden Hunger and Stunting



Nelson CAT et al. (Harvard Medical School), 2017

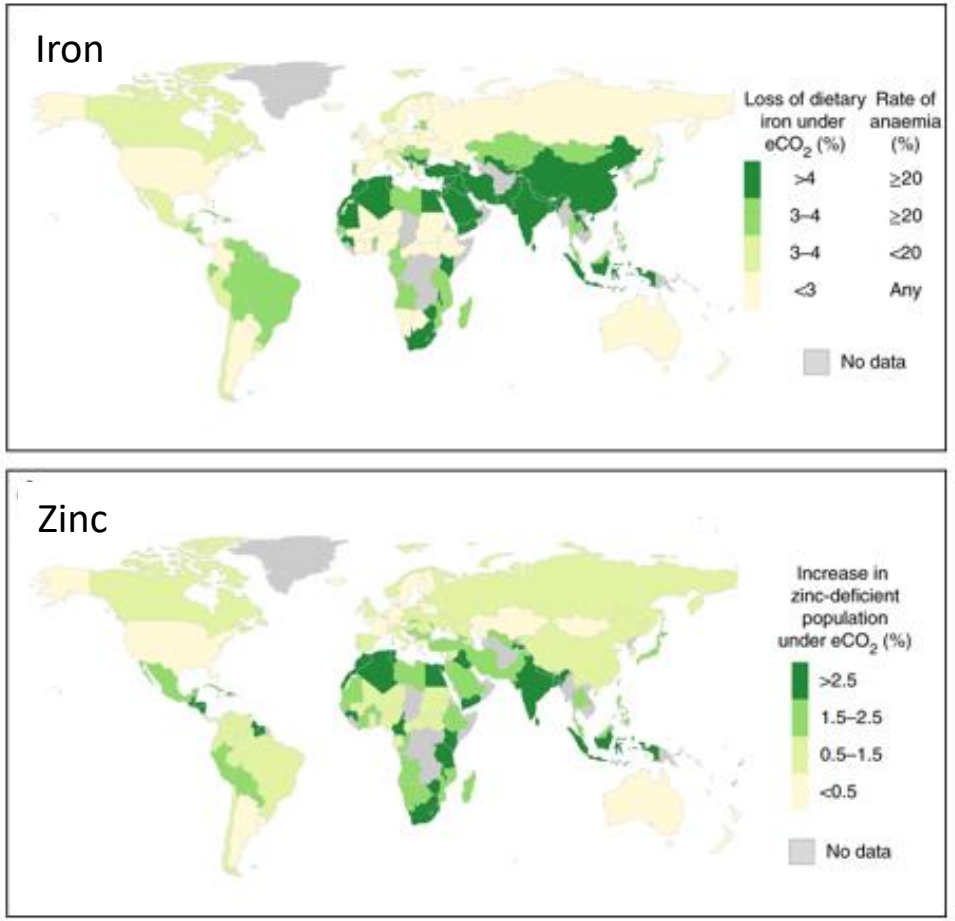
Global Hidden Hunger Index



Source: World Health Organization (WHO) children under 5 prevalence data

Negative Impact of CO_2 Emissions on Crop Nutrition

- **Moreover, rising $C0_2$ levels will likely cause plants to lose nutritional value**
  - Under rising CO2 levels, many food crops have iron and zinc contents that are reduced by 3-17% compared with current conditions
  - Elevated CO_2 could cause an additional 175 million people to be zinc deficient
  - 1.4 billion women of childbearing age and children under would lose >4% of dietary iron



Risk of inadequate nutrient intake from elevated atmospheric CO2 concentrations of 550 ppm. (Smith and Myers 2018).

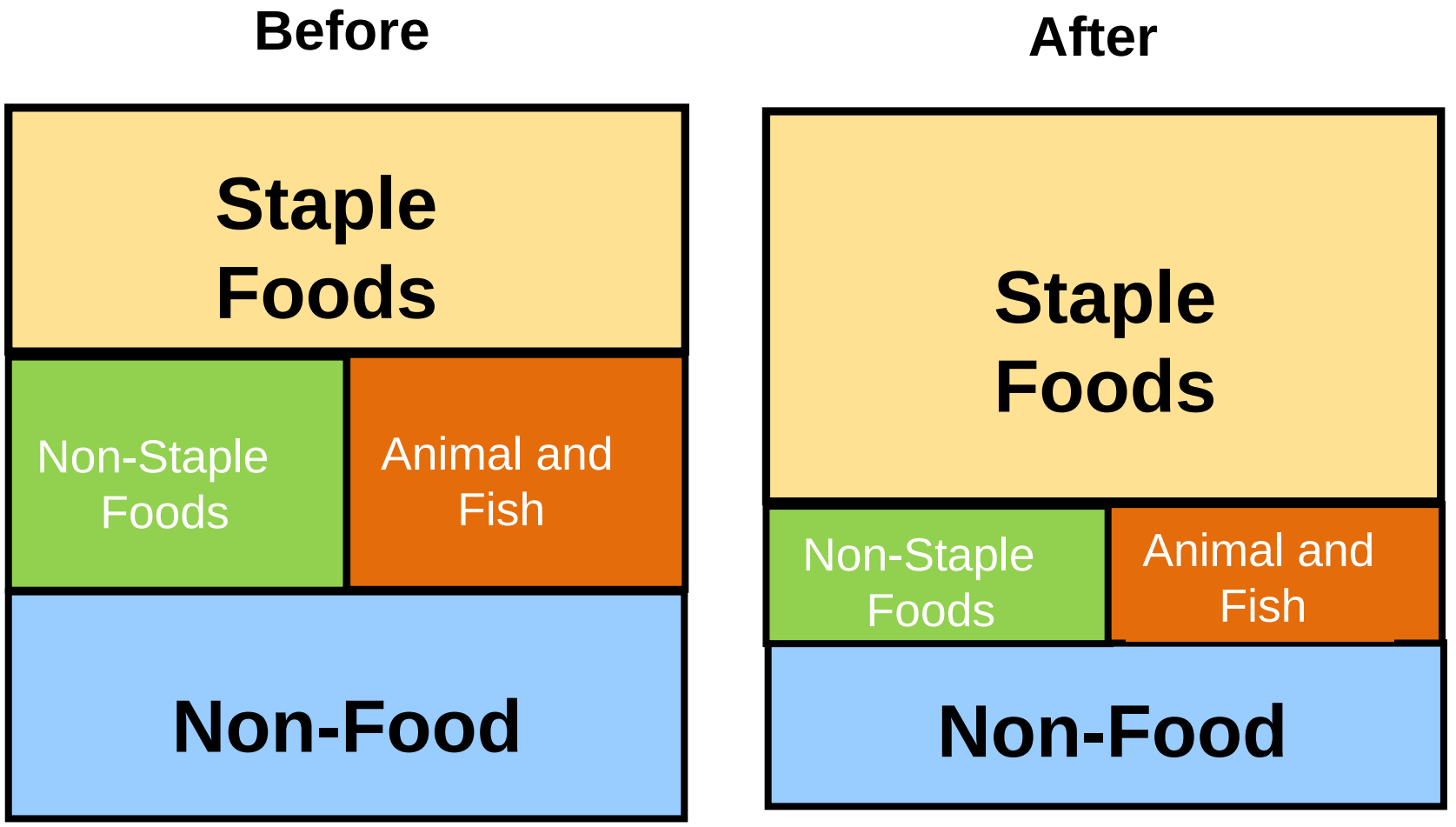
Climate Change lowers Food Security for Smallholders

- Rising temperatures, unpredictable rainfall and extreme weather events have negative impacts on:
  - crop yields
  - pest and disease incidence
  - income generation
  - food security

- Dietary diversity is threatened; fruit and vegetable crops are relatively sensitive to environmental changes

50% Increase in All Food Prices

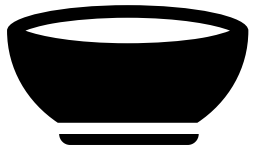
Share of Total Expenditures



(Bouis, Eozenou, Rahman, 2011)

When Dietary Diversity is out of Reach:

Complimentary Solutions:



Food Fortification
-requires ongoing investment
-doesn't reach rural populations who grow their own food

Supplementation
-requires ongoing investment
-expensive to reach rural populations regularly

Biofortification
-sustainable, up-front investment
-reaches rural communities and farming families

A Nutrition Smart, Climate Smart Solution:

BIOFORTIFICATION:

HarvestPlus-supported crops are developed through **conventional breeding techniques** (non-GMO) to increase their density of iron, zinc, or vitamin A.

They are bred based on the **highest-yielding varieties available**, making them highly attractive to farmers.

They are also **climate-smart**—many varieties carry drought- and heat-resistant traits.

These biofortified crops are **global public goods**, distributed through government, NGO, and private sector channels to smallholder farm families who often aren't reached by food fortification and supplementation programs.

Biofortified Crops Include…

Zinc

Wheat
Provides **up to 50%** of daily zinc needs

Rice
Provides **up to 40%** of daily zinc needs

Maize
Provides **up to 70%** of daily zinc needs

Vitamin A

Sweet Potato
Provides **up to 100%** of daily vitamin A needs

Cassava
Provides **up to 100%** of daily vitamin A needs

Maize
Provides **up to 50%** of daily vitamin A needs

Iron

Pearl Millet
Provides **up to 80%** of daily iron needs

Beans
Provides **up to 80%** of daily iron needs

Costs of Micronutrient Deficiencies

We need Iron for:

brain development
immune function
good energy levels
healthy pregnancy

Iron deficiency causes:

Anemia

Fatigue and weakness

Impaired cognition

We need Vitamin A for:

vision health
preventing infections
fetal development

Vitamin A deficiency causes:

Impaired vision

Night blindness

Higher risk of infection/death

Poor pregnancy outcomes

We need Zinc for:

growth/development
immune system function
protein/DNA synthesis
reproductive health
healthy body tissues

Zinc deficiency causes:

Stunting

Susceptibility to infection
(e.g. diarrhea, pneumonia)

Cell damage

Proven Effective in Improving Health

Iron biofortified crops reverse iron deficiency and improve cognitive & physical functions

(Finkelstein *et al*., 2015)
(Haas *et al*., 2016)
(Murray-Kolb et al., 2017)
(Murray-Kolb et al., 2018)

Vitamin A biofortified crops reduce vitamin A deficiency & days with diarrhea and improve vision

(Hotz *et al.,* 2012,), (Gannon *et al*., 2014, Palmer *et al.*, 2016b), (Talsma *et al.,* 2016)

Zinc biofortified crops improve immune function and reduce days with pneumonia, vomiting and fever

(Zyba et al, 2017)
(Sunil et al, 2018)
(Rosado et al, 2009

Biofortification is Climate-Smart

- Biofortified crops are bred and tested:
    - for desirable attributes which include resistance to climate change effects such as tolerance to heat, aridity, and drought
    - for increased levels of micronutrients
    - to ensure their nutritious benefits remain even in adverse climates

Examples:

Heat and drought tolerant iron beans

Drought tolerant vitamin A maize

Heat tolerant/ low water iron pearl millet

Biofortification Benefits Women and Children

- Biofortified foods reach all members of the house, unlike other nutrient dense foods which are sometimes limited or restricted

- Micronutrient requirements are highest for women and preschool children because of their needs for reproduction and growth, respectively

- Biofortified crop nutrient targets meet the estimated average requirements (EARs) of women of reproductive age (as well as children)

Stop Stunting While it's Preventable

- To prevent irreversible stunting, micronutrient deficiencies must be reversed in pregnant mother and the first 1,000 days
  - 21.9% of children under 5 are stunted (UNICEF/WHO/World Bank 2019)

- Interventions like biofortified iron crops can improve maternal and child iron status and mental and physical performance, breaking intergenerational cycles of poverty

Cost Effective and Sustainable

- The Copenhagen Consensus has ranked biofortification as **highly cost effective**, estimating that **$1 of investment in biofortification yields $17 of benefit.**

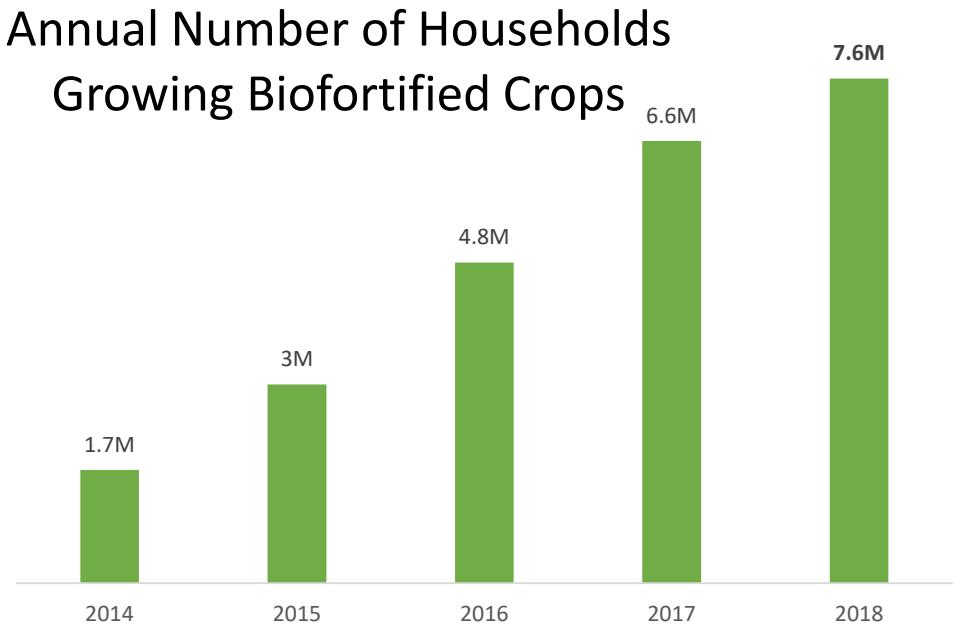
- According to the World Bank, **Cost per disability-adjusted life year** (DALY) saved is estimated at a “highly cost-effective” $15-20.

- Biofortified seeds put a nutrition solution in the hands of farming families that they can grow year after year, letting the plants do the work

Over 340 Biofortified Varieties Released

- Biofortified crops released in 30+ countries. Testing underway in over 20 more

Benefiting from Biofortified Crops



7.6M HH translates to
38M PEOPLE BENEFITING
by the end of 2018

harvestPlus Focus Countries

Africa

Angola
Benin
DR Congo
Ethiopia
Ghana
Kenya
Madagascar
Malawi
Mali
Mozambique
Niger
Nigeria
Rwanda
Tanzania
Uganda
Zambia
Zimbabwe

Asia

Bangladesh
China
Egypt
India
Indonesia
Nepal
Pakistan
Philippines
Vietnam

LAC

Brazil
Colombia
Guatemala
Mexico

Knowledge Transfer and Capacity Strengthening

67,320

Total number of farmers, seed dealers, processors, Retailers trained by HarvestPlus in 2018

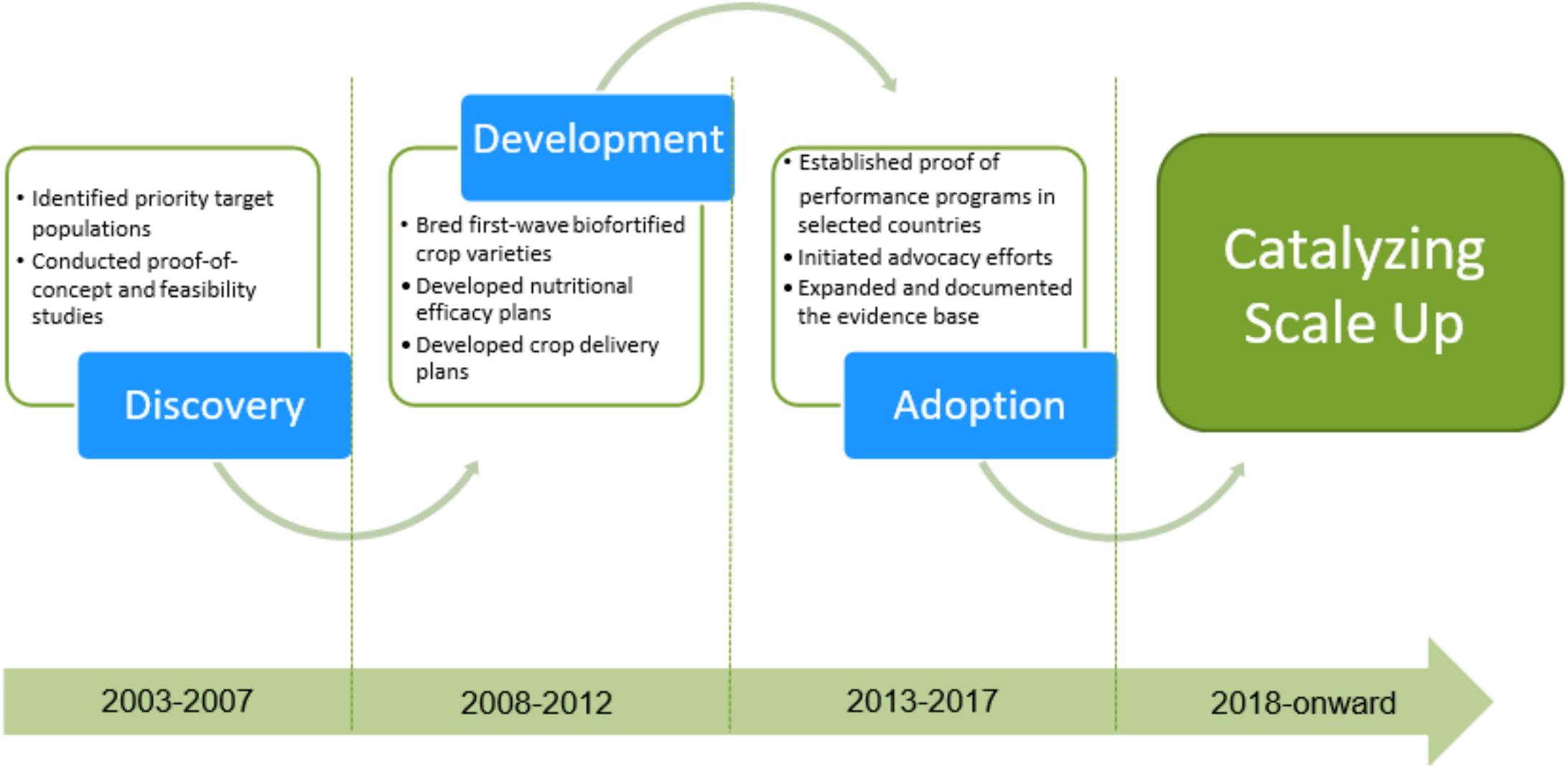
62 percent of trainees were women

The HarvestPlus Program At a Glance

We partner with hundreds of private, government, NGO, and multilateral partners working to build sustainable biofortified food systems.

- **We are a catalyzer, capacity strengthener, advocate, and knowledge hub** for biofortification as a solution to hidden hunger.
- **We are a trusted intermediary** spurring collaboration and learning among diverse stakeholders.
- **We are more than 150 staff** based in 11 countries, with a wide range of expertise in:
  - crop development
  - farmer training and empowerment
  - policy advocacy and engagement
  - food products and value chain development
  - nutrition research
  - impact monitoring/evaluation
  - communication

HarvestPlus: In the Scaling Up Phase



Catalyze Biofortified Food Systems

Ensuring Supply

- Breed and test seeds with CGIAR and national research centers
- Deliver seeds and and support to farmers
- Develop seed value chains
- Strengthen local capacities in extension, aggregation, processing, etc.

Advancing Enabling Environments

- Advocate for biofortification in policies, programs, and budgets
- Support champions networks
- Promote endorsement by global, regional bodies
- Advance global standards

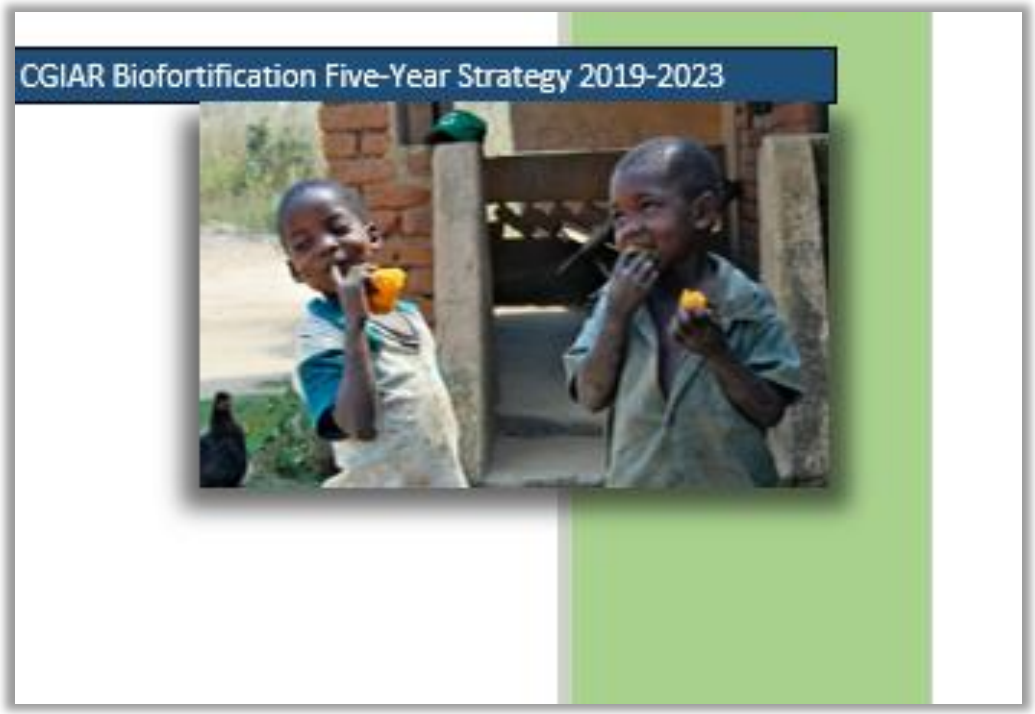
Marshaling Evidence

- Support independent research on nutritional impact, adoption, and cost-effectiveness
- Evaluate uptake and reach
- Convene experts and stakeholders to share knowledge, lessons, and know-how

Stimulating Demand

- Forge partnerships with food and distribution companies
- Provide marketing support
- Include biofortified foods in public support and school feeding programs
- Educate consumers
- Engage media and influencers

Leading the CGIAR Biofortification Strategy



Mainstreaming Biofortification in CG breeding

IITA
Transforming African Agriculture

IRRI

ICRISAT
INTERNATIONAL CROPS RESEARCH INSTITUTE FOR THE SEMI-ARID TROPICS

CIMMYT

CIP
INTERNATIONAL POTATO CENTER
A CGIAR RESEARCH CENTER

Supported in National and International Policy

Over 20 countries included biofortification in national agriculture nutrition and health policies and plans

This has resulted in **endorsements,** such as by

- key committees in **The African Union** – (Technical Committee of Department of Rural Economy and Agriculture Agenda)
--**AfDB** nutrition strategy
-and **54 heads of state**

As well as in **reports** like
-**Malabo-Montpellier Panel Report** "Nourished: How Africa Can Build a Future Free from Hunger and Malnutrition"
and
-the **World Bank's Agriculture Global Practice Report** "An Overview of Links Between Obesity and Food Systems Implications for the Agriculture Agenda"

Setting Standards for Breeding and Nutrition

A new 5-year Nutrition Action Plan from the **African Development Bank** features biofortification among a few high-priority investments with the potential for the generating the “greatest impact on nutrition.”

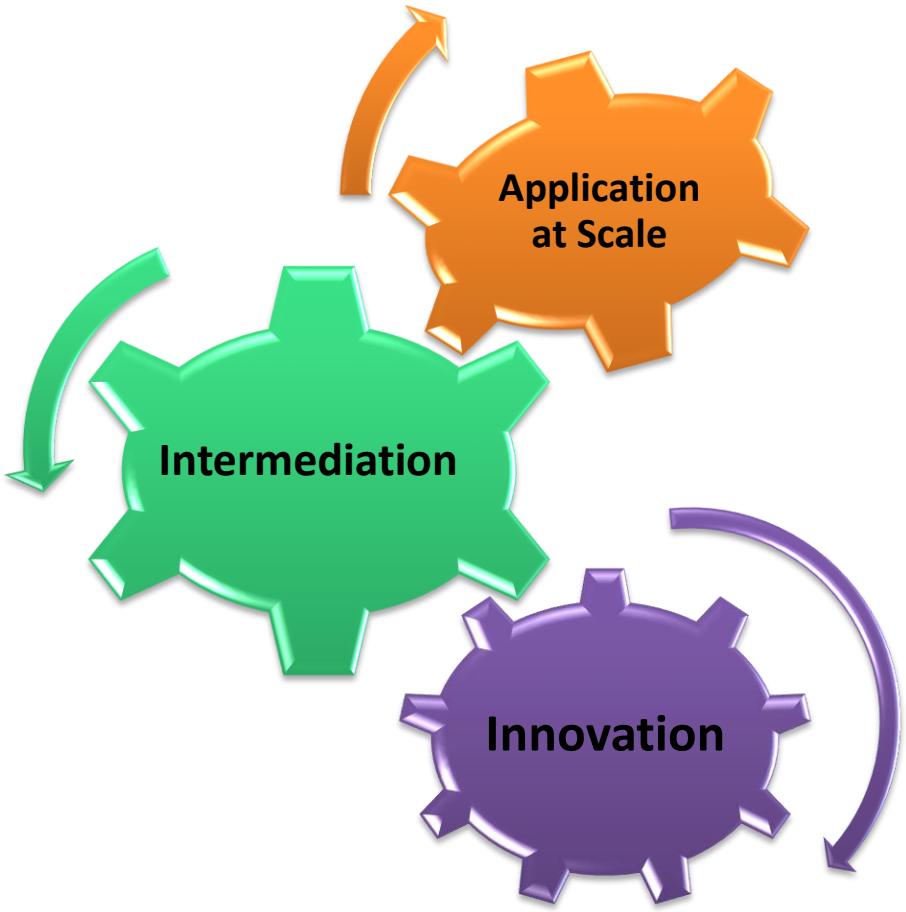
Many national governments are adopting policies and/or regulations to support biofortification activities. Two recent examples:

India set standards for minimum levels of iron and zinc in new pearl millet varieties to spur development of biofortified versions.

Rwanda adopted an official definition for iron beans—the first of any country to do so—aimed at spurring market development of products made with biofortified ingredients.

Engaging the Private Sector: New Models for Scale

- Market Systems Facilitation
  - Technical assistance, stakeholder engagement platforms, incentives/risk mitigation interventions and other “at arms length” initiatives
- Partnerships with market actors utilizing new models
  - Direct partnerships with market actors
    - *procurement partnerships, seed licensing, brand licensing…*
  - Establishments of social enterprises to drive the market and generate revenue for other biofortification programs
    - *grain aggregation models, agribusiness social enterprise models…*
- How do we balance risk vs. control in new partnerships with regard to:
  - Monitoring reach for biofortified crops consumed “through markets”
  - Issues of product/brand risk with regard to licensing
  - Issues of targeting rural consumer vs. urban consumer
  - Balancing price premiums that drive the market and a focus on low-income consumers



Harvest Plus: Working Throughout the Value Chain

Biofortified Food Products: Value Creation

Iron Beans In Zimbabwe

Vitamin A Sweetpotato Flour in Uganda

Iron Beans in Rwanda

Vitamin A Cassava Gari in Nigeria

Vitamin A Maize Grits in Zambia

Making Agriculture Viable for Youth

- HarvestPlus helps train and inspire youth agro-entrepreneurs
- Biofortified crops are value added and offer new business opportunities
- Private sector partners create jobs including producers, market facilitators, bulking agents, processors and distributors of biofortified planting materials and food products

Partnerships: from SMEs to Large Businesses

SkyBrands: Youth owned milling SME in Zimbabwe that specializes in Vitamin A maize and iron bean products.

PRAN: largest food distribution company in Bangladesh, now buying zinc rice from farmers

Partnerships: Nestlé

Nestlé started to use biofortified maize as an ingredient for their cereal porridge production in Nigeria in 2016.

Farmers are highly motivated to be associated with global brands

Since then, the company procures a yearly average of 1,000 MT which is converted into Golden Morn, one of the cereal brand in Nigeria.

GAIN Partnership

- GAIN and HarvestPlus have formed a new partnership to accelerate commercially-driven expansion of demand for biofortified staple crops and food products.

- The partnership focuses on six countries in Africa and Asia with pervasive levels of malnutrition and a combined total population of more than 2 billion.

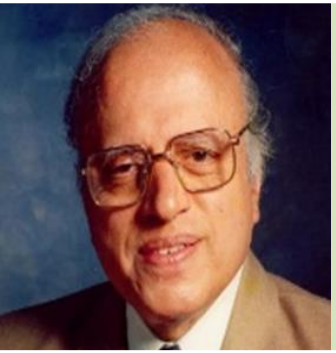
Experiencing the Benefits: Iron Beans in Rwanda

"As a trader, my cash flow increased when I started selling iron beans"

"Consumers like the beans; two pregnant women came back to thank me for the advice"

Time to Scale Up : Biofortification Support

"Biofortified crops are going to be game-changers in dealing with the issue of malnutrition in our world today."
– **Dr. Akinwumi Adesina, President of the African Development Bank. 2017 World Food Prize Laureate**



"Our aim should be to make every family farm a biofortified farm. A food-based approach should be adopted for overcoming micronutrient malnutrition."
– **Dr. MS Swaminathan, World Food Prize Laureate, Father of Indian Green Revolution**

"[Biofortified] crops are not just more resilient to droughts and disease but provide a sustainable source of much needed nutrients to rural communities."
– **Charlotte Watts, Chief Scientist, UK Department for International Development (DFID)**

Enriching the Food System: Biofortification is…

based on food crops that are grown and eaten by resource-poor farm families who are not typically reached by food fortification and supplementation programs.

scientifically proven to reduce micronutrient deficiency and improve health. Farmers are also willing to grow and both farmers and consumers are willing to eat them.

readily available to all members of these farm households, including high-risk groups who benefit most from these crops: women, young children, and adolescent girls

Links smallholders to new markets and is cost-effective. It's an up-front investment with lasting impact, harvest after harvest, at no additional cost to farmers.

Our Goal:
Improve the Lives of 1 Billion People With Biofortified Foods by 2030

Stay Connected!

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