

The Role of Biofortified Crops and Foods in Improving Nutrition



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N4G Summit Side Event

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Introduction

- More and more countries especially in Africa continue to experience the double burden of malnutrition, where undernutrition coexists with overweight, obesity and other diet-related non-communicable diseases.
- These levels of malnutrition including micronutrients deficiencies remain persistently high
- Hidden hunger is a major contributory factor and currently affect and has effect on billions of individuals globally is perhaps the greatest rationale to invest in biofortification.
- Progress is too slow to meet the 2025 global nutrition targets
- The agenda for this week is the need to refocus and change how we look at the malnutrition challenge fully aware about the devastating effects leading to stunted growth, poor health, mental impairment, productivity loss and death.

The Role of Biofortified Crops, Future Outlook

- Biofortified crops increasingly playing central role in addressing malnutrition sustainably
- Nutrition should be mainstreamed into all elements of the food and health systems to ensure that healthy and sustainable food production
- Policies and programs for increased sustainable production using high-yielding, climate-resilient, nutrient-dense varieties of diverse crops
- Influencing consumer behavior on consumption patterns through food-based policies that make healthy foods more available, affordable, and attractive than unhealthy ones.

The State of Affairs

- Availability of highest-yielding resilient varieties, attractive to farmers
- Scientific evidence of the nutritional impact is growing
- Increasing knowledge of importance and relevance in sustainable reduction in prevailing rates of malnutrition
- Extensive research and product development/utilization and processing
- Major gains on progress on access to Biofortified crops

Biofortified Crops Released in Africa

Iron



Pearl Millet

Provides up to 80% of daily iron needs



Beans

Provides up to 80% of daily iron 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

Released in Ghana so far

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

...and in testing

HarvestPlus.org

Biofortification: Progress in Ghana

- Harvest Plus in partnership with International Institute for Tropical Agriculture (IITA), supported development and delivery of Vitamin A Maize with the National Agricultural Research System (NARS), Ministry of Food and Agriculture, seed and food companies, and small holder farmers.
- Operational support and technical assistance have been provided for capacity development for NARS and seed companies, including SMEs.
- Local level actions include work by centers of the Council for Scientific and Industrial Research (CSIR) to develop biofortified varieties, organized demonstration plots, farmer field days, and promotional / marketing activities.
- Advocacy to integrate OFSP into school feeding program and enhanced counselling support for pregnant women and in complementary food.

Requirements for Further Scaling

- A multi-sectoral approach
- Strong advocacy for nutrition sensitive-agriculture
- Government policy focus needed
- Sustained engagement and advocacy involving key sectors
- Strengthen public-private partnerships to increase production, access at markets and utilization
- Comprehensive SBCC to enhance uptake by all especially young children, adolescents and women

Concluding Points

- The other attributes of biofortified crops—such as high yielding, and reaching more people at lower cost—are valuable selling points.
- Need expanded and sustained actions to increase access, uptake and utilization including all actors in the value chain.
- Evidence abounds on what works.
- The high-level political commitments at this year’s Food Systems Summit must be harnessed.
- To ensure that healthy and sustainably produced food is accessible, affordable and desirable choice for all, sectors must work together to mainstream nutrition.
- **The key challenge: How can the health and agricultural policy and decision makers lead this effort, and give priority to our collective agenda of zero hidden hunger for improved survival and well-being across the life course?**

Thank you



Overview of the HarvestPlus Experience

Howarth Bouis

Emeritus Fellow

International Food Policy Research Institute

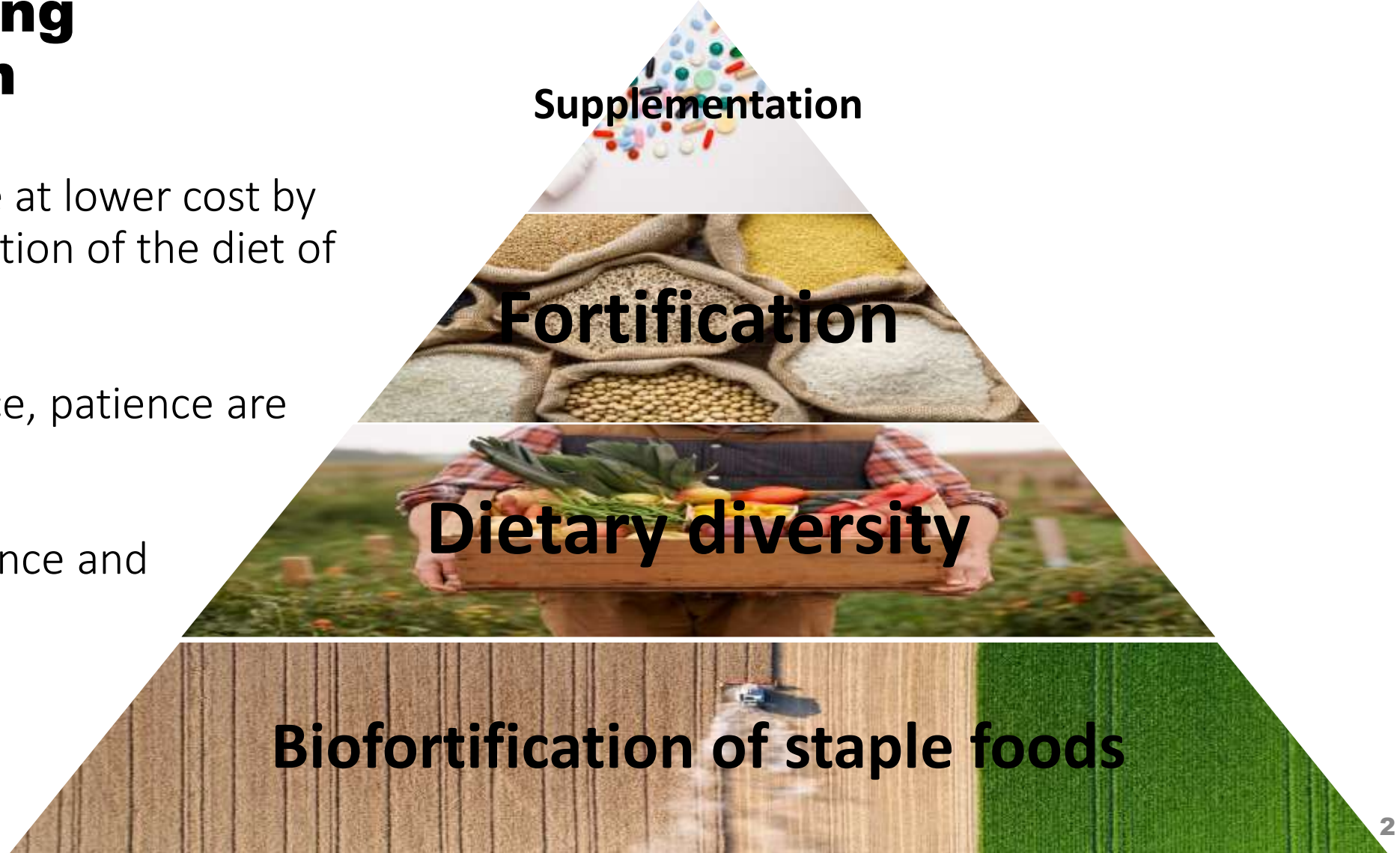
December 6, 2021

Layers of investments in overcoming malnutrition

Reach more people at lower cost by tackling the foundation of the diet of everyone.

Vision, perseverance, patience are required.

The payoff is resilience and sustainability



Excerpt From Recent 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.

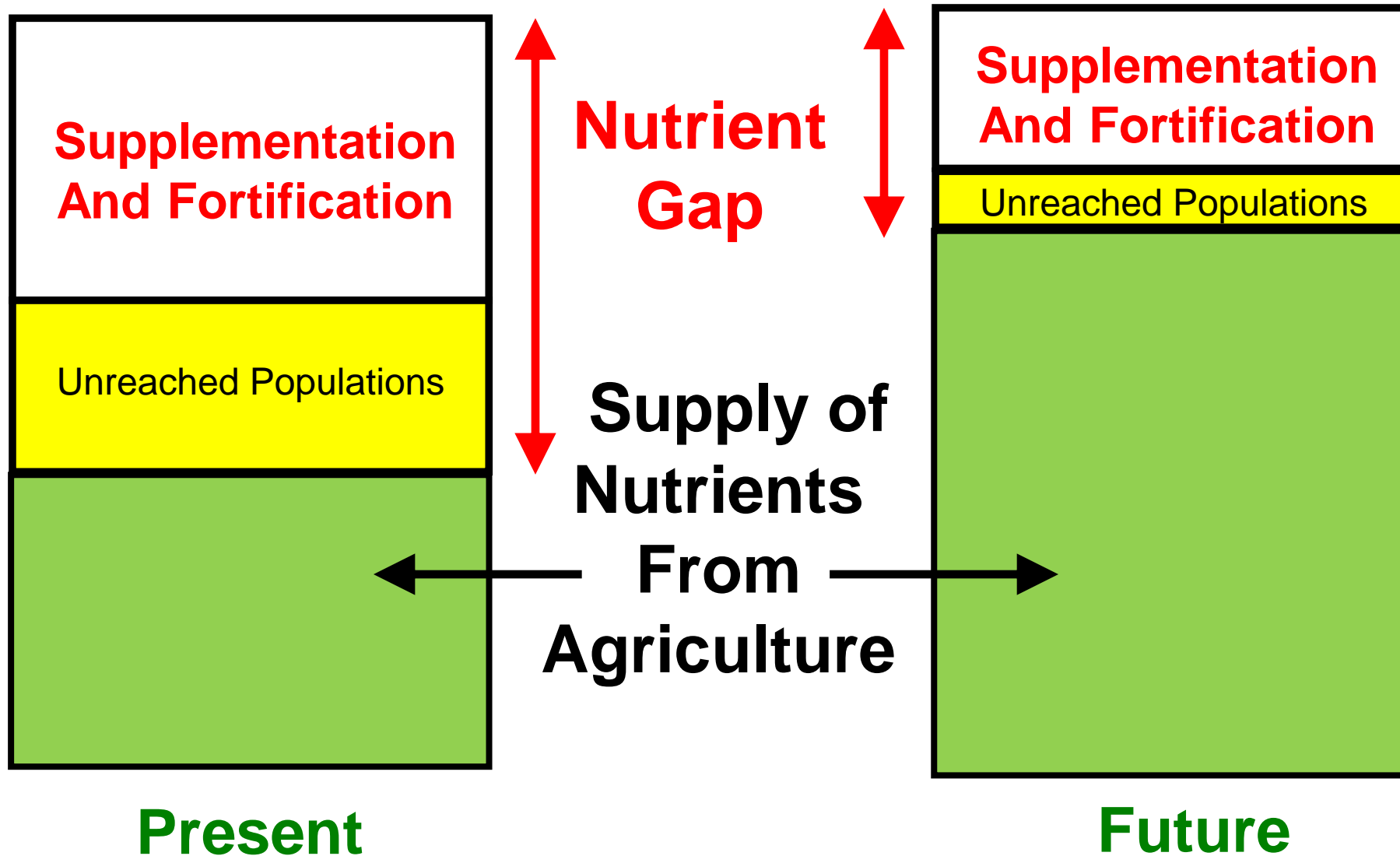


4 MILLION

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

Cost Per Vitamin A Capsule: \$US 1-2

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





Nutrition-Smart Agricultural Strategies

- **Food Staples** – Increase **Density** of Nutrients
 - Biofortification
 - Fertilizers and sprays
 - No extra cost to consumers
- **Non-Staple Foods** – Increase **Quantities**
 - Milk, Eggs, Small Fish, Specific Green Leafy Vegetables
 - Home gardens, hybrid seeds (multiple nutritious foods)
 - Requires higher incomes and/or lower food prices



Percent Contribution of **Rice** to Nutrient Intakes in the Philippines, 2015

Nutrient	Percent Contribution	Nutrient	Percent Contribution
Energy	59%	Protein	40%
Carbohydrates	76%	10 of 11 Amino Acids	30-40%
Calcium	20%	Vitamin A	0%
Copper	32%	Vitamin C	0%
Iron	33%	Thiamine (B1)	39%
Magnesium	38%	Riboflavin (B2)	20%
Manganese	53%	Niacin (B3)	45%
Phosphorous	33%	Vitamin B5	57%
Potassium	15%	Vitamin B6	32%
Zinc	41%	Folate (B9)	10%



Biofortified crops released in **40 countries**

Testing for releases in these and another **20+ countries**



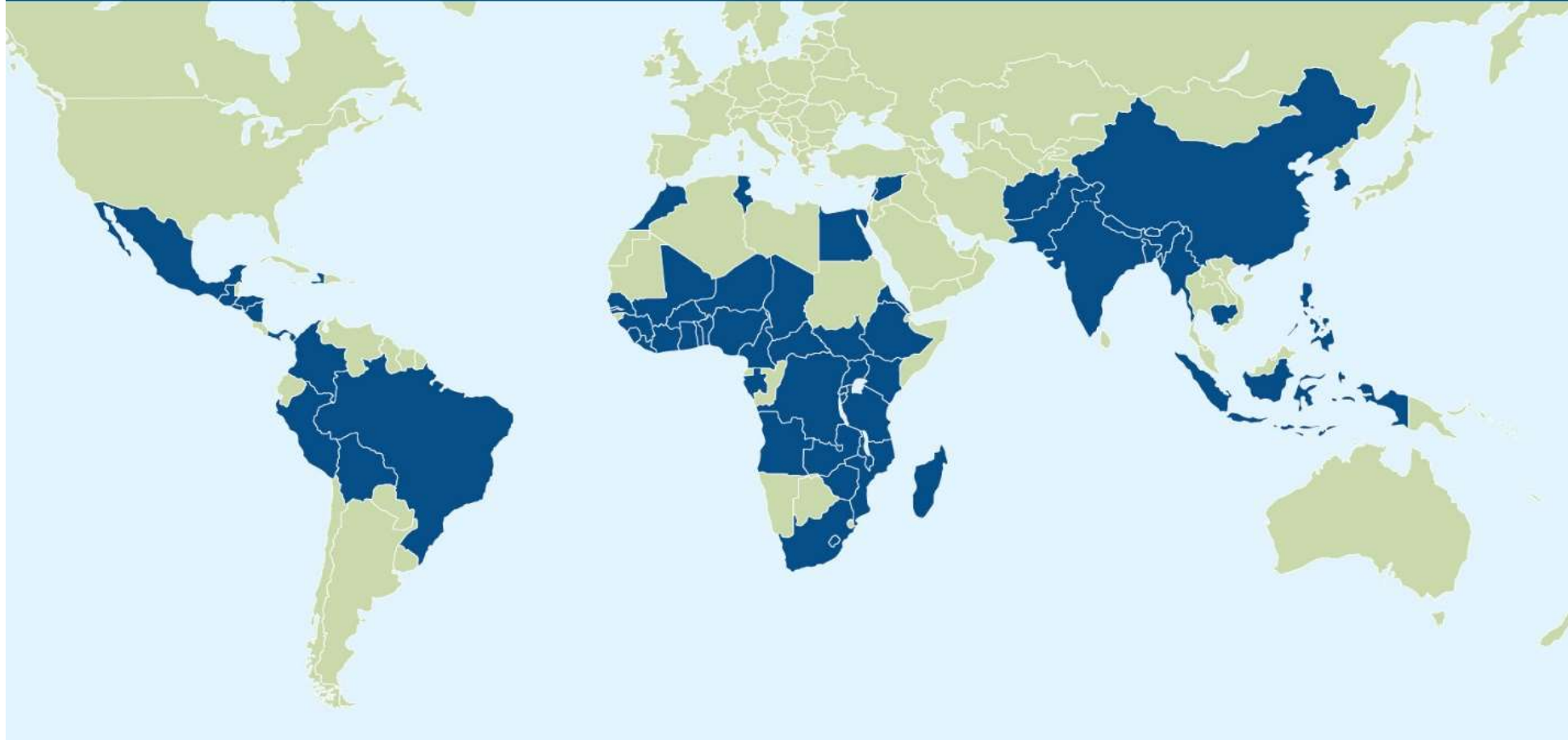


Breeding and Crop Release



Biofortified Crops Around the World

Biofortified crop varieties have been released and/or are in testing in the countries shaded dark blue on the map. See the table below for crop details by country.





Breeding and Crop Release

Biofortified Crop Varieties Released (R) or in Testing (T) by Country

Africa	HIB	IPM	ZIM	ZIR	ZIW	ABP	VAC	VAM	OSP	IZC	IZP	IZL	ZIS
Angola								T	R				
Benin Rep		T					T	T					
Burkina Faso		T						T	R				
Burundi	R					R			R				
Cameroon						T	R	R					
Central African Rep						T							
Chad						T							
Côte d'Ivoire						T	T		R				
DR Congo	R					R	R	R					
Egypt				T				T					
Eritrea		T							T				
Ethiopia			T		T		T	T	R		T	R	
Gabon							T						
Gambia		T					T						
Ghana		T					R	R	R				
Guinea						T	T						
Kenya	T	T					T	T	R		T		
Liberia							T	T					
Madagascar		T		T					R				
Malawi	T	T					T	R	R				
Mali		T						R	T				T
Morocco									T			T	
Mozambique							T	T	R				
Niger		R					T	T	T				
Nigeria		T	T			T	R	R	R	T			T
Rwanda	R					T		R	R		T		
Senegal		T		T			T	T	T				
Sierra Leone							R	T					
South Africa								T	R				
South Sudan		T						T	T				T
Swaziland							T						
Tanzania	R	T				T	T	R	R				
Togo		T						T					
Tunisia		T											
Uganda	R	T				T	T	T	R		T		T
Zambia		T		T			T	R	R				
Zimbabwe	R	T		T				R	T				

HIB = Iron Beans
 IPM = Iron Pearl Millet
 ZIM = Zinc Maize
 ZIR = Zinc Rice
 ZIW = Zinc Wheat
 ABP = Vit. A Banana/Plantain
 VAC = Vit. A Cassava
 VAM = Vit. A Maize
 OSP = Vit. A Orange Sweet Potato
 IZC = Iron/Zinc Cowpea
 IZP = Iron/Zinc Irish Potato
 IZL = Iron/Zinc Lentils
 ZIS = Zinc/Iron Sorghum
 Source: HarvestPlus, International Potato Center (2019)

Asia	HIB	IPM	ZIM	ZIR	ZIW	ABP	VAC	VAM	OSP	IZC	IZP	IZL	ZIS
Afghanistan					T								
Bangladesh				R	R				R				R
Bhutan					T						T		
Cambodia				T									
China				T	T			T	R		T		
East Timor									R				
India		R		R	R			T	R	R	T	R	R
Indonesia				R					R				
Lebanon													T
Myanmar				T									
Nepal					T			T			T	R	
Pakistan					R			T					T
Philippines					T								
South Korea									R				
Syria													R

LatAm/Caribbean	HIB	IPM	ZIM	ZIR	ZIW	ABP	VAC	VAM	OSP	IZC	IZP	IZL	ZIS
Bolivia	R		R		R							T	
Brazil	R			T	T		R	R	R	R			
Colombia	R		R	T			T	T	R				
El Salvador	R		T	R									
Guatemala	R		R	T			T		R				
Haiti	T		T	T				T	T				
Honduras	R		R						T				
Mexico			T		R			T					
Nicaragua	R		R	T					R				
Panama	R			T	T		T	T	R				
Peru									R		T		



Nearly 400 Biofortified Varieties Released; 12 Million Farm Households are Producers*



* Statistics are for CGIAR Biofortification Strategy which includes International Potato Center (CIP) activities

Nutrition Evidence: Improved 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**)

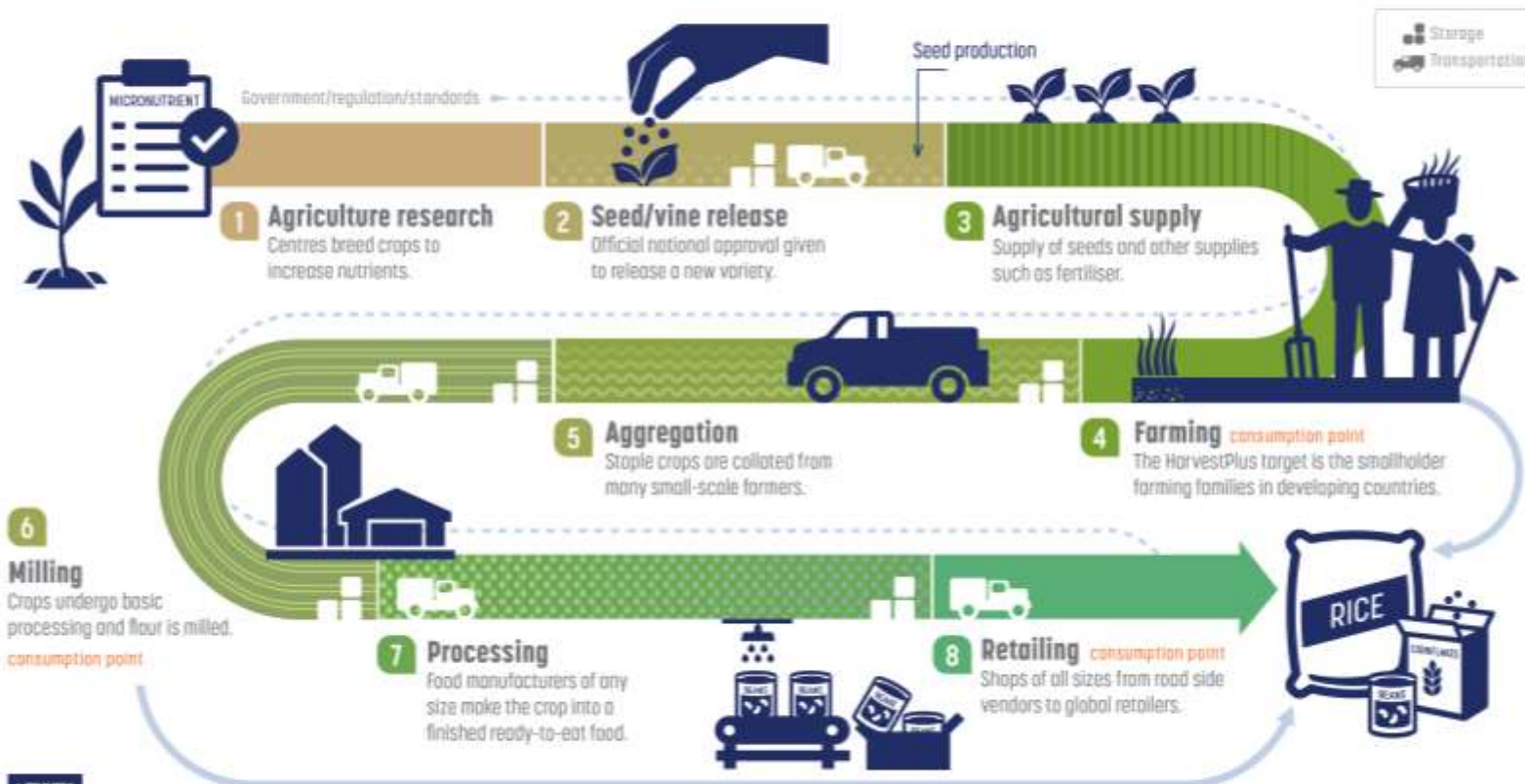


Harvest Plus and Partners are Catalyzing Robust Supply Chains



Ending Hidden Hunger A Value Chain for Biofortified Foods

How do we partner for a biofortified food system across the globe? Beginning at the research phase, knowledge, education and partnership are required at every step so that we can scale up and embed biofortified foods into the food chain. By working together we can reach one billion malnourished consumers by 2030.



This project was funded with UK aid from the UK government

HarvestPlus improves nutrition and public health by developing and promoting biofortified food crops that are rich in vitamins and minerals, and providing global leadership on biofortification evidence and technology. HarvestPlus is part of the CGIAR Research Program on Agriculture for Nutrition and Health (AANH). CGIAR is a global agriculture research partnership for a food secure future. Its science is carried out by its 15 research centers in collaboration with hundreds of partner organizations. The HarvestPlus program is coordinated by two of these centers, the International Center for Tropical Agriculture (CIAT) and the International Food Policy Research Institute (IFPRI).
c/o IFPRI 201 Eye Street, NW, Washington, DC 20005 USA www.harvestplus.org



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

Biofortified Varieties: Sustainable Way to Alleviate Malnutrition



Effect of High Zinc Wheat Intervention in India on Morbidity Indicators for Mother and Child Pairs

Indicator	High Zinc Wheat Subjects	Low Zinc Wheat Subjects	Days of Sickness Averted For ~ 1300 Subjects Over 180 Days	Difference Significant at 5% Level of Confidence?
Children 4-6 Years				
Days With Pneumonia	203	244	41	YES
Days With Vomiting	60	99	39	YES
Women 15-49 Years				
Days With Fever	999	1092	93	YES

Sazawal, S., U. Dhingra, P. Dhingra, A. Dutta, S. Deb, J. Kumar, P. Devi, and A. Prakash. 2018. Efficacy of high zinc biofortified wheat in improvement of micronutrient status, and prevention of morbidity among preschool children and women - a double masked, randomized, controlled trial. *Nutr J* 17:86.



Prime Minister Modi Endorses Biofortification



Screengrab of video posted on PMO India

Highlights

- World Food Day is celebrated on October 16 every year.
- PM Narendra Modi released commemorative Rs 75 coin.
- He also dedicated 17 new biofortified crops to the nation.



Increasing Intakes of **Non-Staple Foods**

- Increase supply of ***specific key foods*** that can contribute importantly to nutrient intakes and where ***supply can be increased cost-effectively*** through public policy and investments.
 - The primary objective is to ***lower the price*** of these specific foods
 - These specific foods will vary greatly by country



Key Issues Moving Forward

- Staple food staples offer advantages under the COVID pandemic
 - Continued high levels of consumption of food staples
 - Government focus on ensuring food staple supplies
 - Extra nutrients at no extra cost, as incomes fall and dietary quality worsens
- Optimal mix of short-run nutrition-direct and long-run nutrition-smart interventions
- More funding under the overall nutrition umbrella



Key Issues Moving Forward

- Long gestation periods for implementation of nutrition-smart agricultural interventions
- Will agricultural policymakers give priority to human nutrition objectives?
- Positive examples are required for encouraging further investments in additional nutrition-smart agricultural interventions.

In Conclusion ...

“Such intimately related subjects as agriculture, food, nutrition and health have become split up into innumerable rigid and self-contained little units, each in the hands of some group of specialists. The experts, ...soon find themselves...learning more and more about less and less...The remedy is to look at the whole field covered by crop production, animal husbandry, food, nutrition, and health as one related subject and...to realize...that the birthright of every crop, every animal, and every human being is health.”

”



Sir Albert Howard, 1873-1947

“The Soil and Health,” 1945

THANK YOU

(some suggested reading and links follow)

Biofortification Reference

- *“Food Biofortification—Reaping the Benefits of Science to Overcome Hidden Hunger,”* Council for Agricultural Science and Technology, October, 2020.
- Link to copy of paper:
 - https://www.cast-science.org/wp-content/uploads/2020/10/CAST_IP69_Biofortification-1.pdf
- Link to Webinar (paper release at World Food Prize):
<https://youtu.be/PqWk47a7db0>

Biofortification Reference

- “Multiplying the efficiency and impact of biofortification through metabolic engineering,” October, 2020
Nat Commun **11**, 5203 (2020). <https://doi.org/10.1038/s41467-020-19020-4>
- Link to paper (open access):
<https://rdcu.be/b8yvp>

Overview of Sasakawa Africa Association Experience

～Agriculture-based Community Nutrition Approach～



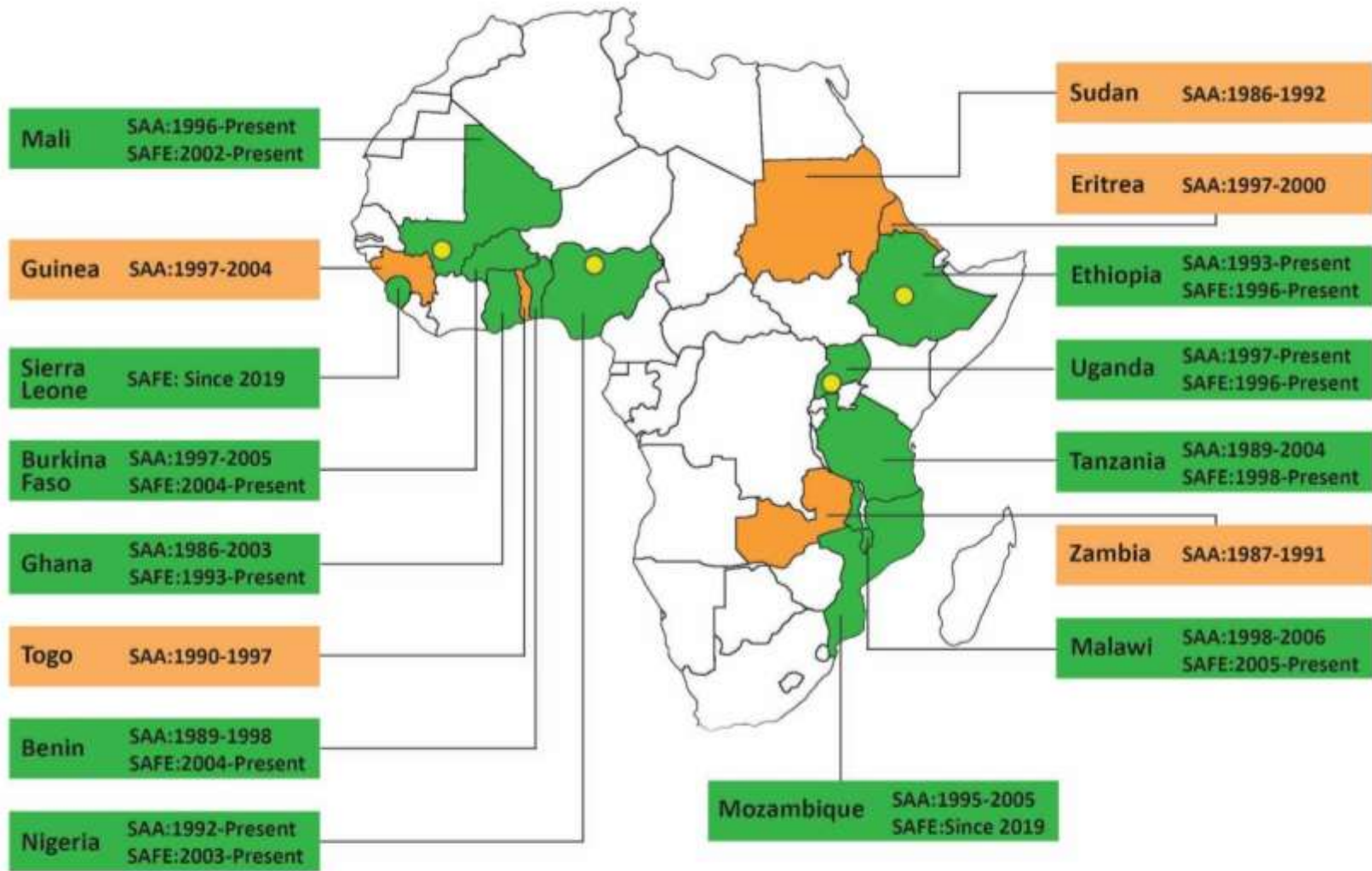
Mel Oluoch

Nutrition for Growth Summit

Tokyo, December 6, 2021

SASAKAWA AFRICA ASSOCIATION



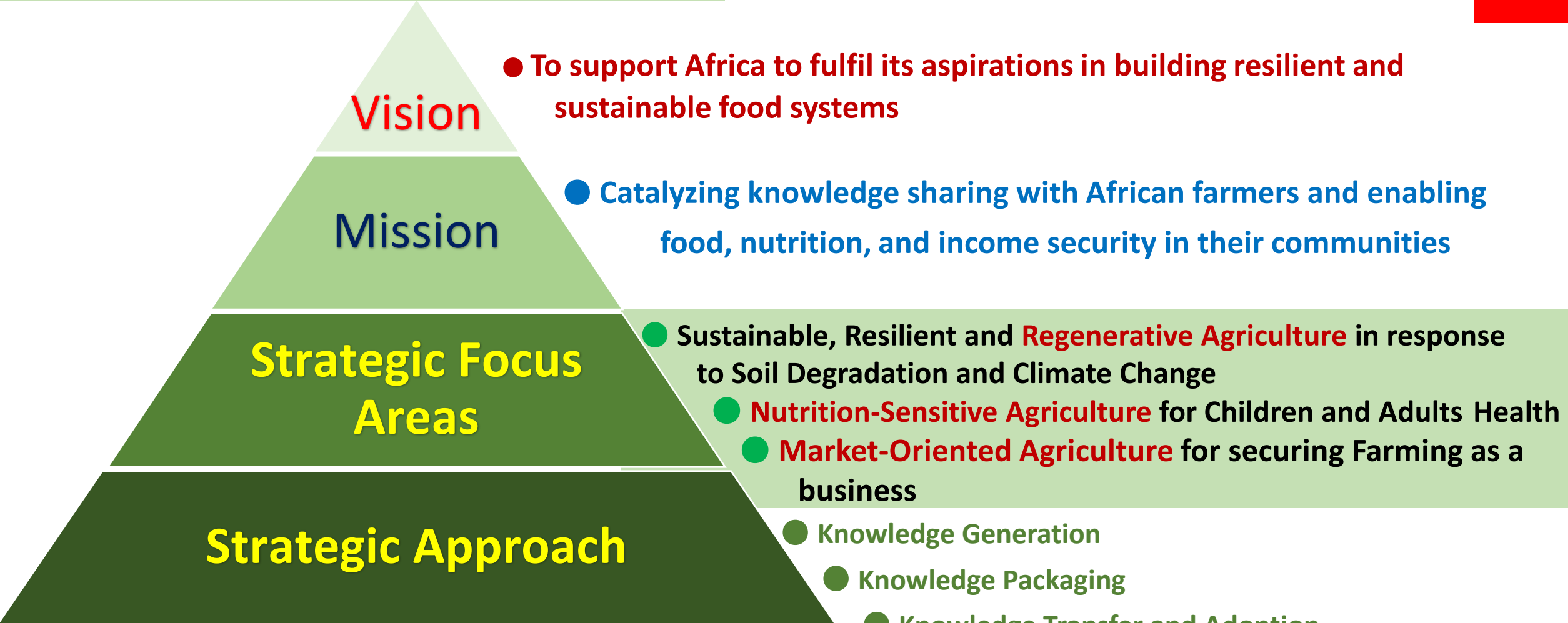


Together with the Carter Center's Global 2000 Program, **Sasakawa-Global 2000 (SG 2000)/SAA** has been operating in 16 African countries

Country Offices in:
Ethiopia, Nigeria, Mali, Uganda

■ SAA Operating Countries
■ Former SAA Intervention Countries
● Country Office





Cross-cutting Issues

- Development of business capacity and entrepreneurship of Youth/Women/PwDs
- Strengthening of partnerships with governments, research institutions and private sector

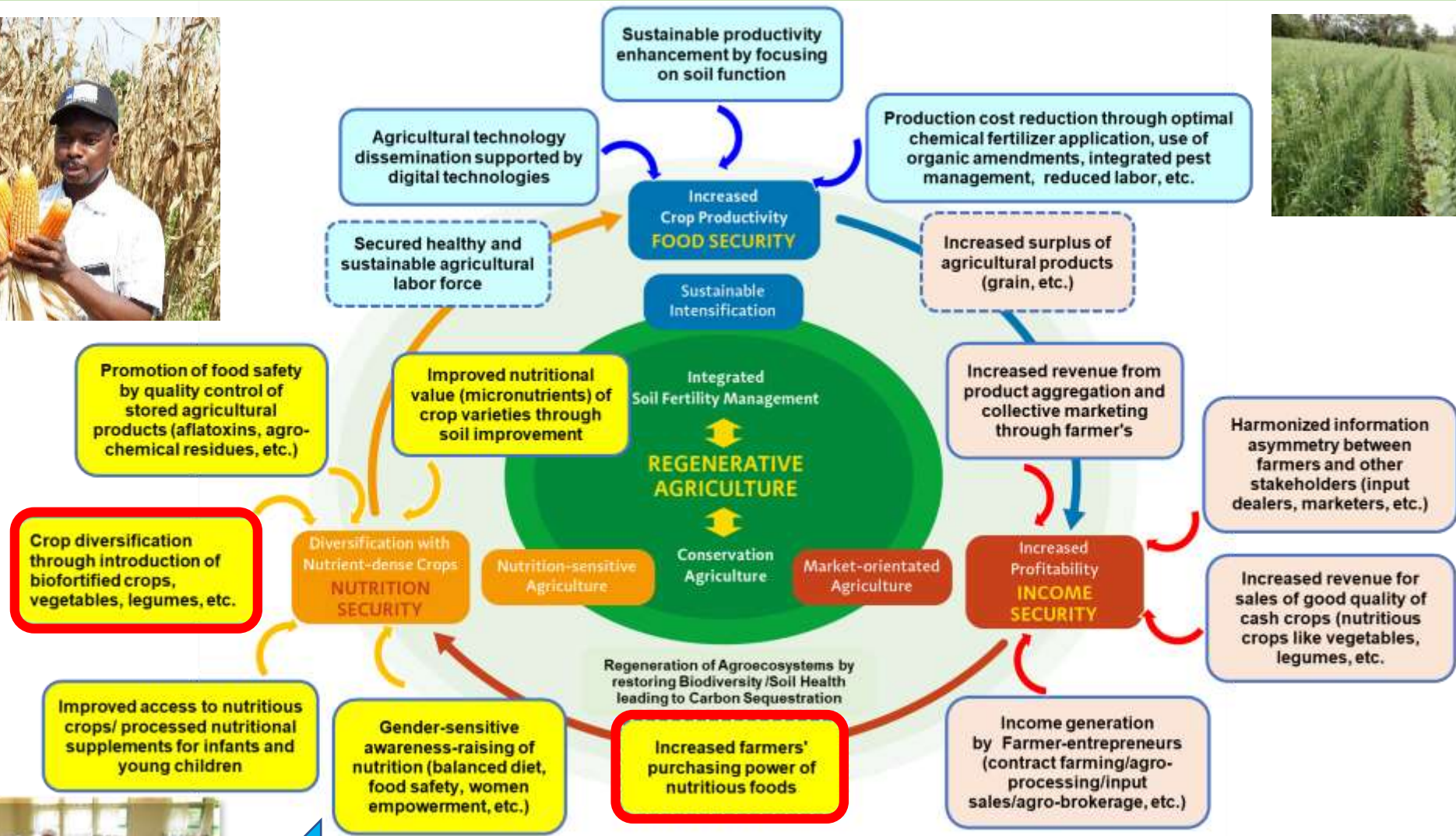


Agriculture-based Community Nutrition Improvement Approach

- SAA aims to improve the nutrition of entire communities through Nutrition-Sensitive Agriculture led by **promotion of biofortified and nutrient dense crops** and **increased food purchasing power** through Market-Oriented Agriculture, based on sustainable intensification through **Regenerative Agriculture**.



Toward virtuous cycle of the three pillars of the strategy



promotion of biofortified crops + increased food purchasing power



Nutrition Sensitive Agriculture Interventions

- Promotion of **biofortified and nutrient dense crops**
- Enhancing the production and consumption of nutritious food by rural households (“**diet diversification**”)
- Postharvest Handling and Agro-processing Services to improve quality
- Gender-sensitive nutrition **awareness-raising**





Wheat Harvesting in Ethiopia



Groundnut butter processing in Mali



Rice parboiling in Nigeria

Demonstrate through trained extension agents & directly, using postharvest and trading platforms, different technology options in harvesting, handling, processing, storage, and value addition, as well as enterprise management



Cassava Grater, Nigeria



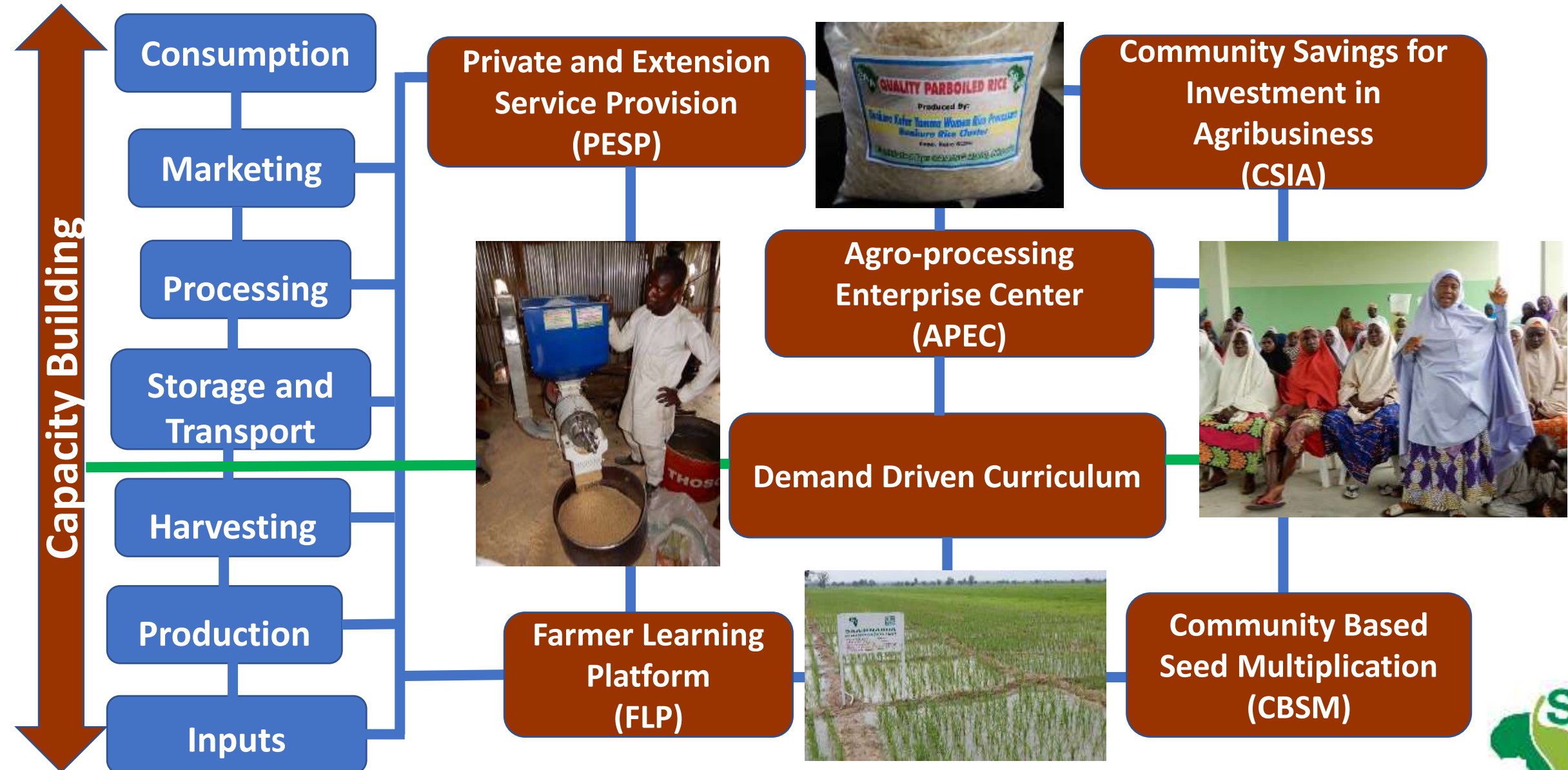
PICS bag storage in Ethiopia

Market Oriented Agriculture Interventions

- Increased revenue from product aggregation and collective marketing through **farmer cooperatives**
- Increased revenue from sales through Smallholder Horticulture Empowerment Promotion (**SHEP**) approach
- Income generation through **farming as a business enterprise** (contract farming/agro-processing/input-output sales/agro-brokerage, etc.)



Integrated SAA extension models (approaches) along the value chain



Private Service Providers – The Journey.....

Reducing Labor intensity and High Postharvest Losses

Reaching farmers in their homesteads



Crops are processed timely
Improved food safety and quality



Private Service Provision

Platform to create employment

- Agro-processing enterprises
- Machine fabrication and maintenance
- Community Seed Multiplication
- Commodity/Community Association Traders (e.g. Agro-dealers)
- Community Based Facilitators
- Youth Business Clinics
- E-Extension services



Short, medium and long-term solutions

- Facilitate technology transfer mechanisms for farmers by using ICT
- Strengthening the supply chain by using ICT to improve farmers' access to input and output markets
- Develop and implement “e-Extension” approaches
- Integrate Youth into Agriculture – Innovation
- **Establish E-Learning Platforms in Agriculture Universities**





“Walking with the Farmer”

Closing Remarks



Walking with the farmer

Makoto Kitanaka

SAA HarvestPlus N4G Summit Official Side Event

6 December 2021



SASAKAWA AFRICA ASSOCIATION

HarvestPlus & SAA will work together to promote and scale out biofortified crops using regional approach, strategically categorizing the target countries into 3 tiers. The areas of collaboration include:

- Improve accessibility of biofortified seeds
- Training and demonstration of biofortified varieties & community sensitization
- Promotion of value addition through agro-processing enterprises
- Improving farmers' access to finance and input/output markets
- Expanding public and private partnerships
- Policy advocacy
- Resource mobilization

Tiers	Description	Countries
Tier 1 Countries	Countries that have both HarvestPlus and SAA presence	Uganda, Nigeria
Tier 2 Countries	Countries where either HarvestPlus or SAA have presence	Zambia, Malawi, Ethiopia, Mali, Kenya, DR Congo, Zimbabwe
Tier 3 Countries:	Countries of interest to both SAA and HarvestPlus but with no presence of field activities of either organizations	Angola, Mozambique, Senegal, Burkina Faso, Tanzania, Benin, Sierra Leone, Ghana

Biofortified Crops of Focus by Country

Focus Country	Biofortified Crops of Focus					
	Iron Beans	Vitamin A maize	Vitamin A Cassava	Vitamin A Sweet Potato	High Iron Pearl Millet	High Zinc Rice
Nigeria		√	√	√	√	√
Uganda	√	√		√	√	
Ethiopia	√	√		√		
Mali		√	√		√	√
Zambia,	√	√		√		
Malawi	√	√	√	√		√
Tanzania	√	√		√		
Kenya	√			√		
DRC Congo	√	√	√	√		
Zimbabwe	√	√		√	√	
Angola		√			√	
Mozambique	√	√	√	√		
Senegal		√			√	
Burkina Faso		√			√	
Benin		√	√			
Sierra Leone			√			
Ghana		√	√			

Iron Beans
Nutritional Benefits: Provides up to 80% of daily iron needs.
Farmer Benefits: High yielding, virus resistant, heat and drought tolerant.

Vitamin A Maize
Nutritional Benefits: Provides up to 50% of daily vitamin A needs.
Farmer Benefits: High yielding, disease and virus resistant, drought tolerant.

Zinc Maize
Nutritional Benefits: Provides up to 70% of daily zinc needs.
Farmer Benefits: High yielding, virus resistant.

Iron Pearl Millet
Nutritional Benefits: Provides up to 80% of daily iron needs.
Farmer Benefits: High yielding, mildew resistant, drought tolerant.

Zinc Wheat
Nutritional Benefits: Provides up to 50% of daily zinc needs.
Farmer Benefits: High yielding, disease resistant.

Vitamin A Cassava
Nutritional Benefits: Provides up to 100% of daily vitamin A needs.
Farmer Benefits: High yielding, virus resistant.

Vitamin A Sweet Potato
Nutritional Benefits: Provides up to 100% of daily vitamin A needs.
Farmer Benefits: High yielding, virus resistant, drought tolerant.

Zinc Rice
Nutritional Benefits: Provides up to 40% of daily zinc needs.
Farmer Benefits: High yielding, disease and pest resistant.





Closing Remarks

Arun Baral
HarvestPlus CEO

N4G Summit Side Event
Oct. 6, 2021

HarvestPlus.org



RESEARCH
PROGRAM ON
Agriculture for
Nutrition
and Health

Led by IFPRI

Strategies for Catalyzing Rapid Scale Up of Biofortification



Advance “mainstreaming” of biofortification in global and national seed breeding programs.



Facilitate partnerships that strengthen biofortified seed and food value chains to benefit smallholder farmers and others.



Strengthen enabling environments with evidence-led engagement globally, regionally, and nationally. Advance supportive policies and regulations; incorporate biofortified foods into feeding and other support programs.



Expand the scientific evidence base for biofortification and facilitate knowledge exchange and learning globally.

Hidden Hunger Is Holding Back Progress on the UN SDGs

Directly Impacted SDG Targets



- Providing access to Nutritious Food
- **Ending all forms of malnutrition, specifically, stunting and wasting of children**
- Increased productivity and income for smallholders
- Sustainable agricultural practices



- Reduced global maternal mortality
- Reduced premature mortality
- Reduced mortality of children under 5 and newborns

Indirectly Impacted SDGs

1 NO POVERTY



4 QUALITY EDUCATION



5 GENDER EQUALITY



12 RESPONSIBLE CONSUMPTION AND PRODUCTION



13 CLIMATE ACTION



15 LIFE ON LAND



Join Us in Catalyzing More-Nutritious Food Systems Worldwide!

