



# Scaling Nutrient Enriched Crops with the HarvestPlus Delivery and Commercialization Model

May 2022





# Revolutionizing the food system by replacing staple grains with higher-nutrient varieties

Two billion people—one quarter of the world's population—do not get enough vitamins and minerals in their diets. This “hidden hunger” causes serious health and developmental problems, as well as billions of dollars in health care costs and economic losses, primarily in low- and middle-income countries.

Seven staple crops—beans, cassava, maize, millet, potato, rice, and wheat—account for the majority of global caloric consumption. In some cases, the vitamin, mineral, and fiber content of whole-grain, minimally processed staples can be comparable to fruits and vegetables; for example, in many countries whole corn (sweet corn) is considered one of the recommended five portions of fruits and vegetables that should be consumed daily. However, for the most part, foods made from staples are low in essential vitamins and minerals.

Staple food consumption patterns are engrained in most cultures and driven in large part by staples' relative affordability to grow or purchase, and that they are less perishable than other types of foods. While preferences for staple-based foods such as bread and pasta are not likely to change, we can make the underlying staples significantly higher in micronutrients. Dietary guidelines issued by many countries<sup>1</sup> also recommend at least one third of our diet should come from whole-grain starchy foods.

While a primary aim of nutrition improvement strategies is to increase dietary diversity (notably, by increasing consumption of nutrient-rich foods such as fruits, vegetables, and animal source foods, while also limiting consumption of processed foods high in fat, sugar, or salt), the world's staples will remain the backbones of healthy diets. Promoting dietary diversity should happen in tandem with increasing the nutrient density of commonly consumed staple foods to sustainably improve nutrition security.

Nutrient enriched crops (NECs) developed through biofortification are a food-based innovation proven to address malnutrition. By the end of 2021, an estimated 12.8 million smallholder farming households were growing biofortified crops, with an estimated 64 million people benefiting from these crops. This paper summarizes how the CGIAR's HarvestPlus program has developed a multifaceted, commercial, supply chain-driven delivery model that is transforming staple food markets at scale, which has already allowed certain biofortified products to reach as much as 20 percent market share in a given country.

For the past two decades, the HarvestPlus program has led a global effort to improve the nutrient density of commonly consumed staples that are scientifically shown to improve nutritional status and health. In collaboration with CGIAR and country partners, nearly 400 varieties of these conventionally bred, nutritious biofortified staples have been released in 40 countries.

1. See for example: The Ethiopian Food-Based Dietary Guidelines <https://www.nipn.eph.gov.et/node/238>; Nutrition and Your Health: DIETARY GUIDELINES FOR AMERICANS <https://health.gov/sites/default/files/2020-01/DGA2000.pdf> and the UK's Eat Well guide <https://www.gov.uk/government/publications/the-eatwell-guide>

HarvestPlus has a database of and working relationships with almost 5000 commercial seed, grain, and food businesses, from producers of micro-volumes to international global food supply businesses. (see examples in Table 1)

**What happens after seed research and development?**

Biofortified seeds only have an impact once the agricultural system ensures that they are made available at scale for farmers to purchase, plant, and grow. This paper focuses on what happens when a new biofortified seed variety enters the market. On average, it takes up to 11 years to develop a new crop variety through classical breeding, which is then followed by varietal release and market launch, early generation seed production, marketing, and promotion. (Note that full crop development may not always be required in the case of adaptive breeding, fast-track breeding, or by introducing a more-nutritious variety supplied from another region or country.)

Once a new crop variety is fully developed, HarvestPlus delivery teams steward it through the early stages of commercialization and catalyze uptake of the seed, grains, and foods made with it (see note in Terminology section). The delivery model extends from farmers to consumers, in collaboration with world-leading scaling strategists; operational partners; seed, grain, and food businesses; and media and marketing specialists. HarvestPlus also works with partners at the local level to foster sustainable supply chains; at the national level to help build the enabling environment with policy-driven action plans and regulatory frameworks; and at the global level, with support from advocates.

---

# Terminology

**Delivery/Implementation:** The sequence of activities to make seed\*, grains, and foods available and accessible to beneficiaries through existing and new market channels.

**Scaling:** Expanding reach through increased investment in key delivery activities in seed, grains, and foods.

**Non-commercial:** Acceleration of seed/vine sharing (diffusion). This is the only part of any value chain where commercialization does not happen and is only for certain countries and crops. Some value chains, particularly for sweet potato and cassava, do not have commercial systems for planting material.

**Commercial:** Use of existing commercial activities (markets/supply chains) to stimulate private sector (and public-sector procurement) trade in NEC commodities.

- Crops/grains grown from non-commercial seeds are now commercial commodities
- Stimulating demand from traders in the seed, grain, and food sectors
- Stimulating consumer demand in market settings
- Subsidizing or kick-starting commercial value chains

**Publicly Developed Goods:** Government- and donor-funded research is required to develop biofortified varieties through the CGIAR system as public goods, but the seeds produced through this research then become commodities for trade, which enter the commercial food system.

\* In this brief, the term “seed” also encompasses other types of biofortified crop planting materials including stems or vines, for crops such as sweet potato, beans, and cassava.

# The delivery model through the biofortification value chain

This delivery model, also referred to as the commercialization model or implementation plan, is a sequence of activities that take place at specific points in the value chain.

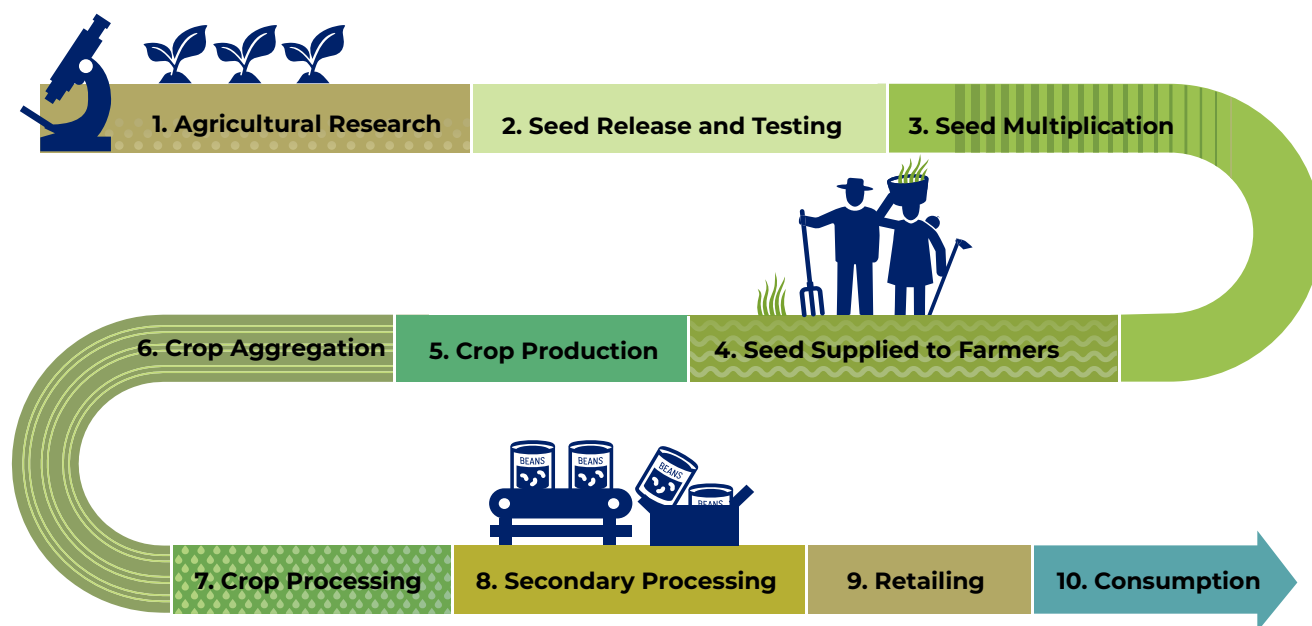


Table 1: Delivery Model Activities

Step	Delivery Activity	Examples of Partners
1. Agricultural research	<ul style="list-style-type: none"> <li>Targeted breeding &amp; testing</li> </ul>	CGIAR breeding centres NARS
2. Seed release and testing	<ul style="list-style-type: none"> <li>Local release, in partnership with the National Agricultural Research Systems (NARS).</li> </ul>	
3. Seed multiplication	<ul style="list-style-type: none"> <li>Foundation seed multiplied by CGIAR centres or government entities. Commercial seed companies start to be involved at this point to take seed to scale.</li> <li>Licensed community-based farmer-producer groups, or individual small-scale commercial farmer seed multipliers, produce certified seeds to assure farmers that it is a genuine product.</li> </ul>	CGIAR The commercial seed industry The Government of Pakistan
4. Agricultural supply (seed/input dissemination to farmers)	<ul style="list-style-type: none"> <li>Commercial seed companies produce, package and market certified seeds (hybrids and open-pollinated varieties, or OPVs).</li> <li>Production of marketing campaigns for seed companies/sellers to support demand creation among farmers.</li> <li>Non-commercial seed diffusion and seed sharing; sometimes conventional/standard varieties of sweet potatoes or cassava stems are destroyed so that the new biofortified stems can be brought in.</li> </ul>	Agro-dealers PXD Marcom Media
5. Farming/growing/producing grain	<ul style="list-style-type: none"> <li>Agronomic support to all growers.</li> <li>Demand creation among farmers, education, and training for farming households on the agronomic and nutritional benefits and uses of biofortified crops.</li> <li>Promote seed availability and/or link farmers to seed sellers.</li> </ul>	Cropin Clinton Development Initiative

Step	Delivery Activity	Examples of Partners
<b>6. Aggregation</b>	<ul style="list-style-type: none"> <li>Establish partnerships with public and private aggregators who aggregate small grain volumes into more-commercial quantities.</li> <li>Create crop variety identity-preserved and traceable food supply chains.</li> </ul>	Baban Gona, Nigeria
<b>7. Milling (Primary processing)</b>	<ul style="list-style-type: none"> <li>Establish partnerships with public and private millers for grains.</li> <li>Link farmers directly to millers, or aggregators to millers.</li> <li>Protect the crop variety identity-preserved and traceable food supply chains.</li> </ul>	Fanyate Mills and Star Milling, Zambia Arti Mills, India
<b>8. Secondary processing (processed food manufacturing, e.g., bread, canning, breakfast cereals)</b>	<ul style="list-style-type: none"> <li>Demand creation from food producers: show food processors the value proposition and potential consumer market for nutrient enriched food products.</li> <li>Establish partnerships and build nutrient enriched grain supply chains for food manufacturers.</li> <li>Food product development, with both existing foods using nutrient enriched inputs, and with new products; other technical services</li> </ul>	Cato Foods, Nigeria Star Brands, Zimbabwe
<b>9. Retailing</b>	<ul style="list-style-type: none"> <li>Consumer marketing</li> <li>In-store promotions</li> <li>Point-of-sale promotion in local/informal food markets; sale of loose grains</li> </ul>	Shoprite, Pick 'n' Pay, Choppies, Zambia Less-formal grain and food markets
<b>10. Consumption</b>	<ul style="list-style-type: none"> <li>Through receipt of direct food aid</li> <li>Home based/subsistence consumption</li> <li>Through commercial food markets</li> </ul>	WFP Local and regional school feeding programs Commercial food processors, retailers, and food service businesses

## Product Marketing: Seed, grains, and foods

HarvestPlus employs various methods to market the benefits of NECs to different actors in the value chain. Marketing seed to farmers requires very different tactics and value propositions to marketing grain to traders, or foods to consumers.

HarvestPlus has a range of marketing materials, from seed packaging and logos, to business-to-business trade marketing, to social media campaigns and radio advertising to consumers. A wide variety of media are also used to target users with bespoke, insight-driven messages.

### Examples of marketing tactics

*Seed:* Advertising seed to farmers on farm radio stations;

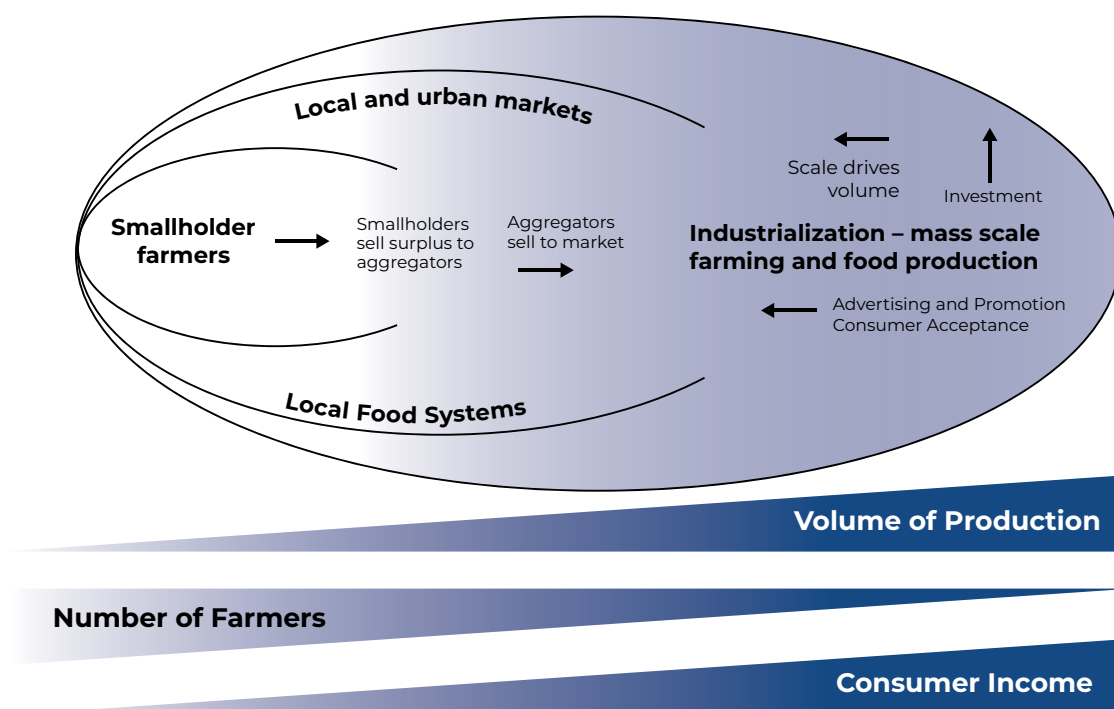
*Grains:* Advertising grains to food producers through business-to-business channels, such as trade fairs or trade media;

*Foods:* In-store or point-of-sale advertising to consumers that highlight the benefits of biofortified varieties versus standard varieties.



Food packaging in Pakistan

## Scaling Biofortification Through the Food System



### Incorporating scaling methodologies and expertise

Complementary to the delivery model is the scaling model, which is a summation of the above delivery activities in defined stages of introduction to market, scaling, anchoring, and sustaining. The activities laid out in the delivery model above go through a process of repetition as new varieties are brought to market. The final stages of scaling and the end-result of the delivery model is to have the biofortified varieties anchored and sustained in the market. This will only happen when the private sector is able to take up biofortification sustainably and profitably from seed to shelf, all through the value chain.

### Impacting food systems through commercial transactions

Food systems are not always segregated into local, regional, or international segments. For example, the grain that comes from the surplus harvest of smallholder farmers can be aggregated and enter regional foods systems. A low-income smallholder family will not only consume what they grow, they will also go to a market to buy branded food products from other locations or even countries.

Gaining access to urban markets and higher-value processed food markets is critical for sustained and accelerated adoption of biofortified products, even if some of the consumers targeted do not have the greatest nutritional need.

**Diversified use and income potential** are important along with improving nutritional status. We can make all foods containing staple grains, irrespective of degree of processing, more nutritious.



Trade marketing in Nigeria

This integrated market trend will increase as the international community promotes dietary diversity and works together to improve livelihoods and purchasing power for low-income farmers.

An understanding of the interactions of local, regional, and global food systems is essential. Small businesses are often the early adopters of innovation as they are nimbler and can adapt quickly. Large businesses create large-scale demand, increase efficiency, and build volume. Other sectors—including brewers and animal feed suppliers—are also large users of grains and staples, which they procure from the same markets, and thereby influence use and demand for grains.

Working with seed, grain and food businesses at every level is essential to ensure all populations are covered, but also to build scale and create push and pull mechanisms in the food supply chain. While the initial, primary beneficiary of the HarvestPlus program is the smallholder farming household, as we move to impacting the greater food system, we want to link smallholder farmers and local SMEs to larger regional markets; we can only reach scale by working with larger partners to benefit the entire food system.



Logo developed for use on packaging to signpost biofortified foods to consumers.

# Key Enabling Factors

Supporting systems and tools are required at each point in the value chain. These tools are common to all value chains, and efficiency can be achieved by developing one set of tools to disseminate to all value chains.

Activity	Outcome	Examples of Partners
Advocacy	<ul style="list-style-type: none"> <li>Spread the word and explain the benefits; crowd in more advocates across the value chain.</li> </ul>	Governments UN Agencies
Policy inclusion	<ul style="list-style-type: none"> <li>Create the push from a policy framework.</li> <li>Utilize all policy avenues—nutrition, public health, agriculture, subsidies, pricing, social protection, food promotion, public procurement.</li> <li>Build nutrient breeding targets into agricultural policy.</li> <li>Demonstrate official/government support of NEC.</li> <li>Turning policy into action – educating stakeholders to use and follow policy.</li> </ul>	Governments UN Agencies
Standards and regulations for seed, food, grain	<ul style="list-style-type: none"> <li>Create the enabling environment and clarity for public and private sector actors to be involved.</li> <li>Ensure end-to-end standards and regulations exist for all points in the value chain.</li> </ul>	Governments BSI
Market research	<ul style="list-style-type: none"> <li>Identify bottlenecks and opportunities in demand and supply.</li> <li>Create insight-based marketing tools to calculate the potential market size.</li> </ul>	Euromonitor IPSOS Kantar Hansa Quantum
Farmer research	<ul style="list-style-type: none"> <li>Establish the needs of farmers.</li> <li>Test the seed products and product concepts with farmers.</li> <li>Support farmers in growing and gaining access to market.</li> </ul>	
Shopper (consumer) research	<ul style="list-style-type: none"> <li>Establish the needs of consumers.</li> <li>Test the products with consumers.</li> </ul>	
Technology advancements	<ul style="list-style-type: none"> <li>Establish solutions to problems using digital and technical advances, e.g. blockchain for traceability, digital marketing, eCommerce platforms, digital training (noncontact Covid-19-adapted solutions).</li> </ul>	The New Fork El-Kanis Cropin PxD (Precision Development)
Gender and inclusivity	<ul style="list-style-type: none"> <li>Ensure everyone has access to NEC.</li> <li>Promote technology and agriculture to women and other underserved populations.</li> <li>Identify barriers to involvement and address them.</li> </ul>	Global Affairs Canada
Evidence generation & impact evaluation	<ul style="list-style-type: none"> <li>Ensure activities are making an impact.</li> <li>Measure nutritional outcomes and impacts.</li> </ul>	Universities, academics, and research institutions

# Consumption of NEC through institutional settings

Public sector procurement (such as for school meal, hospital, and public food assistance programs) is a major volume-driving opportunity for biofortification.

Public procurement not only creates large-scale bulk demand; the recipients of publicly procured foods are also more likely to be populations who are most vulnerable to malnutrition. An estimated 297.3 million children in 85 countries receive a school meal on a daily basis. According to the World Food Programme (WFP), in 2020, 115.5 million consumers in 84 countries received assistance from the WFP.

In institutional settings such as schools, hospitals, and even the workplace, a consumer may receive food at no charge or for a subsidized price. However, the procurement of these foods is still commercial and relies on financial transactions; thus, procurement standards and publicly available specifications are also essential in public food procurement.

HarvestPlus has partnered with feeding programs, including those operated by the WFP, and the Akshaya Patra Foundation—an India-based NGO that develops, prepares, and distributes nutritious meals to two million children daily through the Indian Government's Mid-day Meal Scheme (MDMS).

## The results

HarvestPlus has a network of over 600 implementation partners and a database of nearly 5000 commercial seed, grain, and food businesses operating in NECs.

While NECs reached 64 million people at the end of 2021, the goal of HarvestPlus is to reach 1 billion consumers by 2030 by scaling up biofortification, in part by scaling existing crops in the countries where

they are available, and in part by scaling out into new crops and new countries.

For example, the recent case of [Pakistan](#) shows how biofortified zinc wheat varieties reached 20 percent of the commercial seed market; a zinc wheat variety released in 2022 (Nawab-21) with further improved traits will likely lead to even greater market share.

### How much does it cost to reach users?

Biofortification, used as a tool to tackle widespread hidden hunger, has been funded on the investment side by governments, donors, and private foundations. While scaling and handover is now taking place in close partnership with the private sector, it is essential to understand the cost of biofortification as an intervention.

The expert team of monitoring and evaluation specialists at HarvestPlus calculate the cost of reaching farmers and consumers each year. Costs include: advertising, educational and promotional materials; sales and marketing; trainings/meetings with farmers, agro-dealers, extension workers, trainers etc.; promotional giveaways and incentives; seed production; field expenses (labor, travel, supplies etc.); staff salaries; office supplies; rentals; vehicles; and local transport.

The average cost to reach a farmer across the global HarvestPlus program has fallen significantly in recent years, to USD 1.46, but is as low as USD 0.24 in Nigeria for vitamin A cassava, and USD 0.05 for zinc wheat in Pakistan. As scaling and delivery models evolve and new digital technologies are brought in play, the cost of reach is likely to decline significantly further.

### Other benefits of NEC value chains

- Improving livelihoods. NECs have value to farmers and processors. Involvement in biofortification has the capacity to build and improve the financial viability of SMEs.
- Encouraging youth entrepreneurship
- Promoting gender inclusivity
- Providing access to finance
- Climate adaptation—offsetting nutrient-sapping effects on crops
- Corporate ESG commitments and impact investments
- Building technology solutions
- Crowding in other nutrition interventions
  - Promotion of dietary diversity
  - Industrial large-scale food fortification



Seed marketing in Bangladesh

## The future of delivering NECs through public-private partnerships

The HarvestPlus delivery model has been made possible through support from donors (see current list on last page). Going forward, donors will either continue to support establishment of full-scale country delivery plans, or initiatives focusing on particular parts of the delivery model.

HarvestPlus has the organizational capabilities to drive scale-up of NECs in both subsidized farming systems and in commercial food systems. In commercial markets, our focus is on sustainably embedding NECs in seed, grain, and food value chains through partnerships with private sector actors.

Worldwide, the percentage of people who work in agriculture has dropped from 44 percent in 1991 to 26 percent in 2020, according to data from the International Labor Organization. This partly reflects the growing use of labor-replacing agricultural technology, but it also points to a bigger issue: many people choose not to work on farms anymore. As people make the choice to move away from home-grown food consumption, the delivery model of NECs must be flexible enough to adapt to changing food consumption habits and the move toward market-based food systems.

HarvestPlus will continue to raise funds to improve the household food systems of vulnerable farming families, but as a program, we are also working on increasing the nutritional content of food systems of rural, urban, and higher-income populations. Eventually, these segments will not require support or subsidization, given that NECs have high commercial value for the private sector.

Biofortification and NECs have value to consumers and businesses, once the seed—initially developed as a public good—becomes a commercial commodity. Working with private sector seed, farming, grain, and food businesses is the only way to successfully embed biofortification into food systems; this will be based on partnerships—spanning those with roadside micro- enterprise to the biggest brands in food production.



Point of sale marketing in Uganda

It may be possible to phase out donor support and subsidies when we successfully mitigate collective risk and address non-competitive aspects of the market. This will allow private-sector agriculture and food businesses to integrate biofortification into their policies, business strategies, procurement policies, corporate social responsibility commitments, and environmental, social, and corporate governance (ESG) commitments.

Continued investment in innovation along the full value chain is required, or the hard work to get to the scaling phase will be reversed. Building a delivery model that leads to sustainable practices is essential, and there is an important role for HarvestPlus to play when it comes to intermediation—the work to ensure that an innovation (nutritious varieties) is applied at scale.

There is not a fixed point of market share at which NECs will be judged to be anchored in the food system; anchoring is achieved when the NEC is fully adopted by all actors.

For a detailed case study of this model in practice, please see the Pakistan scaling [brief](#).

For more information about the HarvestPlus scaling models, please contact [Jenny Walton](#).



HarvestPlus improves nutrition, health, and livelihoods by working with partners worldwide to develop and promote biofortified crops that are rich in vitamins and minerals, and are climate-smart. HarvestPlus also provides leadership on biofortification evidence and technology. HarvestPlus is part of the CGIAR and is based at the International Food Policy Research Institute (IFPRI), a CGIAR research center.

The funding partners of HarvestPlus are the UK Foreign and Development Office (FCDO), The Bill & Melinda Gates Foundation, The Government of Canada, the John D. and Catherine T. MacArthur Foundation, the U.S. Feed the Future Initiative, the Children's Investment Fund Foundation (CIFF), and the Waterloo Foundation. The Netherlands Ministry of Foreign Affairs and German Federal Ministry for Economic Cooperation and Development provide funding to HarvestPlus through a partnership with the Global Alliance for Improved Nutrition.

HarvestPlus also thanks its hundreds of [partners](#) worldwide who are sustainably scaling biofortification.

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