

Scaling Up Biofortified Crops and Foods for Healthier, Inclusive, and Resilient Food Systems

Calls to action for the UN Food Systems and Tokyo Nutrition for Growth Summits



HarvestPlus
Better Crops • Better Nutrition

Reaching the Most Vulnerable Families

Addressing hidden hunger with nutrient-dense staple crops—developed through the process of biofortification—has gained considerable traction in low- and middle-income countries since the first varieties were released to farmers 16 years ago. This proven, practical, cost-efficient, and complementary malnutrition response for smallholder farming families and other low-resource populations is ready for rapid scale up to help achieve global development objectives. This brief summarizes the benefits and impact of biofortified crops and foods, and recommends commitments by key stakeholders to help catalyze scale up (see pp. 6-8).

Two landmark global events in 2021—the UN Food Systems Summit (UNFSS) and the Tokyo Nutrition for Growth Summit (N4G)—are opportunities for local, national, regional, and global stakeholders to catalyze positive transformation in the way we produce and consume food. The overarching objective is to agree on strategies aimed at making food systems more nutritious, inclusive, equitable, resilient, and sustainable, and help countries achieve the 2030 Sustainable Development Goals (SDGs).

However, the summits will fall short if the resulting strategies fail to address the needs and priorities of those most vulnerable to food and nutrition insecurity—due to poverty, climate and other pressures, and shocks such as the ongoing COVID-19 pandemic—that disrupt food systems and economies.

The most vulnerable people include hundreds of millions of smallholder farming families in rural areas of Africa, Asia, and Latin America, whose diets and livelihoods largely depend on what they can grow or raise themselves. They are also well represented among the estimated [3 billion people](#) worldwide who cannot afford diverse, healthy diets. Instead, they rely heavily on relatively inexpensive and less perishable staple foods to fill their stomachs.

Unfortunately, this leaves smallholder families susceptible to micronutrient deficiencies and their serious health impacts—such as stunting, anemia, blindness, weakened immune systems, and vulnerability to diarrhea and other infections—as well as physical and cognitive developmental impairments for children and adolescents. The negative effects on productivity also prevent people, communities, and countries from achieving their full potential.

Logically, a priority goal for food systems transformation is to make healthy diets accessible and affordable to all people, regardless of demographics, income level, or location—including during crises. The best outcome is for everyone to be able to eat a healthy diet (including food such as wholegrains, fresh fruits and vegetables, and animal source foods) that provides all essential nutrients.

However, inequities in food systems—such as those related to varying income levels, gender, and rural/urban disparities—are keeping healthy diets well out of reach for many. [One recent study](#) projected that micronutrient deficiencies will remain widespread in dozens of countries at least through midcentury, even under the most optimistic economic and climate scenarios.



As a result, we must ensure that not only are nutritious foods made available to the most vulnerable populations, but also that *all* foods available to these populations are as nutritious as possible. We must also be mindful of the fact that the majority of people affected by malnutrition are in [rural environments](#)—which are also where 80 percent of the world’s extreme poor live.

Biofortification: A game-changing Innovation

The concept of delivering essential micronutrients through nutrient-dense staple crops—an approach known as **biofortification**—emerged in the 1990s within the CGIAR, with the goal of better addressing micronutrient deficiency among smallholder farming communities. Biofortification is aimed at filling a significant nutrient gap in rural diets by delivering micronutrient-dense varieties of staple crops already grown and consumed by rural smallholder households.

Beyond this core mission, biofortified crops are also becoming game changers in the delivery of affordable nutrition to all consumers, through a widening range of food products made with biofortified ingredients. Food companies are finding that naturally nutritious biofortified ingredients are compelling to the increasing numbers of health-conscious consumers.

Over the past 16 years, interest from numerous low- and middle-income countries has grown rapidly: by the end of 2020, [nearly 400 varieties](#) of 12 common staples had been released in 41 countries, benefiting around 50 million people in smallholder farming families; hundreds more biofortified varieties are being tested in about 60 countries. These crops are enriched with vitamin A, iron, and/or zinc—the three micronutrients identified by the World Health Organization as most lacking in diets globally and among the biggest drivers of hidden hunger.

Biofortification is about making all available foods as nutritious as possible.

Research has confirmed a number of important health benefits from biofortified crops.

- **Vitamin A-biofortified crops** were shown to reduce vitamin A deficiency, improve night vision, and reduce the incidence of diarrhea—leading causes of morbidity and mortality in young children.
- **Iron-biofortified crops** were found to reverse iron deficiency and iron-deficiency related anemia, reduce fatigue in women, and improve cognitive and physical performance in women.
- **Zinc-biofortified crops** were shown to reduce susceptibility and duration of various illnesses in women and children, such as respiratory infections, inflammation, pneumonia, vomiting, and fever.

Underpinning the uptake of biofortified crops and foods is a robust [body of scientific evidence on their nutrition and health benefits](#). The primary target groups for biofortification are young children (ages 1-6 years) and women of reproductive age (WRA, ages 15-49 years), due to these groups' relatively high nutritional needs. Indeed, the nutrient breeding targets for biofortified crops are set with these groups in mind. If a young child or a non-lactating, non-pregnant WRA eats biofortified crops on a regular basis, they can receive (depending on which biofortified crop): up to 100 percent of their daily vitamin A requirement; up to 80 percent of their daily iron requirement; or up to 70 percent of their daily zinc requirement.

Farmer adoption studies have also shown that smallholder families want to grow biofortified varieties of crops because they are also bred to be agronomically competitive: high-yielding, climate-smart, and with other desirable traits such as resistance to pests and diseases. Biofortified varieties are also bred to have characteristics that are of particular value to women; for example, some iron bean varieties have been bred to have shorter cooking time, reducing the need for fuelwood and water, and freeing up women's time for other activities. Some vitamin A cassava and orange sweet potato varieties are bred to have dry matter content levels that facilitate post-harvest processing and cooking tasks which are often performed by women.

A cost-effective approach


Growing biofortified crops—which replace non-biofortified varieties on a one-for-one basis—also costs farming families no more than growing comparable non-biofortified varieties, and the biofortified varieties' intrinsic nutritional value is retained in the seed, harvest after harvest. In other words, biofortification is an up-front investment with long-term impact. Farming families also need only eat the same volume of the biofortified crop as the non-biofortified crop they replace to get the full nutritional benefit.

Biofortification is shown to be a cost-effective intervention. **The Copenhagen Consensus**, a leading global development think tank, ranks biofortification (along with other interventions that reduce micronutrient deficiency) among the highest value-for-money investments for economic development: every USD invested in biofortification yields as much as 17 USD in estimated benefits. Ex-ante analyses of several biofortified crops, as well as a recent review of such analyses, have shown that biofortification is highly cost-effective when measured by the World Bank's criteria of cost (in USD) per Disability-Adjusted Life Year (DALY) saved. These analyses show biofortified crops to be in the range of USD 15-20 per DALY saved—far below the World Bank's cost-effectiveness threshold of USD 270 per DALY.

Contributions to meeting the SDGs


Scaling up staple crop biofortification will contribute both directly and indirectly to achieving several Sustainable Development Goals (SDGs), thanks to these crops' proven nutrition, health, and livelihood benefits for vulnerable populations, other specific benefits for women and children, and their climate-smart attributes.

1 NO POVERTY



Biofortified crops are not only nutritious. They are also high-yielding and carry other key traits such as drought tolerance, and disease and pest resistance—all of which can potentially improve farming families' livelihoods.

2 ZERO HUNGER




Biofortified crops have a direct impact on ending all forms of malnutrition by providing access to safe, nutritious, and sufficient food, particularly for women and children, who are most vulnerable to hidden hunger.

3 GOOD HEALTH AND WELL-BEING




Biofortified crops are scientifically proven to improve health outcomes.

4 QUALITY EDUCATION




Biofortified crops are scientifically proven to improve physical and cognitive development of children and increase their learning capacity.

5 GENDER EQUALITY



Biofortified crops empower women farmers (who often are in charge of managing the family's staple crops) and women who run food sector SMEs.

13 CLIMATE ACTION



Biofortified crops have the potential to offset reductions in crops' nutrient content caused by rising levels of atmospheric carbon dioxide.



Growing support for scaling up

Despite its relatively recent emergence as a response to hidden hunger, biofortification has garnered strong endorsements from multiple actors in the global food and nutrition security community, as a valuable addition to strategies to address micronutrient malnutrition among the most vulnerable populations. At the national level, 26 countries so far have included biofortification in national policies on agriculture, nutrition, and/or health.

Below are a few examples of national-level actions taken in 2020 alone:

- On World Food Day, **Indian Prime Minister Narendra Modi** recognized biofortification as an important element in strengthening the government’s campaign to improve nutrition, and committed to their integration in government support programs, such as midday meals for school children.
- **Tanzania’s** government issued [comprehensive national guidelines](#) for biofortification activity across seed and food value chains to provide assurance for market actors and spur growth in the sector.
- The government of the **Democratic Republic of the Congo** plans to include biofortification in its multisectoral nutrition initiatives that are being supported by a sectoral World Bank loan.
- The **Guatemalan** government made biofortified crops part of its [COVID-19 Economic Recovery Plan](#), including in a National System of Strategic Food Reserves to build resilience in crises.

At the global and regional level:

- The **African Development Bank (AfDB)**, in its [Multi-Sectoral Nutrition Action Plan](#) 2018-2025, identified biofortification as a priority nutrition-smart investment. AfDB President Akinwumi Adesina has called it a “game-changer in dealing with malnutrition in our world today.”
- The **African Union (AU)** Commission adopted a “Roadmap for Upscaling Biofortification” to guide and inspire country-level action by the 55 AU member states, saying this is essential for achieving the national food and nutrition targets of the Malabo Declaration, adopted at a 2014 AU Summit to set concrete goals for African agriculture by 2025.
- The **CGIAR** global agricultural research partnership committed to “mainstreaming” micronutrient targeting—that is, making this a core element of breeding programs for major staple crops, including wheat, pearl millet, and beans. CGIAR provides varieties to hundreds of countries.
- The **UN Food and Agriculture Organization (FAO)**, in a [recent brief](#) produced jointly with HarvestPlus, encouraged “the adoption and scaling up of biofortification through national policies and programs.” FAO Senior Nutrition Officer Patrizia Fracassi described biofortification as a “cost-effective, food-based, nutrition-sensitive agricultural approach for improving nutrition.”
- The **2020 State of Food and Nutrition Security in the World (SOFI)** Report recommended biofortification as a cost-effective measure to reduce hidden hunger, particularly for smallholder farming families whose diets “continue to be dominated by staple foods” for economic reasons.



Time to commit to rapid scale up

These and other welcome commitments reflect accelerating momentum in the biofortification movement. However, much more needs to be done to achieve this technology's full potential and impact in improving rural lives and livelihoods. This proven, practical response to pervasive hidden hunger, and valuable building block for more-nutritious, inclusive food systems, is ready for rapid scale up.

In the context of the UNFSS and the N4G Summit, we urge national policymakers, businesses in seed and food sectors, aid donors, and multilateral institutions to make bold new commitments that help scale up the production and consumption of nutrient-dense biofortified staple crops:

Recommended Commitments by National Governments

- Include biofortified crops in national agricultural development and investment plans and public health nutrition policies.
- Integrate biofortified crops and foods in nutrition improvement strategies, particularly those targeted at maternal, infant, young child, and adolescent nutrition.
- Commit national crop research programs to minimum micronutrient standards for newly developed staple crop varieties, thus “mainstreaming” biofortification in crop development.
- Invest in complementary capacity in national agriculture, quality control, and extension agencies to enable implementation of biofortification policy goals.
- Incentivize private sector participation in biofortification by encouraging establishment of startups, building SME capacity, and establishing targeted financing mechanisms.
- Establish national, multisectoral working groups on biofortification to coordinate activity among public, private, and NGO actors, and advocate for biofortification initiatives.
- Integrate biofortified foods in public support programs, such as food assistance and school meals programs.
- Direct farmer-focused subsidy programs (such as for seeds) to include and prioritize promotion of biofortified varieties.
- Support farmer extension services in strengthening their capacity to promote and support farming of biofortified crops.

Recommended Commitments by Value Chain Businesses

Seed Companies

- Commit to integrating nutrient targets as a core element in advancing genetic gain.
- Adopt marketing practices that highlight the unique nutritional selling points of biofortified varieties, for example through specific labeling and packaging.
- Commit to developing and offering different classes of biofortified seed to reach different market segments (such as certified seed and “quality declared” seed).
- Offer promotional incentives and technical extension to farmers to try and increase the adoption of biofortified varieties.
- Support market monitoring/measurement efforts by reporting volumes of biofortified seed purchased, via corporate websites and other platforms.

Agribusinesses and Traders

- Evaluate and develop methods to efficiently procure biofortified crops from groups of smallholder and low-income farmers.
- Support development of, and adherence to, publicly available standards for biofortified products to ensure they will positively impact nutrition and health.
- Conduct assessments of farmer evaluation of and demand for biofortified products, and share results with seed companies for product adaptation and production planning.
- Develop supply linkages to high-volume food assistance programs that reach the most vulnerable populations (such as through the World Food Programme or USAID Office of Foreign Disaster Assistance).
- Support market monitoring/measurement efforts by reporting volumes of biofortified products sold and purchased, via corporate websites and other platforms.

Food Businesses

- Commit to using biofortified ingredients where they can easily replace non-biofortified counterparts in the processing and/or manufacturing stage.
- Assess, through market research, potential demand for products made with naturally nutritious biofortified ingredients.
- Support development of labeling schemes that provide guideposts for consumers for products that include biofortified ingredients.
- Develop healthy food products with biofortified ingredients that are affordable and accessible to low-income consumers.
- Support market monitoring/measurement efforts by reporting volumes of biofortified products sold and purchased, via corporate websites and other platforms.

Recommended Commitments by Donors and Global Institutions

- Support biofortification “mainstreaming” efforts by global and national crop research systems, particularly in terms of capacity strengthening, and technology development and acquisition.
- Support initiatives to develop publicly available standards for biofortified seed and food products to increase market participants’ confidence and interest in them.
- Support initiatives to develop biofortified product tracing and authentication systems (for example, through the application of distributed ledger technologies) to ensure proper differentiation and segmentation of biofortified products in value chains.
- Support national farmer incentive programs and extension services schemes to drive initial engagement and promotion of biofortified crops with smallholder farming communities.
- Integrate and prioritize biofortified crops in procurement efforts that supply relief and humanitarian support programs.
- Support national government to integrate development of biofortification supply and value chains as part of agricultural and health sector loan programs for low- and middle-income countries.
- Support research programs focusing on measuring the effectiveness and impact of biofortification.

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 (A4NH) and based at the International Food Policy Research Institute (IFPRI).



For more information about staple crop biofortification, its benefits, and its impact,
contact: HarvestPlus@cgiar.org

Cover photo credit: Jonathan Jones | All other photos: HarvestPlus