
A boy in Brazil eats a meal containing biofortified sweet potato. The country's biofortification program aims to increase iron, zinc and vitamin A levels in diets. (Tarcila Viana/HarvestPlus)

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Improving Nutrition Through Biofortification

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Introduction: Exploring the Potential of Biofortification

Micronutrient deficiencies, also known as hidden hunger, afflict more than two billion individuals, or one in three people, globally (FAO, 2013). Such deficiencies occur when intake and absorption of vitamins and minerals are too low to sustain good health and development. During the past 40 years, agricultural research for developing countries has helped increase production and availability of calorically dense staple crops, but the production of micronutrient-rich non-staples, such as vegetables, pulses and animal products, has not increased in equal measure. In the long term, increasing the production of micronutrient-rich foods and improving dietary diversity will substantially reduce micronutrient deficiencies. In the short term, consuming biofortified crops can help address micronutrient deficiencies by increasing the daily adequacy of micronutrient intakes among individuals throughout the life cycle (Bouis *et al*., 2011).

Biofortification is the process of increasing the density of vitamins and minerals in a crop through plant breeding, transgenic techniques, or agronomic practices. Biofortified staple crops, when consumed regularly, will generate measurable improvements in human health and nutrition. This chapter provides a critical summary of HarvestPlus-led research and implementation results (2003–2017) and has been developed from Bouis and Saltzman (2017). It discusses delivery experiences and an action-oriented agenda for scaling biofortification to improve nutrition globally. Delivery experiences are discussed from the perspective of HarvestPlus, which leads a global interdisciplinary alliance of research institutions and implementing agencies in the biofortification effort.

Biofortification Research and Development

For biofortification to be successful, the following broad questions must be addressed.

- Can breeding increase the micronutrient density in food staples to make a significant impact on nutritional status?
- When consumed, will the extra nutrients improve micronutrient status?
- Will farmers grow the biofortified varieties and will consumers buy/eat them in sufficient quantities?

To answer these questions, researchers carry out a series of activities in three phases: discovery, development, and dissemination, explained in greater detail below and in Bouis *et al*. (2011).

Discovery

The overlap of cropping patterns, consumption trends, and prevalence of micronutrient malnutrition, as well as ex ante cost–benefit analyses, determine target populations and focus crops. Nutritionists then work with breeders to establish nutritional breeding targets. Breeding targets for biofortified crops are designed to meet the specific dietary needs and consumption patterns of women and children. These target levels take into account the average food intake and habitual food consumption patterns of target population groups, nutrient losses during storage and processing, and nutrient bioavailability, and are updated as more data becomes available (Hotz and McClafferty, 2007).

Plant breeders screen existing crop varieties and accessions in global germplasm banks to determine whether sufficient genetic variation exists to breed for a particular trait, such as high provitamin A content. Initial research has indicated that selection of lines with diverse vitamin and mineral profiles could be exploited for genetic improvement (Saltzman *et al*., 2013). Genetic transformation is an alternative method to incorporate specific genes that express nutritional density.

Development

Plant breeding can increase nutrient levels in staple crops to target levels required for improving human nutrition, without compromising yield or farmer-preferred agronomic traits. For example, several iron beans for Rwanda and the Democratic Republic of the Congo (DRC) fit into farmers' existing crop production schemes. The crop development process entails screening germplasm for available genetic diversity, pre-breeding parental genotypes, developing and testing micronutrient-dense germplasm, conducting genetic studies, and developing molecular markers (fragments of DNA used to identify particularly relevant genetic sequences) to lower the costs and quicken the pace of breeding.

Initial crop development is undertaken at international research institutes to develop varieties with improved nutrient content and high agronomic performance, as well as preferred consumer qualities. Once promising high-yielding, high-nutrient lines emerge, they are tested in several locations across target environments to determine the genotype × environment interaction (G×E) – the influence of the growing environment on micronutrient expression. Robust regional testing enables reduced time-to-market for biofortified varieties. National research partners select the most promising varieties for multi-locational testing over multiple seasons and subsequently submit them to national governments for release. The formal release process varies by country, but in general requires that a variety be grown and evaluated in several different locations (called multi-locational trials) for at least two seasons, and its performance compared with other candidate and widely released varieties, before the national government approves the variety for dissemination. The breeding, testing, and release process can take 6–10 years to complete.

Parallel to crop improvement, nutrition research measures retention and bioavailability of micronutrients in the target crop under typical processing, storage, and cooking practices. Participatory research on consumer and farmer evaluation of biofortified varieties, as well as varietal adoption studies, further informs crop improvement research during the development phase.

Dissemination

Biofortified crops must be formally released in the target countries prior to their delivery to the target populations. By the end of 2017, more than 290 varieties of 12 biofortified crops had been officially released in over 30 countries, and hundreds of varieties of 13 biofortified crops were being tested in over 30 more. Released biofortified crops include vitamin A orange sweet potato (OSP), vitamin A yellow cassava, vitamin A orange maize, vitamin A banana/plantain, iron beans, iron pearl millet, zinc maize, zinc rice, zinc wheat, iron and zinc cowpea, iron and zinc sorghum, and iron and zinc lentils. Additional biofortified crops being tested are iron and zinc Irish potato, iron and zinc sorghum, and vitamin A squash.

Economists lead consumer acceptance, varietal adoption, and seed and grain value chain studies to inform effective, efficient, and targeted delivery and marketing strategies to maximize adoption and consumption of these crops. Delivery experiences are discussed in greater detail in the 'Delivery Experiences' section below.

Comparative Advantages and Cost-effectiveness

The ideal solution for the elimination of micronutrient deficiencies is consumption of appropriate age and activity-level balanced diets that include sufficient quantities of micronutrient-rich vegetal and animal-source foods. Unfortunately, these ideal, balanced diets are often not available (due to seasonality) or accessible (due to price) to many households, especially those in rural areas of developing countries. In the absence of balanced diets, biofortification, fortification and supplementation are three effective interventions that are complementary across time and space.

Vitamin and mineral supplements, in particular vitamin A supplementation, are very effective in improving the micronutrient intakes and the health outcomes of the recipients. Supplementation, however: (i) requires annual mobilization campaigns to sustain reach and coverage, which requires political will, and donor support; (ii) is specific to certain segments of the population (pregnant women or children under 5) and does not reach other members of the household; (iii) requires regular access to clinics or health facilities, or donor-funded child health days held twice per year, where such supplements are given; and (iv) may not protect for a full 6 months in the case of several supplements, such as vitamin A supplementation.

Fortification of commonly consumed food vehicles (like oil, sugar, flour) is a very effective intervention in improving micronutrient intakes. Fortification, however, also has its challenges, in particular: (i) industrially processed, fortified foods are not always easily accessible to rural families, given infrastructure and market access challenges that are common in developing countries; (ii) government mandates are necessary (but often not sufficient) to fortify 100% of the supply of a given fortification vehicle; (iii) proper investment in quality control is necessary to ensure compliance and achievement of target levels; and (iv) incremental costs of fortification are typically transferred to the consumer in terms of higher food prices.

As another food-based approach, biofortification of commonly consumed staple crops is found to significantly improve micronutrient intakes of rural populations in developing countries, as explained in greater detail in the next section. Biofortified foods are self-targeting to rural farm households who tend to consume what they produce, and biofortified staple foods are consumed by all household members. Biofortification delivers nutrients in their natural food matrix, which lessens the likelihood of excess consumption of nutrients. By coupling breeding for nutrients with other desired and essential traits, investment in breeding ensures the maintenance of a robust healthy food supply.

The World Development Report for 1993 (World Bank, 1993), which reviewed many public health interventions, suggested that interventions costing less than US$150 per disability-adjusted life year (DALY) averted (approximately US$261 in 2018 dollars) are highly cost-effective. Ex post results on the cost-effectiveness of biofortification are currently limited to OSP in Uganda. These results show biofortification to cost US$15–20 per DALY saved (HarvestPlus, 2010), while for the same country the cost of vitamin A sugar fortification is US$56 per DALY saved (Fiedler and Macdonald, 2009) and the cost of vitamin A supplementation is US$52 per DALY saved (WHO, 2018).

For other countries where large-scale delivery efforts have recently started or are about to begin, HarvestPlus has calculated the ex ante cost per DALY saved for each context. Peer-reviewed (Meenakshi *et al.*, 2010) and HarvestPlus documents (Birol *et al.*, 2014) showed that for every country–crop–micronutrient combination, biofortification is cost-effective by the World Bank standard, and that biofortification was significantly more cost-effective than supplementation and fortification for most country–micronutrient combinations analyzed. Even in countries where relatively few DALYs are lost due to micronutrient deficiency, biofortification is expected to have an advantageous benefit–cost ratio (Lividini *et al.*, 2017).

Further analyses must be conducted to better understand the optimal portfolio of strategies for improving diets and micronutrient deficiencies. Biofortification is not a ‘silver bullet’ for the elimination of micronutrient deficiencies, but presents an opportunity for increasing micronutrient intakes of rural households in developing countries.

Biofortified Crops Can Improve Human Nutrition

To develop evidence of nutritional efficacy, nutritionists first measure retention of micronutrients in crops under typical processing, storage, and cooking practices to be sure that sufficient levels of vitamins and minerals will remain in foods that target populations typically eat (Boy and Miloff, 2009; Carvalho *et al.*, 2012; De Moura *et al.*, 2014, 2015; Mugode *et al.*, 2014; Taleon *et al.*, 2017). Nutritionists also study the degree to which nutrients bred into crops are absorbed, first by using models, then by direct study in humans in controlled experiments (La Frano *et al.*, 2014). Absorption is a prerequisite to demonstrating that biofortified crops can improve micronutrient status, but the change in status with long-term intake of biofortified foods must be measured directly. Therefore, randomized controlled efficacy trials are used to demonstrate the impact of biofortified crops on micronutrient status and functional indicators of micronutrient status (e.g. visual adaptation to darkness for vitamin A crops; physical activity and cognition tests for iron crops). Highlights are discussed below.

Iron crops

Iron nutrition research has demonstrated the efficacy of biofortified iron beans and iron pearl millet in improving the nutritional status of target populations. Biofortified iron beans have been demonstrated to be efficacious in two different populations. In Mexico, after consuming biofortified black beans for 3.5 months, the iron status of primary school children improved (Haas, 2014). In Rwanda, iron-deficient university women showed a significant increase in hemoglobin, ferritin, and total body iron after consuming biofortified beans for 4.5 months (Haas *et al.*, 2016). The latter study also found that iron beans had a profound effect on cognition: iron-deficient women who ate biofortified beans experienced improved memory and ability to pay attention (Murray-Kolb *et al.*, 2017), key skills for optimal performance at school and work. The study also measured physical performance and preliminary results suggested that improvements in iron status were accompanied by a reduction in time spent in sedentary activity (Luna *et al.*, 2015).

Similarly, iron pearl millet was demonstrated to be an efficacious approach to improve iron status in adolescent children in a 6-month study conducted in rural Maharashtra, India. Iron deficiency was significantly reduced and serum ferritin and total body iron were significantly improved in secondary school children who consumed iron pearl millet flat bread twice daily, after only 4 months. Children who were iron deficient at baseline were 64% more likely to resolve their deficiency by 6 months (Finkelstein *et al.*, 2015). Results from the same trial indicated that iron biofortified pearl millet consumption also improved cognitive performance (Scott *et al.*, 2018) and levels of physical activity (Luna *et al.*, 2016).

Finally, a recent systematic review of randomized efficacy trials on iron-biofortified crops reinforced the conclusion that iron biofortification significantly improves iron status – particularly among women and children in poor communities who need it most (Finkelstein *et al.*, 2017).

Vitamin A crops

Consumption of OSP can result in a significant increase in vitamin A body stores across age groups (Haskell *et al.*, 2004; van Jaarsveld *et al.*, 2005; Low *et al.*, 2007). The primary evidence for the effectiveness of biofortification comes from OSP, assessed through a randomized controlled intervention effectiveness trial called the Reaching End Users (REU) with OSP project. The REU project delivered OSP planting material to 24,000 households in Mozambique and Uganda from 2006 to 2009, with adoption rates of OSP reaching over 60% among the beneficiaries (i.e. intervention group). In Uganda, the introduction and promotion of OSP over four growing seasons resulted in significantly increased serum retinol at endline for children under 5 years of age in the OSP intervention group who had low vitamin A status at the beginning of the study (Hotz *et al.*, 2012a, b). In Mozambique, consumption of OSP by children under 5 significantly reduced the burden of diarrhea, the second leading cause of death in this age group globally; the likelihood of experiencing diarrhea was reduced by 39% and duration of diarrhea episodes was reduced by more than 10% (Jones and de Brauw, 2015). Vitamin A yellow cassava, another root-and-tuber crop, was also demonstrated to be efficacious in an efficacy study conducted in Eastern Kenya with 5–13-year-old rural school children. That study found a modest but significant improvement in vitamin A status, measured by serum retinol and beta-carotene, in the vitamin A yellow cassava versus the control group (Talsma *et al.*, 2016).

The beta-carotene in vitamin A orange maize is an efficacious source of vitamin A when consumed as a staple crop. An efficacy study in rural Zambia with 5–6-year-old children showed that, after 3 months, total body stores of vitamin A in children eating orange maize increased significantly compared with those in the control group (Gannon *et al.*, 2014). A larger trial conducted with over 1000 marginally malnourished 4–8-year-old children in another rural farming district of Zambia demonstrated that vitamin A orange maize meal consumption increased serum beta-carotene concentrations but did not improve serum retinol (Palmer *et al.*, 2016a). In this same trial, visual adaptation to darkness was assessed: among children who were vitamin A deficient at baseline, those who consumed orange maize had greater improvement in pupillary responsiveness than those in the control group, improving their ability to see in dim light (Palmer *et al.*, 2016b). Another study in the same region with lactating women showed no increase in mean breast milk retinol concentration among women who consumed vitamin A orange maize, but this issue warrants further investigation (Palmer *et al*., 2016c).

Zinc crops

Brnić *et al*. (2016) compared the absorption of zinc from a biofortified rice variety (22 ppm) and artificially fortified commercial rice (24 ppm) in 16 healthy adults. They found that biofortification of rice was likely as good as post-harvest zinc fortification at tackling zinc deficiency. Rosado *et al*. (2009) and Signorell *et al*. (2015) both found total absorbed zinc from zinc biofortified wheat to be higher than from non-biofortified wheat (the former) and post-harvest fortified wheat (the latter). The evidence on the efficacy of zinc crops is still at its infancy, due to the unavailability of adequate tools for measurement of impact at the levels of zinc which biofortified crops provide. In lieu of such tools, a recent efficacy study investigated the impact of zinc wheat on women's and children's health outcomes in India, and found consumption of zinc wheat to significantly reduce the number of days children had pneumonia and vomiting; and the number of days women had fever (Sazawal *et al*., 2018).

Delivery Experiences

After biofortified varieties have been developed and released, they enter national farming and food systems. By the end of 2017, at least 30 million people were benefiting from biofortified crops. Operations research and monitoring and evaluation of delivery programs continue to add to the evidence that farmers are willing to grow biofortified crops (Asare-Marfo *et al*., 2016; Tedla-Diressie *et al*., 2016) and that consumers are willing to eat them (Chowdhury *et al*., 2011; Meenakshi *et al*., 2012; Birol *et al*., 2015; Banerji *et al*., 2016; Oparinde *et al*., 2016). HarvestPlus and partners are also generating evidence on which delivery and promotion mechanisms have the biggest impact on adoption and consumption, and at what cost (HarvestPlus, 2010). The majority of such evidence is from HarvestPlus's phase I priority countries (including Bangladesh, Brazil, China, Colombia, DRC, India, Nigeria, Pakistan, Rwanda, Uganda, Zambia, and Zimbabwe) where HarvestPlus and national partners are taking the lead in delivery. Phase I countries represent a variety of market environments for biofortified crops, from a primarily commercial, private-sector approach for hybrid crops (e.g. for pearl millet in India and maize in Zambia), to various mixed public–private delivery systems for vegetatively propagated and open-pollinated crops (e.g. cassava in Nigeria, beans in Rwanda and sweet potato in Uganda), to primarily public or informal market systems (e.g. beans and cassava in DRC). Progress in the integration of biofortified crops into the seed and food value chains in these countries is discussed below, using case studies to show how HarvestPlus and its partners have strengthened seed systems, created knowledge and demand, and expanded partnerships to ensure the future sustainability of biofortification.

Vegetatively propagated crops

Vegetatively propagated crops – those for which farmers plant stems, tubers or vines rather than seeds – typically have seed systems characterized by small, informal (rather than commercial) actors. Planting materials are perishable, expensive, and bulky to transport over long distances, and must be replanted within several days of harvesting. The lack of commercial private sector participation creates both a challenge and an opportunity for producing planting materials of biofortified crops like OSP (distributed as vines) and vitamin A cassava (distributed as stem cuttings).

Cassava in Nigeria

In parallel with strengthening the seed system through both community-based and commercial stem production, awareness of and demand for biofortified crops must be created. In the case of vitamin A cassava, extension to farmers was at the forefront of this effort. Initially, free bundles of stems were distributed to farmers, and accompanied by agronomic training and nutrition information. In the following season, farmers who received free stems were required to distribute an equal amount of free stems to two additional farmers, a delivery strategy that reduced costs by almost 95%. This promotional strategy was effective in reaching vulnerable populations who typically do not have market access to improved varieties for planting. It also piqued interest and allowed farmers a low-risk way to test a new product. Many of the farmers who received and planted free stems liked the yellow cassava and are now buying additional stems from commercial traders.

In the early years of delivery, HarvestPlus estimated that about 75% of all biofortified harvested roots were consumed on farm, as many households were not yet producing surplus from the stem packs they received for trial. Diffusion (both within and across farms) and subsequent commercialization were observed in 2016 and 2017 and are likely to increase going forward.

Self-pollinated crops

Self-pollinated crops – those which produce seed true to their parent characteristics – can be replanted year after year. While farmers do need to periodically replace their seed to maintain its desirable agronomic traits, the relatively small annual market for seed typically limits private-sector investment in producing seed for self-pollinated crops. For crops with a low seed rate, like pearl millet, farmers are more likely to purchase seed annually. An open-pollinated variety of biofortified iron pearl millet has been successfully deployed through the private sector in India, where farmers generally purchase seed annually. In many countries, the public sector instead multiplies and distributes self-pollinated seed, and further farmer-to-farmer dissemination is common. Self-pollinated biofortified crops include iron beans, delivered in Rwanda and Democratic Republic of the Congo, zinc rice in Bangladesh, and zinc wheat in India and Pakistan. Delivery has progressed most quickly in Rwanda, where initial public-sector investments have now spurred private-sector interest in meeting growing demand for iron bean seed. Delivery of zinc wheat in India and Pakistan started in 2016 and accelerated in 2017, with numbers of households reached doubling for the former, and tripling for the latter.

Rice in Bangladesh

At the core of the Bangladesh biofortification strategy are rice varieties with attractive agronomic properties and a robust farmer demonstration program. One released zinc rice for the wet season (BRRI dhan 64) is a short-duration variety (100 days as compared with the average 140 days), which allows production of a third crop of lentils or other food between wet and dry season rice crops. Other biofortified zinc rice varieties carry different farmer-preferred agronomic traits, like high height at maturity, which is beneficial for flooded areas in Southern Bangladesh. A robust demonstration program provides farmers a chance to observe these new varieties, as well as training on growing the biofortified rice and the health benefits of zinc.

Seed is produced by both the private and the public sector. A private seed association called SeedNet produces truthfully labeled seed alongside the foundation and certified seed produced by government entities. In order to kick-start the scaling up process, HarvestPlus initially both guarantees a market for a portion of the private-sector production (demand pull) and subsidizes the price for any seed that the private-sector markets directly to farmers (supply push). Free seed is distributed by non-government organization (NGO) and government partners in small seed packs, and all free seed recipients agree to pass on the same amount of seed to three neighboring farmers in the subsequent season. As an increasing amount of zinc rice is available on the market, efforts to increase consumer and miller awareness (demand pull) have increased, including outreach via SMS (text messaging) and programs on local television and community radio channels. As a result of these supply- and demand-side interventions, biofortified seed and food are expected to comprise greater shares of the seed and food systems.

Hybrid crops

Hybrid crops – those for which seed must be replaced each year to maintain the same yield and agronomic traits – offer the most potential for private sector commercialization. While utilizing the private sector for delivery may lead to long-term sustainability, the speed of private-sector uptake is dependent on its assessment of demand. Therefore, the activities of biofortification proponents must focus on targeted demand creation for both farmers and consumers.

Maize in Zambia

Because private seed companies dominate the hybrid maize seed market in Zambia, upon release, biofortified varieties were licensed to companies for commercialization of seed production and distribution. The inclusion of vitamin A maize seed in the Zambian government's Farmer Input Support Programme has further facilitated access to orange maize seed, particularly for vulnerable households.

A central element of the delivery strategy is to use educational and awareness-creation activities to stimulate consumer demand for orange maize products, while engagement with the private sector helps meet growing consumer demand. HarvestPlus also links major grain buyers to farmers and offers test grain to millers and food processors interested in incorporating orange maize in their product lines. Growing interest from farmers and food processors has encouraged increased private-sector seed production.

Building Blocks for Global Delivery

For biofortification to reach scale and be truly sustainable, a number of institutions must become involved in establishing an enabling environment. This includes recognition of biofortification among global normative and regulatory agencies, integration into development policies and programs funded by multilateral institutions, and incorporation into development programs being implemented on the ground, both in target countries and beyond. This enabling environment is essential to encourage the scaling up of biofortified crops and to support national-level actors in various spheres.

Efforts are underway to integrate biofortification into global standards and guidelines, such as the Codex Alimentarius, the food standards-setting agency administered jointly by the World Health Organization (WHO) and the Food and Agriculture Organization of the United Nations (FAO) and recognized by the Sanitary and Phytosanitary Agreement (SPS) of the World Trade Organization (WTO) as its reference organization. Progress toward the development of a definition and standards for biofortification within the Codex Alimentarius continues. A WHO Cochrane review committee was assembled in 2016 to review the scientific evidence and country experiences of scaling up biofortification, and the WHO recommendations for global guidelines on biofortification are anticipated in 2019.

Beyond their individual investments and activities, multilateral institutions, including the World Bank, the African Development Bank, the World Food Programme (WFP), and the WHO, collectively influence national government policymakers and operational partners. The World Bank considers biofortification as a low-cost, high-impact and scalable solution, and is now implementing biofortification projects, including the Multisectoral Food Security and Nutrition Project in Uganda, which is accelerating the scale-up of orange sweet potato and iron beans. As a convener of development partners, the Bank plays an important role in encouraging nutrition-sensitive agricultural approaches, including biofortification, in arenas like the Global Donor Platform for Rural Development. The African Development Bank's new 'Banking on Nutrition' technical partnership is implementing a multisectoral and integrated approach to nutrition interventions, including the integration of biofortified crops. The WFP's Purchase for Progress and School Feeding programs are both very interested in local purchasing of biofortified crops, and partnerships are being developed in several countries, including Rwanda and Zambia in Africa, and Colombia, El Salvador, Guatemala, Honduras, and Nicaragua in Latin America.

While private-sector participation is essential in creating sustainable markets for biofortified seed and foods, NGOs remain important in delivering this nutrition intervention to vulnerable households. The existing global partnership between World Vision and HarvestPlus is an example of how a leading development NGO can incorporate biofortified crops into its existing agricultural programs, linking them to health and nutrition programs. While HarvestPlus provides technical assistance, World Vision takes the lead in delivery. This type of partnership, whereby biofortified crops are integrated into existing agriculture and nutrition projects or included in collaboratively developed new projects, will continue to be important to reach the most vulnerable households, which may also be the most likely to suffer from micronutrient deficiencies. Local NGOs, such as Programme Against Malnutrition (Zambia) and Volunteer Efforts for Development Concerns (Uganda), and international charities, like Caritas and Self-Help Africa, have also been essential partners in reaching vulnerable households with biofortified crops.

Scaling Up and Mainstreaming Biofortification

There is much unfinished business in scaling up and mainstreaming biofortification. In 2018, HarvestPlus entered its fourth 5-year phase and is implementing its new strategic plan, which is designed to lay the groundwork for biofortification to benefit 1 billion consumers globally by 2030. In this new phase, HarvestPlus has commissioned efficacy studies on zinc biofortified crops, as well as effectiveness studies on both zinc and iron biofortified crops. Additional studies are planned to understand the efficacy of biofortification for additional target groups, like adolescents, and on health outcomes beyond micronutrient deficiency status. As part of this new phase, HarvestPlus will work closely with others to further elucidate the comparative advantages of different interventions (biofortification, fortification, and supplementation) across time and location and to establish optimal micronutrient intervention portfolios for scenarios such as global population growth and climate change. This new phase will also analyze, document and make publicly available the data, tools, processes, and the lessons learned from interventions to introduce and scale up biofortification. The ultimate aim of these efforts is to anchor biofortification within the various national and international policies, programs and investments in the agriculture and nutrition nexus.

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