Accomplishments & Plans

Phase 1 Discovery (2003–08)
• Identified target populations that can benefit from more nutritious food crops
• Screened seed banks to identify nutrient-rich seed lines to use in breeding
• Set nutrient target levels for breeding and began breeding programs
• Identified genes responsible for synthesis, degradation, and translocation of micronutrients
• Assessed retention and bioavailability of nutrients bred into crops
• Identified promoting compounds to increase bioavailability of iron and zinc
• Developed fast and cheaper methods to measure micronutrients in crops and foods
• Initiated research to determine if farmers would adopt micronutrient-rich crop varieties
• Research whether consumers will buy and/or eat crops that are more nutritious
• Developed methods to measure the potential health impact of micronutrient-rich crops
• Implemented pilot programs to deliver vitamin A-rich orange sweet potato in Africa
• Helped establish national biofortification programs in Brazil, China, and India
• Shared findings through peer-reviewed journals and other publications and at conferences

Phase 2: Development (2009–13)
• Developing and adapting nutrient-rich crops to perform well in target countries
• Testing and improving crops in collaboration with national partners
• Augmenting nutrition research and findings from Phase 1
• Conducting nutritional efficacy trials to assess benefits of micronutrient-rich crops
• Identifying factors that affect whether farmers and consumers will accept micronutrient-rich crops
• Completing assessment of vitamin A-rich orange sweet potato pilot programs in Africa (Phase 1)
• Establishing country teams and networks of national partners to facilitate delivery
• Developing strategies and implementing pilot delivery of selected crops in target countries

Phase 3: Delivery (2014–18)
• Strengthen crop development pipeline and technologies to further improve micronutrient-rich crops
• Establish biofortification as a core component of agricultural research centers’ breeding programs
• Scale-up micronutrient-rich crops to remaining target countries and leverage partnerships to expand delivery into new countries
• Implement strategies with public and private sector partners to create consumer demand for micronutrient-rich crops and food
• Study adoption of micronutrient-rich crops and its impact on improving the nutrition of target populations
• Mainstream biofortification through strategic research, communications, and advocacy

CGIAR Partners
Center for International Forestry Research (CIFOR)
International Center for Tropical Agriculture (CIAT)
International Maize and Wheat Improvement Center (CIMMYT)
International Potato Center (CIP)
International Crops Research Institute for the Semi-Arid Tropics (ICRISAT)
International Food Policy Research Institute (IFPRI)
International Institute of Tropical Agriculture (IITA)
International Rice Research Institute (IRRI)
WorldFish

Country Programs
Embrapa (The Brazilian Agricultural Research Corporation)
HarvestPlus China
India Biofortification Program

Donors
Asian Development Bank (ADB)
Austrian Ministry of Finance
The Bill and Melinda Gates Foundation
Canadian International Development Agency (CIDA)
European Commission
The International Fertilizer Group
International Life Sciences Institute (ILSI)
Royal Danish Ministry of Foreign Affairs (DANIDA)
Swedish International Development Agency (SIDA)
Syngenta Foundation for Sustainable Agriculture
United Kingdom Department for International Development (DFID)
United States Agency for International Development (USAID)
United States Department of Agriculture (USDA)
The World Bank
World Food Programme (WFP)
Better Nutrition through Agriculture

Hidden Hunger

One in three people in the world suffer from hidden hunger caused by a lack of micronutrients in their diets. Micronutrients are vitamins and minerals that are essential for good health. When they do not get enough micronutrients, children’s growth can be stunted, and they can even go blind. This diminishes their prospects for healthy and productive lives because micronutrients are essential for children to grow, learn, and build healthy immune systems. Hidden hunger even affects adults—they can repeatedly fall ill or be too weak to work, and women may die during childbirth.

Making Food More Nutritious

HarvestPlus identifies target regions where specific crop and nutrient combinations can have a sizeable impact on reducing hidden hunger. We focus on three crucial micronutrients that are most limiting in the diets of the poor (vitamin A, zinc, and iron) and breed these into key staple food crops.

We screen thousands of different types of crop seed stored in seed banks to discover unused varieties that have naturally higher amounts of micronutrients. We use these to breed new crop varieties with higher micronutrient content that are also high yielding and have other traits farmers want. Nutrients can be lost from the crop during storage, processing, or cooking. In addition, once the food is eaten, the body will only absorb some of the nutrients. We account for these losses in setting micronutrient target levels in crops.

Together with farmers, we test these new varieties in target regions. This participatory approach helps ensure buy-in from farming communities. We also conduct studies to ensure that these new crops have sufficient amounts of the nutrient needed to improve nutrition. National governments officially release the best performing varieties of micronutrient-rich crops for farming communities to grow, eat, and sell in local markets.

In target countries, delivery teams with a wide range of skills ensure that micronutrient-rich crops are successfully adopted by farming communities and eaten by poor households. In most cases, these foods look and taste the same as commonly eaten varieties, which makes it easier to introduce them into the diet. When there is a detectable change (as in the case of vitamin A-rich crops that tend to be yellow to orange in color), consumers are educated on the nutritional benefits of these new varieties and encouraged to make the switch. When eaten regularly, these micronutrient-rich foods can contribute to body stores of micronutrients and to the overall reduction of hidden hunger in malnourished communities.

Food-Based Strategies Can Reduce Hidden Hunger

Dietary diversification is the ideal solution to hidden hunger. However, poverty and rising food prices make this harder to achieve. Providing supplements (such as vitamin A pills) and fortified foods (such as iron-enriched flour) have been the main methods to help reduce hidden hunger. While these have had much success, they can be expensive. They also require robust health and market infrastructures, which may not exist in many regions or do not extend to rural areas where most of the poor live.

Biofortification is an additional strategy that can help people meet their daily micronutrient requirements.

Biofortification has several advantages:

**Targeted:** It makes staple foods that the poor already eat in large amounts more nutritious. Furthermore, it starts in and focuses on rural areas where about 75% of the poor in developing countries live.

**Cost Effective:** After one up-front investment in developing micronutrient-rich crops, recurrent costs of developing subsequent, high-nutrient varieties are relatively low. Once the nutrient has been bred into the crop, it is fixed, and most of these nutrient-rich seeds can be planted year after year.

**Sustainable:** Biofortification uses staple foods that poor people already eat regularly. Farmers can save most micronutrient-rich seeds, roots, and plant cuttings and share them freely with their neighbors.

### Target Crops, Nutrients, Countries, & Release Dates

<table>
<thead>
<tr>
<th>Target Crop</th>
<th>Nutrient</th>
<th>Country</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sweet Potato</td>
<td>Vitamin A</td>
<td>Mozambique, Uganda</td>
<td>2007</td>
</tr>
<tr>
<td>Maize</td>
<td>Vitamin A</td>
<td>Nigeria, Zambia</td>
<td>2012</td>
</tr>
<tr>
<td>Pearl Millet</td>
<td>Iron</td>
<td>India</td>
<td>2012</td>
</tr>
<tr>
<td>Rice</td>
<td>Zinc</td>
<td>Bangladesh, India</td>
<td>2013</td>
</tr>
<tr>
<td>Cassava</td>
<td>Vitamin A</td>
<td>DR Congo, Nigeria</td>
<td>2011</td>
</tr>
<tr>
<td>Wheat</td>
<td>Zinc</td>
<td>India, Pakistan</td>
<td>2013, 2015</td>
</tr>
<tr>
<td>Bean</td>
<td>Iron</td>
<td>DR Congo, Rwanda</td>
<td>2012</td>
</tr>
</tbody>
</table>

Note: All varieties are conventionally bred.

### Global Micronutrient Deficiency

Combined vitamin A, zinc, and iron data

A diverse diet that includes a variety of fruits, vegetables, and animal products can provide us with enough micronutrients. However, millions of people, mostly in poorer developing countries, rely upon staple foods such as rice or wheat to fill their stomachs. These foods do not provide them with enough micronutrients. Foods that are more nutritious are often too expensive or simply unavailable.