

## Food Biofortification—Reaping the Benefits of Science to Overcome Hidden Hunger *A paper in the series on The Need for Agricultural Innovation to Sustainably Feed the World by 2050*

An estimated 2 billion people in the developing world suffer from the effects of [micronutrient malnutrition](#), widely known as hidden hunger.

- Preschool children, adolescent women, and in general, women of reproductive age are most vulnerable due to their higher requirements for rapid growth and reproduction, respectively.

One of [first challenges](#) confronting proponents of biofortification was to provide rigorous evidence that additional iron, provitamin A carotenoids (PVAC), and zinc in biofortified crops were sufficiently bioavailable to produce a public health benefit.

- [Studies with biofortified crops](#) have shown that (1) these nutrients are absorbed in significantly greater quantities than their non-biofortified counterparts, (2) PVACs from biofortified crops are efficiently converted to VA by humans, (3) consumption of biofortified crops can significantly contribute to women and children's physiological requirements for iron, VA and zinc, and (4) iron and VA stores can be significantly improved when the biofortified foods are consumed as the main staple food.



The initial question facing [plant breeders](#) was could high iron, zinc, and vitamin A density be combined with high yields and profits?

- In addition to direct breeding for higher nutrient levels, genotypic differences in bioavailability and retention offer potential to contribute to effectively achieving targets through indirect breeding if genetic variation and prerequisite criteria to address these relevant complex traits through breeding exist.

Since 2010, the International Potato Center (CIP) and HarvestPlus have engaged in major efforts to collaborate with public sector, private sector, and NGO partners to [bring biofortified planting materials](#) to farming households, and biofortified foods to consumers.

- For the [vitamin A enriched crops](#), the bright color has been used as an effective marketing tool.
- Consumers liked the sensory attributes of the [iron pearl millet variety](#) as much as those of the conventional variety.
- Nutrition information had a positive effect on the premium consumers in urban wholesale and retail markets in Rwanda were willing to pay for [iron beans](#): when provided, both IB varieties were preferred to the local variety.

In order to ensure sustainability of biofortification it is crucial to ensure biofortification is included [in national policies](#), strategies, plans and programs, and then specific budgets/funding is allocated to implement these policies/strategies and plans.

- [Twenty four countries](#) have now included biofortification in their national agricultural and/or nutrition agendas, policies, plans and programs.
- Inclusion of biofortification intervention in policies, programs, and loan portfolios of international financial institutions can be considered as the opposite side of the coin to inclusion of biofortification in national policies and programs.
- [A value chain approach](#) is essential for sustainable mainstreaming of biofortification in seed and food systems.

[Crop biofortification using GE](#) has been successfully achieved in a range of crops for many different nutrients.

- Golden rice (GR) is a famous example of provitamin A biofortification by GE.
- Current and future research aims to [harness the full potential](#) of transgenic multi-nutrient biofortification strategies by incorporation of agronomic traits, increasing the crop's potential from an economic point of view, while also utilizing the possibilities provided by novel genome editing tools where applicable.

When the concept of biofortification was first broached in the 1990s there was much skepticism that implementation would be feasible and that biofortification could make a significant public health impact.

- [Biofortification is in the forefront](#) of demonstrating just how resilient, sustainable, and cost-effective agricultural interventions can be for improving nutrition and health.

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**Experts to Contact for More Information:** Howard Bouis, h.bouis@cgiar.org; Matin Qaim, mqaim@uni-goettingen.de; Alexander J. Stein, alexander.st@web.de; Erick Boy, e.boy@cgiar.org; Jere Haas, jdh12@cornell.edu; Saurabh Mehta, smehta@hey.com; Bryan Gannon, bg348@cornell.edu; Ross Welch, rrw1@cornell.edu; Chelsea Reinberg, C.Reinberg@cgiar.org; Kristina Michaux, k.michaux-cp@cgiar.org; Wolfgang Pfeiffer, w.pfeiffer@cgiar.org; Torbert Rocheford, torbert@purdue.edu; Ekin Birol, E.Birol@cgiar.org; Jan Low, j.low@cgiar.org; BhoMudyahoto, B.Mudyahoto@cgiar.org; Dominique Van Der Straeten, Dominique.VanDerStraeten@UGent.be; Simon Strobbe, Simon.Strobbe@UGent.be; Vincent Verbeecke, Vincent.Verbeecke@UGent.be;

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