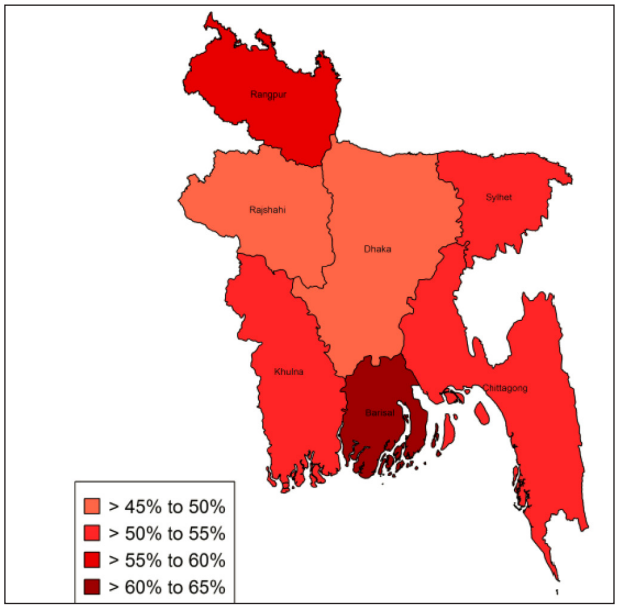
# Healthier Rice Varieties

## High-iron and high-zinc rice

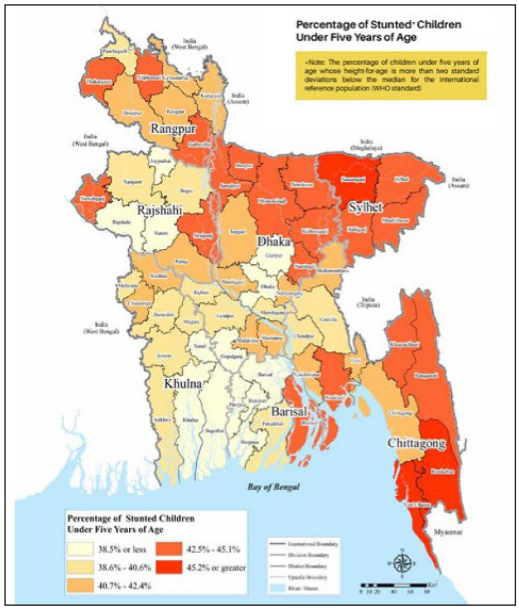
*Deficiencies in iron and zinc are the most pervasive form of malnutrition. The International Rice Research Institute (IRRI) is developing high-iron and high-zinc rice as a novel, food-based approach to complement current interventions that aim to alleviate iron and zinc deficiencies. IRRI scientists and collaborators were successful in developing a proof of concept— a product delivering the desired levels of iron and zinc biofortification in milled rice.*

**Prevalence of anemia in Bangladesh**




**Approximately 30–50% of all anemia cases is iron deficiency anemia (IDA)**
Source: Khan et al. (2016). BMC Pediatr. 16, 3.

**Stunting in children under 5 years of age**




**Zinc deficiency is a major cause of stunting in children**
Map source: HarvestPlus Bangladesh

### Iron and Zinc deficiencies

Globally, more than 1.6 billion people are anemic. Iron deficiency anemia (IDA) can affect productivity and cause serious health consequences, including impaired cognitive development in children, a weakened immune system, and increased risk of morbidity. Similarly, zinc deficiency is a major cause of stunting among children, affecting about 165 million children under the age of five who are at risk of compromised cognitive development and physical capability (WHO, 2016).

The most recent Bangladesh National Survey (2013) shows that iron and zinc deficiencies on average affect around 11% and 45% respectively, of preschool-age children, with prevalence of zinc deficiency going as high as 52% in urban slum areas. In total, micronutrient deficiency in Bangladesh accounted for a USD 7.9 billion reduction in gross domestic product (GDP).

### Strategies for reducing IDA and zinc deficiency

- *Dietary diversification.* The ideal way to ensure sufficient iron and zinc intake is to consume a diverse diet that includes good sources of iron and zinc.
- *Supplementation.* Iron and zinc pill or syrup.
- *Food fortification.* Fortified food items include rice, flour, cereal, or noodles.
- *Crop biofortification.* Biofortification is the process by which the nutritional quality of food crops is improved through agronomic practices, conventional plant breeding, or modern biotechnology.

Biofortification offers a sustainable approach particularly to people with limited access to other dietary interventions.

## Why rice for iron and zinc biofortification?

In countries like Bangladesh, Indonesia, India, and the Philippines, rice is deeply embedded in social and cultural aspects of society and is the major staple food.

In Bangladesh, rice contributes up to 71% of daily caloric intake and approximately 60% of dietary protein (FAO, 2014).

Enriching iron and zinc in rice will improve the base line of iron and zinc in the sub-population whose main source of diet is rice.

Iron is an essential micronutrient for humans. It is used primarily by the hemoglobin in red blood cells to store and transport oxygen throughout the body. Iron is also essential for the proper functioning of several other proteins involved in various bodily processes.

Zinc is found in cells throughout the body. It is needed for the body's defensive (immune) system. It plays a role in cell division, growth, and wound healing.

## IRRI's approach to developing high-iron and high-zinc rice (HIZR)

Most of the iron and zinc in the rice grain is accumulated in the external part of the grain. Consequently, the iron and zinc content of rice drops significantly after polishing.

IRRI is using biotechnology approaches that safely and responsibly deliver additional benefits to farmers and consumers that cannot be achieved through conventional breeding.

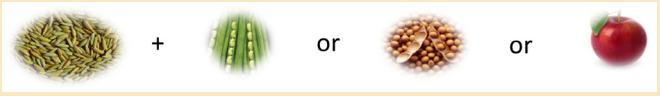
One of these approaches is the genetic modification of rice (biotech rice) to increase the iron and zinc concentration in the milled rice.

IRRI strives to ensure that the development of any biotech rice will be done in full compliance with national and international biosafety regulations. Advanced bioavailability studies will also be conducted prior to public release.

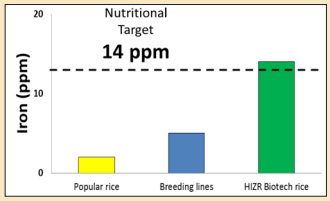
In the process of developing HIZR, we added a gene from rice responsible for iron and zinc movement from plant roots and leaves into the rice grain.

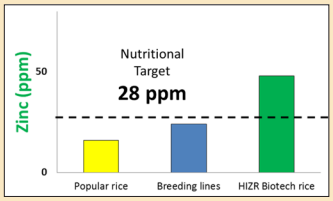
We combined it with ferritin genes from bean or apple to enhance iron storage capacity of the grain. This particular protein is a primary source of iron for people following vegetarian diets and is readily absorbed by the human body.

**IRRI biotech rice =**




Through this strategy, scientists at IRRI and collaborators from HarvestPlus have already developed rice lines with an average iron concentration ranging from 12–15 ppm in the milled grain and 40–45 ppm zinc, as measured in confined field trials. This level potentially met the nutritional target to increase around 30–50% of human daily need.




### International Rice Research Institute (IRRI)

IRRI is the world's premier research institute committed to convening international knowledge and expertise in the creation of a sustainable global rice sector to achieve food and nutrition security, improve the quality of life of rice-related communities, and protect the rice-growing environment for future generations. The organization works to connect dual spheres, generating and harnessing international expertise to expand the horizons of knowledge, and building local capacity to leverage best practices in agriculture, economics, and climate change management.

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January 2017

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