Towards Nutrition Security in the Drylands of Asia and Africa

High-yielding biofortified crops address hidden hunger and food insecurity

The dry facts

The majority of world’s undernourished are in Asia and Africa

The numbers are growing faster than in any other region of the world

Source: The state of food security and nutrition in the world 2021 (fao.org)

The global harvested area of dryland cereals and legumes is over 160 million hectares located in the dryer areas of South Asia, West and East Africa, the Middle East and North Africa, Central America and other parts of Asia.

Why BIOFORTIFY dryland crops

Climate change and its uncertainties poses potentially serious threats to agricultural production, severely affecting the poor in semi-arid areas.

More nutrition per unit harvest is needed to meet the growing population needs. High future demand for dryland crops is indicated by Foresight Analysis.

What is Biofortification?

It is an effective and sustainable approach to address micronutrient malnutrition by increasing the density of vitamins and minerals in them through plant breeding, agronomic practices or biotechnology.

Biofortified GLDC crops and their impact

Reach of biofortified varieties India, Niger, Rwanda, Bangladesh and Nepal

High iron and zinc pearl millet (Dhanashakti)
In India, 94,000 households benefited from cultivation of biofortified pearl millet cultivar “Dhanashakti”. Seven high Fe and Zn Hybrid (HHB 299, AHB1200, DHBH1211, AHB 1269, RHB 234, RHB 233, HHB 311) were released in India during 2018 to 2020.

Micronutrient-rich lentils (BARI Masur 4, 5, 6, 7, 8 and 9, and Khajura Masuro 4 in Nepal, IPL220 and Pusa Ageti in India)
With improved production package, biofortified varieties showed a 35-67% yield advantage over local cultivars in Bangladesh, Nepal and India.

High-iron beans (Biofortified bean varieties released from 1985 to 2020)
An estimated 20% of beans produced in Rwanda were high-iron varieties, consumed by 15% of the population.

High iron and zinc sorghum (Parbhani Shakti)
Has a higher yield of 10-15%, higher protein content with market-preferred traits. Low phytate in it facilitates greater bioavailability of nutrients.

High-iron groundnuts (Girnar 4 & 5)
The new high-oleic groundnut cultivars Girnar 4 & Girnar 5 contain about 80% oleic acid as compared to regular varieties 45-50%. Oleic to linoleic acid ratio is 17:1.

Estimated cost of anaemia % of GDP lost as a result of anaemia through impaired cognition and productivity, 2001

Bangladesh
India
Oman
Mali
South Africa
Pakistan
Tanzania
Nicaragua
Bolivia
Egypt
Honduras

Source: World Bank

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40% of the human population in Asia and Africa i.e., around 2 billion people live in the drylands. (Reynolds et al. 2007a)

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Better Nutrition, Better Livelihoods

Grain Legumes and Dryland Cereals (GLDC) approach

1. Mainstreaming nutrition

**Mainstreaming nutrition** into breeding programs to produce biofortified varieties with farmer-preferred traits like early maturity, climate-smart, disease-resistant, fodder quality, etc. for better uptake.

**Double advantage - biofortified varieties with market traits**

The thrust of pearl millet biofortification research in India and Africa is on the development of high-yielding and high-Fe hybrids. Efforts in the public and private sector focus on **commercial hybrids** as markets are largely driven by hybrids (80% in India) and biofortification initiatives engage both actors in mainstreaming.

2. Modern technologies

- **Genome technologies** use cost-effective SNP genotyping to select the desirable traits.
- **Speed breeding** reduces breeding cycle time and enhance rate of genetic gain.
- **Customize to agro-ecology**: To address Genotype x Environment interactions for efficient selection decisions, select cultivars based on multi-location trials with NARS.
- **XRF technology** for rapid phenotyping.

**Accelerated crop development**

Genomic tools enabled selection of **high-oleic groundnut** lines. Robust and cost-effective evaluation using Near Infrared Reflectance Spectroscopy enabled the identification of ‘high oleic’ lines. The fast-track development, testing and advancement were possible through use of low-cost controlled conditions for reducing generation interval, early generation and multi-location testing.

3. Seed systems

**Seed systems** facilitate access to improved seed.

**Partnerships for seed dissemination**

**High iron and zinc sorghum** variety ‘Parbhani Shakti’ was released in Maharashtra, India. The National Agricultural Research System facilitated large-scale seed production and dissemination, benefitting 25,000 farmers. In Africa, **Chakti** (**High Fe-Zn pearl millet**) was released by the Government of Niger for commercial cultivation. The ECOWAS seed laws facilitated farmer access to high-quality seed.

4. Agri-food system approach

**Agri-food system approach** ensures crops are bred to fit into specified agro-ecologies to address specific dietary/health needs.

**Addressing local needs effectively**

40 **iron-biofortified bean varieties** were released in six African countries through the CGIAR, including in Rwanda, where one in five women and four in 10 children are anaemic. Rwanda is also the world’s second-highest consumer of beans. Iron bean yields were about 20% higher than other varieties, providing $57–78 additional profit per hectare.

5. Higher farmer income and nutrition

**Higher farmer income and nutrition**: Higher incomes can result in better nutrition through improved dietary diversity.

**Contributing to better health and nutrition**

In India, **inbred lentil variety IPL 220** with high iron (73 ppm) and zinc (51ppm) was released for cultivation in four regions in 2018. In Bangladesh, about 1 million small farmers grew early-maturing **micronutrient-rich lentils**. Close to 99% of the 150,000 hectares of lentil area was under improved varieties resulting in 27% higher yields (356 kg/ha more) and 29% more income (US$ 210 ha) to farmers.

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[Photo: ICARDA](http://gldc.cgiar.org)