

# India: Building Sustainable Commercial Supply Chains Amid a Fragmented Market

Author: Ravinder Grover, Lead for the Commercialisation of Biofortified Crops Programme



Biofortified crops with value chain activities: **Zinc Wheat**, **Iron Pearl Millet**, **Zinc Rice**

## Biofortified varieties released to date

Variety Name	Year Release	Micronutrient conc. (ppm)	Yield (t/ha)
<b>Zinc Wheat</b>			
BHU-3	2014	30.5	4.4
Zn-Shakti	2014	34.2	3.5-4.0
BHU-1	2013	34.8	5
BHU-5	2013	29.5	3.3
WB-02	2017	31	5.2
HARVESTPLUSBW01	2017	31	5.2
BHU-25	2018	31	4.0-4.5
BHU-31	2018	39.5	4.5-4.8
HUW 711	2019	31	5.2
<b>Zinc Rice</b>			
DRR Dhan 49	2018	25.2	>5.0
<b>Iron Pearl Millet</b>			
Dhanashakti	2014	72	2.5
Shakti 1201 (Dhoni)	2015	74	3.6
HHB 299	2017	73	3.3
AHB 1200 Fe	2017	77	3.2
HHB 311	2018	62	3.2
RHB 234	2018	62	3.2
AHB 1269 Fe	2018	73	3.2
RHB 233	2018	64	3.2
Moti Shakti(GHB 1225 )	2019	74	3.2
Mahashakti (DHBH 1211)	2018	78	3.5

List of other available biofortified varieties in India (developed and released by other parties) can be accessed [here](#).

## Donors and key projects in India:

The UK Foreign, Commonwealth and Development Office (FCDO): Core funding

The Bill and Melinda Gates Foundation: The Bihar-Odisha Nutrition Initiative Project

The Netherlands Ministry of Foreign Affairs and the German Federal Ministry for Economic Cooperation and Development: Commercialisation of Biofortified Crops (CBC) Programme

The Happel Foundation: School Feeding Program

## Commercial value chains

### 1. Agricultural research

- HarvestPlus supports the Indian Council of Agricultural Research-National Agricultural Research System (NARS), state agricultural universities (SAUs), and international agricultural research organizations such as ICRISAT, CIMMYT, and IRRI in breeding, testing and release of zinc wheat, zinc rice and iron pearl millet.

### 2. Seed and vine release

- Several varieties of zinc wheat, iron pearl millet, iron/zinc lentils and zinc rice have been released and now commercialised.

### 3. Commercial seed production

HarvestPlus works with private seed companies, farmers, non-governmental organizations, farmer-producer organizations, and state seed corporations to develop quality-controlled seeds. Some of our partners include:

- Private seed companies:  
Nirmal Seeds, Sone ganga seeds, Ratnagiri Seeds and Farms, JK Seeds, Sampoorna Seeds
- NGOs and Farmer Production Organizations (FPOs):  
Sustainable Human Development Association (SHDA)  
UPPRO Kisan Producer Company
- State seed corporations:  
Karnataka State Seed Corporation (KSSC), Maharashtra State Seed Corporation (MSSC),  
Telangana State Seed Corporations (TSSC)

### 4. Farming/growing

- In India, 800,000+ farmers are growing zinc wheat and 200,000+ farmers are growing pearl millet. The grain is being produced and aggregated under the following model:
- **Agri Entrepreneurs (AE) model:** The Agri Entrepreneurs (AE) model is a decentralized approach to empowering rural youth, especially women, and incentivizes them to play an active role in agricultural development in their region. These AEs are the focal points for biofortified seed distribution, input supply, and regular training and capacity building to a cluster of 150-200 farmers. These AEs aggregate the biofortified grain produced and supply the same to millers and processors. HarvestPlus is currently working with 200+ AEs in Uttar Pradesh, Bihar, Rajasthan, Maharashtra, and Karnataka.
- **Collectives model (direct implementation):** Similar to the AE model, here an FPO plays the role of a nodal agent with shareholders ranging from 100-1000 farmers. HarvestPlus is currently working with 80+ FPOs in Uttar Pradesh and Bihar.
- **Commercialization model (indirect implementation):** Private seed companies and state seed corporations continue to sell biofortified seeds to farmers.

#### 4a. Fertilizers and agronomic biofortification (including scope or demand)

- Farmers under direct implementation are being trained three times per season on good agricultural practices. Trainings are conducted physically and online where necessary due to COVID-19 restrictions. WhatsApp groups are formed and flyers are distributed to improve information availability. More than 1.3 million farmers (70% women) were trained in 2021 on biofortification and agricultural practices.

## **5. Aggregation**

- HarvestPlus is supported by 200+ FPOs and 80+ AEs for grain partner organizations such as Syngenta Foundation India, Grameen Foundation India, Bihar Rural Livelihood Promotion Society (BRLPS), and IFFCO Kisan. HarvestPlus has also developed SOPs for aggregation and market linkages for biofortified crops, from estimation of grain production, quality checks to final sale of produce and stock keeping.

## **6. Milling**

- Small- and medium-scale millers have been identified at the local and district level to commercialize the grain for ZW and IPM. Millers are made aware of biofortification through meetings at the beginning of the season.
- Farmer representatives and millers are connected through WhatsApp groups for a transparent negotiation facilitated by HarvestPlus and partners.

## **7. Processing**

- Small-, medium-, and large-scale processors have been identified for processing grains. A near-farm processing model is being initiated with our partners to encourage entrepreneurship and local consumption of nutrient-enriched crops.

## **8a. Retailing**

- Retailing will be done through the small- and medium-scale milling and processing units available at the local and district levels. Multiple products palatable to the Indian diet are being sold in urban and peri-urban areas.

## **8b. Public procurement (schools, hospitals, safety net schemes)**

- We are engaging with local Anganwadi centers and MDM institutions to increase awareness of the benefits of consuming nutrient-enriched zinc wheat and iron pearl millet.

## **9a. Consumption on farm**

- 30-50% of the grain produced (IPM, ZW) is consumed by the smallholder farmers; roughly 4.4 million families benefited from this in 2021.

## **9b. Commercial food consumption (by all population)**

- 50-70% of the grain produced at the farm level is consumed commercially and is made available to off-farm consumers.

## **9c. Consumption from institutional settings (Schools, hospitals)**

- HarvestPlus partnered with the Akshaya Patra Foundation and the IISc Bangalore to pilot the integration of iron-biofortified pearl millet and zinc-biofortified wheat in their meals menu. Akshaya Patra is currently testing iron pearl millet in their kitchen in Ahmedabad. They are working to understand the implications of their kitchens using whole pearl millet, coarse ground millet or fine flour in their recipes, in terms of amount, taste, cooking time, etc. Based on the results, schools in Rajasthan and Maharashtra will be targeted in the coming season.
- Under the Commercialisation of Biofortified Crops (CBC) Programme, 3.2MT of iron pearl millet were sold to 8 SHGs in the Ahmednagar district of Maharashtra last year. The SHG members were made aware of the nutritional benefits of iron for themselves as well as for the development of their children. They will now utilize this IPM as a staple in their diet.

## Non-commercial value chains, conflict, and fragile environments

Integration of nutrient enriched crops (NECs) in food security and nutrition programs, including in fragile and conflict-affected settings, are mostly targeted at producer households and/or people served by public institutions. *What is the minimum package of interventions that should be considered?*

All activities in India are based on commercial activities

	Value chain step	Activities
4	Noncommercial seed/ vine dissemination to farmers	<ul style="list-style-type: none"> <li>Noncommercial seed dissemination is done for trial induction, on a case-by-case basis, mostly to the farmers who are growing biofortified crops for the first time.</li> </ul>
7	Access to public procurement mechanisms (e.g. emergency programs, food aid, etc.)	<ul style="list-style-type: none"> <li>Currently, public procurement for biofortified crops is not happening. However, We are working on inclusion of biofortified crops in PDS and school feeding programs. Not much is done currently on inclusion in humanitarian and relief programs.</li> </ul>

## Other agricultural activities and points of consideration

### *Soil health monitoring and improvement*

The Government of India is implementing Soil Health Management in a mission mode. Under this mission, 230 million soil health cards (SHCs) have been issued to farmers. SHC contains the status of soil with respect to 12 parameters, namely nitrogen, phosphorus, potassium, selenium, zinc, iron, copper, manganese, boron; and pH, EC, OC (Physical parameters). Based on this, the SHC will indicate fertilizer recommendations and soil amendments required for the farm. More and more farmers are being added to this scheme and taking advantage of soil testing facilities. This analysis can also help farmers select the right NEC and reap the full benefits of biofortification. An advisory about these crops in the SHC will encourage farmers to adopt biofortified crops.

## Policy, advocacy and enabling activities for biofortified crops

Activity	Summary
Government advocacy and engagements	<ul style="list-style-type: none"> <li>Integrating biofortification into regional and national policies, through collaborations with PricewaterhouseCoopers (PwC), a leading consulting firm for stakeholder engagement; the Associated Chambers of Commerce and Industry of India (ASSOCHAM), an advocacy group; and the National Institute of Agricultural Extension Management (MANAGE), a leading agri-business school.</li> <li>HarvestPlus and Grameen Foundation India co-hosted a seminar with the theme “Digital Pathways for Scaling Up Nutrient Enriched Crops” on 23rd March 2022 in New Delhi. The attendees comprised of actors in the Ag-Tech space, providing services based on precision agriculture, remote sensing, AI-based weather forecasts, and traceability mechanisms. The objective of the event was to bring together these participants to discuss how participants are solving important problems in agricultural value chains, the available technologies, and the feasibility of solving these problems. The discussion also included strategies for digital pathways can pave the way for scaling up the adoption and consumption of nutrient enriched crops in India.</li> </ul>



Activity	Summary
Policy inclusion (list all relevant policies agriculture and nutrition)	<ul style="list-style-type: none"> <li>On World Food Day 2020, marking the 75th anniversary of FAO, PM Modi launched 17 recently-developed biofortified seed varieties of local and traditional crops, including wheat and paddy rice, that are being made available to Indian farmers.</li> <li>Independence Day 2021: PM Modi announced fortification of rice distributed under various government schemes including the Public Distribution System (PDS) and Mid-Day-Meal scheme by 2024.</li> <li>PM Modi on September 28, 2021, launched 35 crop varieties with special traits—developed by the Indian Council of Agricultural Research (ICAR)— to address the twin challenges of climate change and malnutrition. According to the PM, 35 crop varieties with special traits like climate resilience and higher nutrient-content were developed in 2021. These include a drought-tolerant variety of chickpea, a wilt and sterility mosaic resistant pigeon pea, an early maturing variety of soybean, disease resistant varieties of rice, and biofortified varieties of wheat, pearl millet, maize, chickpea, quinoa, buckwheat, winged bean and fava bean.</li> <li>ICAR established minimum levels of iron and zinc to be bred into national varieties of pearl millet. The news came during the National Year of Millets and as the government of India articulates its vision for a <i>Kuposhan Mukh Bharat</i> (Malnutrition Free India) by 2022.</li> </ul>
Standards and regulations	<ul style="list-style-type: none"> <li>Launch of the Publicly Available Standards for zinc wheat and iron pearl millet with the British Standards Institution (BSI). Standards enable trade, which leads to increased consumption of NECs with a clear path to reduction in micronutrient deficiencies. Soon-to-be-published guidelines for the food industry will show how to label biofortified and fortified foods following a regulatory review.</li> </ul>
Market research	<ul style="list-style-type: none"> <li>Willingness to pay surveys were conducted from the consumer end, while farming community surveys assessed acceptability of biofortified seed.</li> <li>Consumers enjoy sensory attributes of IPM and local foods made from it more than conventional pearl millet varieties.</li> <li>Consumers are willing to pay 28.4% more for IPM products.<sup>2</sup></li> <li>Almost 73% of first-time adopters of iron pearl millet said they would grow it again next season.</li> </ul>
Technology advancements	<ul style="list-style-type: none"> <li>Under the CBC program, we are trying to create a traceable digital value chain to ensure visibility on the origin and authenticity of biofortified seed and grain.</li> <li>Our partner tested the digi-tech-enabled value chain, starting out in two states, Rajasthan for IPM and Bihar for zinc wheat. Objectives: <ul style="list-style-type: none"> <li>Facilitate farmers to grow biofortified crops by ensuring a supply of biofortified seed, providing quality input material, and advisory support to help them improve their yield.</li> <li>Ensure supply of quality farm produce as per requirements of food processors, while maintaining traceability of the produce, demand forecasting and processed output distribution.</li> <li>Physical and digital efforts to create awareness among Rajasthan and Bihar farmers for adoption of biofortified seed, and for improving/ developing market linkages with bulk buyers/processors.</li> </ul> </li> </ul>

Activity	Summary
Data collection and monitoring	<ul style="list-style-type: none"> <li>With data collection application and geo-tagging of farms, we are now able to create farmer profiles along with monitoring of production on a real-time basis. The next step is to send customized advisories based on real-time monitoring.</li> </ul>
Gender and inclusivity	<ul style="list-style-type: none"> <li><a href="#">Grameen Mittra Model</a>: The all-women Grameen Mittras are self-employed and serve communities around them through training and handholding as a trusted agent.</li> </ul>
Supporting startups in promoting biofortified foods	<ul style="list-style-type: none"> <li>Mahesh Londhe, an entrepreneur from Maharashtra, is an expert in creating sustainable value chains for nutritious foods. He established Agrozee Pvt Ltd four years ago with the aim of mainstreaming millets into our daily diets. His motto of Quality   Innovation   Excellence has fit well with biofortification, and now he plans to increase his business 20-fold by processing and selling biofortified millet products in the gated societies of Maharashtra.</li> <li>Our Food is disrupting the traditional centralized food processing industry by establishing a network of “Farmer Franchises” that deploy new-age, low-cost micro-processing units to help rural entrepreneurs process raw material at the farm gate. We are working with them to establish a value chain for zinc wheat for farmers in Uttar Pradesh.</li> </ul>

## Monitoring and evaluation/Reach in 2022

<b>Seed Volumes</b> It is expected that approximately 7000MT of Zinc Wheat seeds and 1150MT of Iron Pearl Millet seeds will be produced.	<b>Grain Volumes</b> 1.3M metric tons of ZW expected to be produced 460,000 ton of IPM expected to be produced	<b>Food products commercial</b> ZW: An estimated 35% of produced grain is consumed on-farm, while the remainder of 65% is sold in the market. IPM: An estimated 55% of produced grain is consumed on-farm, while the remainder 55% is sold in the market.
<b>Market share %</b> 0.23% for ZW (based on the total coverage of wheat i.e. 29.8 million hectares). 3% for IPM (based on the total coverage of IPM i.e. 11.34 million hectares).	<b>Market share %</b> ZW production will be about 1.3% of the total 99 million tons of expected production. IPM production will be about 5% of the total 9.3 million tons of expected production.	<b>Food Products institutional</b> N/A

## Consumer reach

Households growing	It is projected that 1.3 million MT of ZW and about 0.5 million MT of IPM grain will be produced in 2022 by a projected 850,000 and 300,000 households respectively.
Off farm consumption	It is estimated that ZW and IPM will be consumed by 76 million and 17 million people off-farm respectively.
Institutional consumption	It is not currently being measured.

## SWOT analysis summary

<b>Strengths</b>	<b>Weaknesses</b>
<ul style="list-style-type: none"> <li>• Launch of the new Publicly Available Standards for ZW and IPM in government procurement systems</li> <li>• Gender inclusiveness models</li> <li>• Climate resilient and cost-effective crops</li> <li>• Partnerships with leading organization for variety development and release</li> <li>• Transparent seed supply chain</li> </ul>	<ul style="list-style-type: none"> <li>• Preservation issues due to seed packaging</li> <li>• Enabling social and behavior change among farmers</li> </ul>
<b>Opportunities</b>	<b>Threats</b>
<ul style="list-style-type: none"> <li>• Endorsement of PM Narendra Modi for biofortification</li> <li>• Inclusion of biofortification in Government schemes and programs in line with National Nutrition Mission and Millet Mission</li> <li>• Budding partnerships with pan-India grain producers, processor and retailers exploring commercial opportunities</li> </ul>	<ul style="list-style-type: none"> <li>• Emergencies, such as Covid-19 affecting seed and grain logistics</li> <li>• Better yield of currently available non-biofortified varieties</li> </ul>

**About the author:** Ravinder Grover is the HarvestPlus Program Lead for the Commercialisation of Biofortified Crops Programme. He has led many large-scale engagements with public, private, and development sector partners in supply chain optimization, route-to-market initiatives, policy advocacy, and digital transformation.

*These case studies were developed in collaboration with the FAO as part of a Letter of Agreement to create “Guidance and tools to promote nutrient enriched crops as part of healthy diets to address micronutrient deficiencies in vulnerable rural communities”*