



Pulses of Power: How Biofortification Can Nourish India's Future

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Biofortification, an approach that enriches crops with essential vitamins and minerals, is emerging as a powerful tool to combat hidden hunger in India and across the world. Pulses are an integral part of Indian diets and play a key role in meeting daily protein and nutrition requirements, especially for vegetarian populations. However, despite their importance, many widely grown pulse varieties are naturally low in iron, zinc, and other micronutrients critical for human health. Biofortification aims to bridge this nutritional gap by enhancing the nutrient content of pulses through scientific breeding or improved agronomic practices. This strategy is sustainable, affordable, and aligns perfectly with the dietary patterns of Indian households.

The Growing Need for Biofortification in India

India continues to battle micronutrient deficiencies, particularly iron-deficiency anaemia, which affects women, children, and rural communities at alarming rates. While supplements and fortified foods are available, they often fail to reach remote populations consistently. In such contexts, biofortification offers a long-term solution i.e., nutritious crops that reach the plate without requiring changes in eating habits. Pulses such as chickpea, lentil, pigeon pea, and mungbean are consumed widely across socio-economic groups. Enhancing these crops with iron, zinc, and other essential minerals can significantly improve the nutritional security of millions. Moreover, climate change, soil degradation, and intensive farming practices are gradually reducing nutrient levels in traditional crop varieties. Biofortified pulses help counter this decline by delivering stable nutritional improvement through plant genetics and improved cultivation methods.

How Biofortification Works

Biofortification follows three primary pathways, each contributing uniquely to producing nutrient-dense pulses.

Genetic biofortification involves identifying naturally nutrient-rich germplasm and breeding varieties that carry these traits. For instance, certain lentil and chickpea lines naturally contain higher iron levels. Breeders cross these with high-yielding, disease-resistant varieties to produce biofortified lines that are both nutritious and farmer-friendly.

Agronomic biofortification uses soil amendments or foliar sprays to enhance micronutrient content in seeds. In micronutrient-deficient soils, applying zinc or iron fertilizers can significantly increase the mineral concentration in harvested pulses. This approach is particularly effective in regions where soils are naturally low in key minerals.

Processing interventions, though not the primary focus of biofortification, complement the above methods. Techniques such as soaking, sprouting, and fermenting pulses improve nutrient absorption by reducing anti-nutritional factors. These processing methods, combined with biofortified varieties, can further enhance the overall nutritional impact of pulses.

Market Potential and Consumer Acceptance

Consumer awareness of nutrition is steadily increasing in India, especially in urban areas. Families are seeking healthier food options, and biofortified crops align perfectly with this trend. Pulses enriched with iron and zinc not only add health value but also retain the taste, texture, and cooking qualities people are familiar with. This makes consumer acceptance naturally high. The growing emphasis on wellness, fitness, and preventive healthcare has opened new market avenues for nutrient-rich foods. Retailers, online grocery platforms, and health food brands are showing interest in differentiated, value-added agricultural products. Biofortified pulses have the potential to capture a premium market segment while also serving as affordable, everyday foods for the masses. Farmers also benefit from cultivating biofortified varieties. These varieties are bred to suit local agro-climatic conditions, ensuring good yields, disease resistance, and resilience to environmental stress. With increasing support from government programs, agricultural universities, and extension agencies, farmers can adopt biofortified pulse varieties without major shifts in cultivation practices.

Economic and Nutritional Advantages

One of the major strengths of biofortification is its ability to deliver health benefits without increasing production costs significantly. Once farmers adopt seed varieties enriched with micronutrients, the improved nutritional content becomes a consistent part of the harvest. This reduces the long-term dependency on external interventions such as supplements or fortified foods. For economically vulnerable populations, especially women and children, consuming biofortified pulses can help reduce iron-deficiency anaemia, fatigue, impaired cognitive development, and poor immunity. In regions where pulses form the backbone of the diet, nutrient-enriched varieties can substantially improve overall health outcomes. From an economic standpoint, biofortified pulses require minimal additional investment beyond seed purchase. With proper seed distribution systems and awareness programs, farmers can adopt these varieties as easily as any other improved cultivar. Integrating biofortification into existing pulse development programs including national missions such as NFSM-Pulses, can significantly accelerate nutrition-focused agricultural growth.

Challenges and Practical Considerations

Despite its potential, biofortification in pulses also faces challenges. First, many farmers are still unaware of nutrient-enriched varieties or hesitant to adopt them due to concerns about yield stability or market demand. Extension programs, community seed banks, and demonstration farms are essential to build confidence and promote adoption. Second, the availability of biofortified seeds is uneven across states. Some regions have well-developed supply chains, while others struggle with limited access. Strengthening seed multiplication and distribution networks is critical for scaling biofortification. Consumer awareness is also a key factor. Although biofortified pulses taste and cook the same as regular varieties, many consumers remain unaware of their nutritional advantages. Educational campaigns, clear labelling, and partnerships with retailers can help increase acceptance. Additionally, ensuring that biofortified pulses reach public institutions such as mid-day meal schemes, anganwadis, and government food programs can significantly expand their nutritional impact. Integrating these varieties into institutional supply chains would help millions of children and women access improved nutrition without major cost increases.

A Promising Future for Nutritional Security

As India aims to improve public health and reduce micronutrient deficiencies, biofortification stands out as a practical, cost-effective, and farmer-friendly solution. Pulses, being deeply rooted in Indian cuisine and culture, offer an ideal platform for delivering better nutrition to every household. The future of biofortified pulses looks promising, with growing research dedicated to developing varieties enriched with multiple nutrients. With coordinated efforts among breeders, policymakers, extension workers, and farmers, biofortification can become a cornerstone of India's nutrition strategy. In a country where pulses are consumed daily in the form of dal, curries, snacks, and flours, even a small increase in nutrient content can create a significant impact. Biofortification ensures that this impact reaches the most vulnerable populations quietly, sustainably, and effectively.