

AGRI STIMULUS

Underutilized crops for improving nutritional security



Wheat, rice and maize are the three major cereal crops cultivated in the world. The top 10 largest international seed companies which controls two-thirds of the global and Indian seed market, primarily focus on major staple crops i.e. rice and maize leaving wheat because it is a self-pollinating crop making it less attractive for breeders. Dependence on handful of major crops is leading to agronomic, ecological, nutritional and economic risks which is probably unsustainable in the long run. Global climate change further adds to the unsustainability which have a major impact causing biotic and abiotic stresses in agricultural production and

threatens crop yields. Inclusion of underutilized/minor crops in current cropping system provides opportunities to build spatial and temporal heterogeneity thereby enhancing resilience to biotic and abiotic stresses. Underutilized/minor crops are usually grouped into categories based on their end use such as beverages, cereals, oils, spices and flavouring, fruits and vegetables etc. However, majority of underutilized crops have multiple use. These crops constitute an important part of the local diet of communities by providing valuable nutritional components, which often lack in staple crops.

Majority of underutilized crops are indigenous species, which means that much of the produce is collected from the wild. The cultivation of these species and the development of their quality characteristics through plant breeding can encourage their acceptance for commercial purpose. Significant research, breeding and development efforts are needed for a range of promising crops to convert existing local landraces into competitive varieties with wide adaptation and promising commercial potential. Green Revolution have replaced many of these traditional crop species by high-yielding staple crops developed through modern breeding programs.

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Currently underutilized food sources ranging from minor grains and pulses, root and tuber crops and fruits and vegetables to non-timber forest products. Most of these minor crops are hardy in nature which can be grown with minimal external inputs. For example, in the southern part of Rajasthan where harsh climatic conditions exists only robust, drought-tolerant traditional vegetables with short growth cycles such as kachri can survive and produce food.





Underutilized minor fruits can also help bridge the gap of nutrition as they are very rich in nutrients and also they can grow in adverse conditions on all kinds of soil. This strength of minor fruits is particularly useful in a country like India, where majority of the farmers are resource-poor and carry out farming under not so

favourable conditions. Bioversity International, at its genetic garden, is conserving minor fruits collected from different sources and evaluating them for medicinal and nutritional values. Among the important tropical minor fruit crops, jackfruit, custard apple, jamun and ber are excellent sources of

essential vitamins, minerals and antioxidants.

There are some other underutilized/minor crops such as Finger millet, Winged bean, Syrian rhubarb, Seabuckthorn, Rice bean, Foxtail millet, Faba bean, Rose apple and Qui, etc.

These crops have the potential to make a substantial contribution to food and nutrition security, to protect against internal and external market disruptions and climate uncertainties, and lead to better ecosystem functions and services, thus enhancing sustainability.

Crop	Introduction	Nutritional benefits	Other benefits	Opportunity
Amaranthus 	Widely grown as a leafy vegetable and for grain production in tropical countries of Africa, Central and South America, Mexico and parts of Asia	Nutritious leafy vegetable, both in raw and cooked form. The nutritional value is comparable to spinach, but much higher than cabbage	Often produced with relatively low inputs and thus has low capital risk for small-scale farmers.	Gaining importance both for household consumption & commercial production in Africa and Asia. Commercial seed companies have recognized market potential and are now including amaranth in their product portfolio.
Moringa 	Economically important crop in India, Philippines, Ethiopia and Sudan.	Young, tender pods (drumsticks) are highly valued as a vegetable in Asia. The root bark is used as a condiment. Dried leaf powder is good for children and pregnant & lactating women. It is rich in many essential micro-nutrients and vitamins as well as antioxidants and bioavailable iron	It can be planted as a windbreak or living fence, has a potential in alley cropping and as a component of agro-forestry systems. It can be intercropped with a range of vegetables such as cluster bean hot pepper, cowpea and onion.	There are good opportunities in Moringa value added products such as oil, cosmetics, pharmaceuticals and feed production.
Buckwheat 	Multipurpose minor crop used for food, feed, medicine and manure	Grains are a rich source of dietary proteins for gluten-sensitive individuals, leaves and flowers are rich source of rutin, catechins and other polyphenols that are potential antioxidants. Buckwheat proteins have anticancer, hypoglycemic, and antihypertension properties.	Green manure crop which produces biomass and offers rapid growth, improves soil and make phosphorous available	Increasing opportunities for seed companies. Increasing opportunities for buckwheat value added products
Kodo millet 	Grown primarily in India, Philippines, Indonesia, Vietnam, Thailand, & in West Africa (origin)	Anti-diabetic, Anti-obesity, Anti-cholesterol and anti-hypertension, Helps in weight management, Cholesterol reduction	The plant has shallow root system which may be ideal for intercropping. Also offer nutritious fodder.	Opportunities for commercial seed production and processed food products

Sathguru compilation

Asafoetida Cultivation in India – A promising business opportunity!

Asafoetida, also popularly known as heeng in North India, is powdered dried gum-resin which is extruded from the roots and rhizome of Ferula herb (*Ferula assa-foetida* L.). For decades, this pungent and strong spice, has been a part of Indian cuisine and has also been used for medicinal compositions. Asafoetida is abundantly loaded with a large assortment of nutritional elements including iron, fiber, potassium, calcium, and volatile essential oils. It has been popularly used as an anti-bacterial and an anti-inflammatory agent for enhancing skin health, and for treatment of flatulence, respiratory problems, hypertension & menstrual cramps. There are around 130 species of Ferula found across the world, and two of these species also grow in India: *Ferula jaeschkeana* (grown in the Chamba), and *Ferula narthex* (grown in Kashmir and Ladakh), but only *Ferula assa-foetida* L. species yields asafoetida. Although asafoetida is a high value spice crop, cultivating *Ferula assa-foetida* L. in India is challenging as the plant needs stringent climatic conditions. The plant needs cold and dry conditions (between -40 C and 350C) with sandy soil, very little moisture and an annual rainfall of not more than 200mm. Under suitable climatic conditions, the plant grows up to 6 feet and it takes about 5 years to develop the fleshy roots from which raw asafoetida can be extracted in the form of oleo-gum resin. Extreme conditions and high moisture can lead the plant to become dormant. The plant can be under prolonged dormant stage leading to shortage of planting material for its [cultivation](#).

Asafoetida is native to Afghanistan and historically, India has been one of the major importer of this raw spice from Afghanistan, Uzbekistan, United Arab Emirates, Tajikistan and Iran. India imports both, the white variety (water soluble) native to Afghanistan and the red variety (oil soluble) of asafoetida from countries such as Uzbekistan, Tajikistan and Iran. The white variety is quite popular and around [130.5 USD Million](#) of asafoetida was imported to India during FY 2019-20 from Afghanistan which accounts for 98.2% of the total import of asafoetida. Asafoetida currently is imported in its raw form and processed in India to save costs. Few challenges like the political instability in Afghanistan, and air transportation costs have posed a challenge for Indian importers in importing raw asafoetida and resulted in fluctuating prices in the past.

To reduce the import debt and enable cultivation of this expensive crop in India, Council of Scientific and Industrial Research (CSIR) — Institute of Himalayan Bioresource Technology (IHBT) (Palampur, Himachal Pradesh) procured six accessions² of asafoetida seeds in 2018 from Iran through ICAR-National Bureau of Plant Genetic Resources (ICAR-NBPGR). As the seeds remain dormant for prolonged periods as a part of adaptation technique to survive in desert conditions, germination was a challenge and only 1% of the seeds germinated. To tackle IHBT developed an



agro technology which included special chemical treatment. 800 saplings of *Ferula assafoetida* were planted in the cold desert region of Lahaul and Spiti. Further cultivation will be done in a staggered manner.

The cultivation of asafoetida plant in cold desert areas like Ladakh and certain areas of Himachal, Uttarakhand and Arunachal Pradesh will be suitable for its growth and will in turn also change the economic condition of people in these regions. Each plant is estimated to yield about 500 gm of concentrated resin, which when processed can yield up to 250 kg of asafoetida powder. So, with an investment of INR 3 lakhs per hectare, the farmers have an opportunity to earn about INR 10 lakhs per hectare from the fifth year onwards³. Also, in the next 5 years, the government is targeting to cover a total of 750 acres of land under saffron and asafoetida crop cultivation in the Himachal Pradesh. The government support for the cultivation of asafoetida will surely ensure livelihood for the farmers in the cold desert regions of India and also enable reduction in the prices providing a good business opportunity!

Adoption of biofortified crops through PPP model

India ranks 94th out of 107 countries in the latest [GHI index](#) and over 80 per cent adolescents in India suffer from micronutrient malnutrition also known as hidden hunger caused by lack of critical micronutrients such as vitamin A, zinc, folate, vitamin B12. Though micronutrient deficiencies can be alleviated through nutritional supplements, it could be an expensive solution. Biofortification is proven to be a sustainable and cost-effective approach to address malnutrition. Biofortified cultivars holds great promise for providing micronutrients to people who has limited access to diverse diets and other micronutrient interventions. This can be achieved through agronomic interventions, genetic engineering and conventional plant breeding. It is recognized as a nutrition-sensitive-agriculture intervention that can reduce vitamin and mineral deficiency.

Indian diets typically involve consumption of staple food such as rice and wheat, with limited dietary diversification towards micronutrient-rich foods like fruits, vegetables, and animal products. Our agricultural system so far has been focusing on improving grain yields and crop productivity and has not been aimed at promoting human health. Now it is undergoing a paradigm shift from producing more quantity of food crops to producing nutrient-rich food crops in sufficient quantities. Various organizations in India like ICAR, DBT, ICMR, and private sector along with international organizations, like HarvestPlus, IRRI are converging their research efforts of biofortification for product development, testing and validation. According to [Biofortification Priority Index \(BPI\)](#), developed by HarvestPlus

India ranks number 3 for likely benefits in investment in zinc wheat and ranks 10 and 12 in iron pearl millet and zinc rice respectively among the top ranked crops. In an effort to alleviate malnutrition ICAR-AICRP has also set minimum levels of iron (42ppm) and zinc (32ppm) to be bred into national varieties of pearl millet.

The concept of biofortification, which involves enhancing a crop's inherent nutritional value through genetic improvement has received strong support

recently from Prime Minister Narendra Modi when he released 17 biofortified varieties of eight food crops for commercial cultivation. These 17 varieties are 1.5 to 3 times more in nutritional value which have been developed by utilizing local landraces and farmer's varieties. Adoption of these new varieties together with improved agronomy is expected to scale up significantly with the public-private partnerships (PPP) and would be beneficial to farmers when compared to agronomic biofortification.

Crop	Variety	Biofortification
Rice	CR Dhan 315	High Zinc
Wheat	HI 1633	Protein, Iron, Zinc
Wheat	HD 3298	Protein and iron
Wheat	DBW 303 and DDW 48	Protein
Maize	Ladhowal Quality Protein Maize Hybrid 1, 2 and 3	Lysine and tryptophan
Finger Millet	CFMV1 and 2	Calcium, iron and zinc
Little Millet	CLMV1	Iron and zinc
Mustard	Pusa Mustard 32	Low Erucic acid
Groundnut	Girnar 4 and 5	High Oleic acid
Yam	Sri Neelima and DA 340	Enhanced zinc, iron & anthocyanin content

Sathguru compilation

The public sector plays a vital role, through enabling policies and programs, and ensure that biofortified crops reach the most vulnerable populations to address the problem of hidden hunger. Efforts towards procuring and distributing fortified rice through the Food Corporation of India (FCI) to all the districts under Integrated Child Development Services (ICDS) and Mid-Day Meal (MDM) scheme from the next financial year is also in place. This will



also pave the way for higher income of farmers and will open opportunities for entrepreneurship development.

However, there are multiple limitations and challenges that are affecting the broader adoption and consumption of biofortified crops. One of the important factor for slow adoption among farmers is the fear that biofortified varieties have lower yields. Since most of the nutritional traits like protein, iron, zinc and others are phenotypically invisible, it is difficult to convince the farmers about the extent of quality of the produce. Some of these challenges can be addressed by ensuring that technology and

infrastructure are in place and the seeds are accessible to farmers to help them to grow biofortified crops. Enabling strong linkages with agri food-processing industry and the recently enacted contract farming law would also help in the production and marketing of bio fortified crops. Development of hand held and easy to use equipments such as Brix meter which can provide some reliable estimates of the quality parameters of the produce would also be helpful. Providing subsidized seed and other inputs along with assured price through minimum support price might encourage the farmers to grow more biofortified crops.

Including nutrition objectives to the breeding programs along with standard goals such as productivity and disease resistance and investing in biofortification research by government, private sector and CGIAR centres for scaling up the biofortification is essential to make biofortified crops a new normal. Private seed companies are playing a critical role in developing and commercializing seed and also has an opportunity for in-licensing of released seed varieties for multiplication and distribution to farmers. Biofortified crops hold a bright future to address the malnutrition challenge and drive nutrition sensitive agriculture.

<u>Company</u>	Product	Fe(ppm)	Zn(ppm)
Nuziveedu Seeds*	Balwan	53	41
	NBH 4903	51	37
Bioseed*	Bio 70	46	38
	Bio 8145	58	39
Metahelix*	MP -7872	44	35
	MP -7792	43	33
JK Agri Genetics*	JKBH 1008	42	38
	JKBH 1326	48	33
Corteva Agriscience*	86M82	57	39
	86M84	52	40
	86M86	53	45
	86M01	48	43
Bayer*	PB 1852	56	32
	PROAGRO 9450	71	58
Kaveri Seeds*	KBH 3940	48	40
	Kaveri Super Boss	46	40
<u>Astha Beej</u>	Chitra (Wheat)		High Zinc

***Pearl millet**

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EXPERT SPEAK

Biofortification: A Transformative Innovation to Unlock Agriculture for next Nutrition Revolution

Message from HarvestPlus

HarvestPlus, a global program under Agriculture for Nutrition and Health (A4NH) of Consultative Group for International Agriculture and Research (CGIAR), that improves nutrition and public health by developing and promoting biofortified food crops that are rich in vitamins and minerals, providing global leadership on biofortification evidence and technology.

Globally, more than two billion people did not have regular access to nutritious and sufficient food in 2019, this trend will affect people's health, especially diets of women and children, according to The State of Food Security and Nutrition in the World 2020 (SOFI 2020) report. Stunting rates in India is about 38%, and anemia affects about 65 -70% of the preschool children and women. COVID 19 pandemic situation has brought renewed focus to healthy and nutritious food that is cost-effective, safe, locally accessible, and food supply chain resilience.

Staple foods form a major share of the resource-poor population's daily diet, which provides energy requirements, but they do not provide most of the micronutrients required for healthy living. An affordable, diverse diet rich in micronutrients is still a challenge to many of the resource-poor population. By enhancing the micronutrient content of the energy-rich staples, intakes of micronutrients can be increased.

Biofortification is a process of enhancing micronutrients in the staple food crops that people consume daily, developed by conventional breeding methods. They have all the traits that the farmers desire to grow, high in yield, disease resistance, and a measurable health impact on the populations when eaten daily. The advantages of biofortification are that it starts in the rural areas, it is cost-effective and sustainable. The focus of the program is on three micronutrients, iron, zinc, and vitamin-A, that are considered limiting in the diets of the resource-poor population, according to the World Health Organization (WHO). Biofortification has the potential to complement the existing interventions like fortification and supplementation to create far more impact. Biofortification was ranked fifth by the expert panel at the Copenhagen Consensus 2008.

HarvestPlus has developed partnerships with CGIAR centers- ICRISAT, CIMMYT, IRRI, ICARDA; ICAR, SAUs, Seed Companies, FPO's and NGO's for



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product development and dissemination. The focus of the program in India is on zinc-rich wheat, zinc-rich rice, and iron-rich pearl millet that are major staples for millions. Seven hybrids, one variety of iron-rich pearl millet, and four zinc-rich wheat varieties have been developed in the partnership program. Iron-rich pearl millet is grown in Maharashtra, Rajasthan, Haryana and Karnataka. Zinc-rich wheat is grown in UP, Bihar, and Punjab.

Agri-Food Value Chains and Enabling Agri-Policies for greater impact:

There are a growing market and shift of the health-conscious consumer space for naturally nutritious, healthy, wholesome foods and ingredients. Agri-Food partnerships can help to leverage investments, technology, and capacities to overcome the gaps in the existing

EXPERT SPEAK

supply chains for nutritious crops, help in creating traceability of raw materials supply, last-mile capabilities, systems, and processes to meet the supply-demand imbalance.

On the occasion of World Food Day, 16th October 2020, Prime Minister Shri. Narendra Modi dedicated biofortified crops to the nation. Prime Minister also stressed in this speech the plans to incorporate biofortified crops in the existing food and nutrition program (Mid-day Meal, PDS, ICDS, etc.), which can enhance the nutritional component of the food programs. These Agriculture-Nutrition linkages can create demand

and incentivize farmers to increase the adoption of biofortified crops.

Conclusion

More than 50 million people globally consume and benefit from eating biofortified crops in Asia, Africa, and Latin America. In India, an estimated 640,000 people, are benefiting from growing and eating iron-rich pearl millet and zinc-rich wheat. The mission of HarvestPlus is to reach One Billion people by 2030. To leap and reach these numbers requires innovative partnerships across the value chain.

Developing long-term sustainable

markets for biofortified crops will require public and private investments and partnerships to accelerate further product development and wider reach of biofortified seeds to farming communities. Enabling agriculture policies for promoting Agri-Nutrition linkages will help in sustainable production and demand creation. Agri-Food partnerships have the potential to create greater efficiencies across the value chain for biofortified crops.

Biofortification, a novel agriculture technology, has the potential to spur the next nutritious revolution towards Kuposhan Mukht Bharat.

NEWS

Centre nods for subsidised loans for implementing micro irrigation projects

The steering committee of micro irrigation fund (MIF) has approved projects for loan worth Rs 3,971.31 crore. Subsidised loans are provided for not only taking up special and innovative projects but also for incentivizing micro irrigation to encourage farmers to install micro irrigation systems. Maximum loan has been approved for Tamil Nadu followed by Haryana, Gujarat, Andhra Pradesh, West Bengal, Punjab and Uttarakhand.

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10% likely increase in fertilizer sales for Rabi season than previous year

With good soil condition for Rabi cultivation, stable prices of raw material and enhanced domestic production of fertilizer during the pandemic, the sales of fertilizers are expected to rise for the upcoming Rabi season 2020 – 21. Farmers have already started procuring fertilizers from August onwards and with stable prices the sales are increasing.

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NEWS

Acreage of Rabi sowings increases by 10% compared to previous year

Overall acreage of all Rabi crops put together recorded an increase of nearly 10 % compared to same period last year mostly coming from increased sowing of pulses this year. Farmers have sown pulses across large area and has risen to 8.25 million hectares from 6.45 million hectares last year.

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FMCG and food processing companies come together to solve stubble burning issue in North India

To tackle the recurring stubble burning issue in North India, firms like PepsiCo, DCM Shriram, ITC, and CII are closely working with farmers of Haryana, Punjab, and Rajasthan on sustainable farming practices and aim at addressing stubble burning issue effectively. The firms are engaged in providing field trainings, and encouraging the use of alternate practices and adopting advance agriculture practices to address the problem of stubble burning.

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Advanced countries receive agri-machinery from India

In 2019-20, India exported 76.41% of its total agri-machinery export to North America, Eastern Europe, EU,UK, Africa, ASEAN and SAARC. Among these exports, tractors accounted for 66% of the total shipments of agri-machinery.

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Sugarcane growers to benefit with government considering export subsidies for 20-21 season

Extension of export subsidy for sale of sugar in international markets will be welcome move for the industry given the bumper sugar production expected for the current season. Higher export volumes of sugar will help in ensuring that the domestic rates do not fall below cost of production and thus growers getting paid by the millers.

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Ensuring MSP to the farmers by tweaking policies

To achieve the goal of ensuring that the farmers receive the right prices for their products and at least receive the MSP from the market every season, Government has been tweaking the import and export policies to maintain sufficient stocks of commodities and has also been using the buffer stock to control market prices.

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ICRISAT permitted for deployment of drones for agricultural research activities

With drones set to play a big role in the sector through precision agriculture, pest management, yield enhancement the government is currently encouraging research for developing low cost drone based solutions. This permission will help in operationalization of the Digital Sky Platform. The condition has been granted for 6 months (or under completion of task whichever is earlier) a set of stipulated conditions and limitations.

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Indo – Israel collaboration to utilize latest technology and boost farmer income

Proposal for setting up two centers of excellence to boost the farmers' income by utilizing the latest technology has been discussed. The collaboration will facilitate knowledge sharing of best agricultural practices from Israel with North-eastern region farmers to boost their income.

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Decline in India's tea production pulled down the global black tea output over 5%

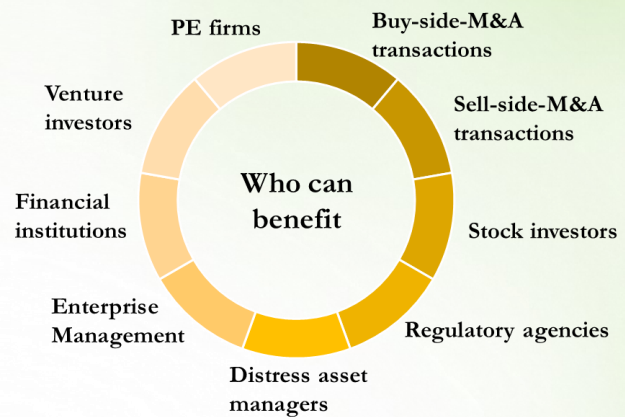
Lockdown and adverse weather conditions in North Indian plantations has pulled down the global black tea output in the three quarters of the current calendar. The global black tea production has fallen to 1570 million kg from 1660.72 million kg for the same period last year. India has contributed the largest share in this decline.

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Agritech opportunities in India can broadly be segmented – Biotech companies, Precision Agriculture, Agribusiness companies, Market Linkages, Farming-As-A-Service, Big Data & ERP solutions etc

Case Studies



Seed Regulatory and IP Audit for leading seed company with global presence



Diversification and market expansion: Agro-chemicals to Biologicals



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