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Biofortification: Eradicating and alleviating hidden hunger for food

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It is a notion that sustainable agriculture is the root of solutions for eradication of malnutrition for long run. In these contemporary years, several strategies are taken up for reduction or elimination of this hidden hunger. The resolution initiated for this crucial subject involves number of measures which include dietary diversification, supplementation, and industrial fortification of food products and most importantly biofortification. Though all of the above strategies have been successful in some parts of the world but it requires continuous investment and extensive infrastructure for limiting their effectiveness in reaching the most vulnerable groups. Out of all strategies, biofortification is considered as a lead agricultural approach focused to target micronutrient malnutrition worldwide. Once implemented, biofortification will lower the number of micronutrient deficient people which requires more costly interventions dependent on supplementation and fortification programmes. Although micronutrients are required in very trace amount but the magnitude of micronutrient under nutrition is immense. It has been observed that nearly 2 billion people suffer from various health disorders due to) iron) deficiency, inadequate zinc intakes and high deficiency of Vitamin A. Unlike the cases with insufficient energy intakes, micronutrient malnutrition has no such manifestation except in extreme cases and for this very reason; it is termed as "hidden hunger".

Malnutrition is an alarming problem in the world. The large population in the developing countries is the major victim as they mainly rely on a staple diet of cereals. Unfortunately all of our major cereal food crops lack certain essential vitamins and minerals, as milled cereal grains are poor sources of lysine, vitamin A, folic acid, iron, zinc and selenium, which are essential for normal growth and metabolism of human beings. In order to reclaim the micronutrient deficiencies, the developing countries have taken the initiative to use the biofortification approach of staple crops for increasing the density of vitamins and minerals in a crop through plant breeding, transgenic techniques or agronomic practices. Biofortified staple crops when consumed regularly, will generate measureable improvements in human health and nutrition. Biofortification is proven to measurably improve human health and nutrition. It is a feasible and cost-effective means of delivering micronutrients to populations that may have limited access to diverse diets and other micronutrient interventions. More than 20 million people in farm households in developing countries are now growing and consuming biofortified crops.

Comparative advantages : Over the last few decades, it has been observed that agricultural research for developing countries has increased production and availability of calorically dense staple crops but there is lack of micronutrient-rich non-staples production such as vegetables, pulses and animal products.Moreover, the prices of non-staple food have increased steadily and substantially, making it onerous for the poor to afford dietary quality. Hence to alleviate these issues of micronutrient deficiencies, biofortification intervenes as a supplementation and industrial food fortification and acts as feasible means of reaching rural populations who may have limited access to diverse diets. It has two key comparative advantages- Cost-effectiveness and ability to reach the undeserved rural population.

Cost-effectiveness : Biofortification is an emerging approach to address micronutrient malnutrition, based on the fact that it is essentially a food based problem. The interventions exhibit relatively high up-front costs initially for the first 6-10 years. These costs mainly depend on some factors such as type of crop and micronutrient, size of the target country, research infrastructure and seed sector. This method has a multi-part solution and high probability of success, to reach the rural poor in developing nations.

Ability to reach the undeserved rural population : To reach scale, biofortification must be integrated in public and private programmes. The biofortified crops can be promoted with extension strategies based on their agronomic qualities, nutritional qualities, or both. There is need of awareness programmes and studies regarding the effectiveness and utilization of the biofortified crops among

the farmers. In India, it has been noticed that the rate of adoption of biofortified crops is average in the rural mass. Some cases of adoption like high iron (71 mg/kg), early-maturing, open pollinated pearl millet variety Dhanashakti have been adopted by >35,000 farmers. Similarly, high-yielding and high-iron hybrid ICMH 1201 have been adopted by 25,000 farmers mostly in Maharashtra and Rajasthan.

Nutritional bioavailability and efficacy evidence: Biofortification puts a solution in the hands of farmers, combining the micronutrient trait with other agronomic and consumption traits that they prefer. Therefore, to develop evidence of nutritional efficacy, nutritionists first measure retention of micronutrients in crops under typical processing, storage, and cooking practices to be sure that sufficient levels of vitamins and minerals will remain in foods that target populations typically eat. Genotypic differences in retention and concentrations of compounds that inhibit or enhance micronutrient bioavailability are considered. Absorption is a prerequisite to demonstrating that biofortified crops can improve micronutrient status, which makes nutritionists study the degree to which nutrients bred into crops are absorbed, first by using models, before direct study in humans.

Iron crops : Iron nutrition research has demonstrated the efficacy of biofortified iron bean and iron pearl millet in improving the nutritional status of target populations. Dhanshakti is the first iron biofortified crop cultivar of pearl millet to be officially released in Maharashtra, India by ICRISAT in 2013 and has been included in the Nutri-Farm Pilot Program launched by the Indian government. According to Dr. Govindaraj (Senior scientist ICRISAT), the intake of 100 g of Dhanashakti can provide children 100% of the Recommended Dietary Allowance (RDA) of Iron and 200 g can provide women with more than 80% of their daily iron needs.

Vitamin A crops : Vitamin A bioavailability studies found efficient conversions from pro-vitamin A to retinol, the form of vitamin A used by the body. Efficacy studies demonstrated that increasing pro-vitamin A intake through consuming vitamin A-biofortified crops results in increased circulating beta-carotene, and has a moderate effect on vitamin A status, as measured by serum retinol. Consumption of orange sweet potato (OSP) can result in a significant increase in vitamin A body stores across age groups.

Zinc crops : Zinc studies have demonstrated that zinc in biofortified wheat is bioavailable. Because plasma zinc concentration, the biomarker widely used to estimate zinc status, has limitations in measuring changes in dietary zinc, foundational research to identify and test more sensitive biomarkers is underway.

Crop development : Plant breeding can increase nutrient levels in staple crops to target levels required for improving human nutrition, without compromising yield or farmer-preferred agronomic traits. The crop development process entails screening germsplasm for available genetic diversity, prebreeding parental genotypes, developing and testing micronutrient-dense germplasm, conducting genetic studies, and developing molecular markers to lower the costs and quicken the pace of breeding. Nowadays, only application of macro nutrients leads to deficiency of micro nutrients in soil as well as in food grains. Agronomic biofortification is a holistic approach to eliminate micronutrient deficiency in food crops through agronomic practices by the means of soil and foliar applications. The micronutrient enrichment of staple food crops has been considered as a sustainable strategy for immediate solution to tackle the problems of micronutrient deficiencies in human beings and animals.

Though, according to various studies the benefit of biofortification is evident but there is still indispensable need of awareness among the farmers. A huge communication gap exists between the researchers and the needful farmers which needs to be reduced for the betterment. Biofortification is a boon to sustainable agriculture which gives us a sustainable, climate-resilient, inexpensive super-grain. It has shifted our focus from quantity to quality food. Eventhough, in India the biofortified foods are not available off the shelf just yet, its really the next big thing in nutrition to look out for.

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