

## Global grid of genetic gardens of biofortified crops

The 2016 Global Nutrition Report of the International Food Policy Research Institute (IFPRI) indicates that one of the high priorities of humankind should be ending malnutrition, because of its multiple adverse impact on human health and quality of life. Children are the worst victims and it is now realized that we should adopt a life cycle approach in terms of nutrition intake with special emphasis on the first thousand days in a child's life. The IFPRI report brings out that the economic consequences of hunger are equally high with a loss of 11% of GDP every year in Africa and Asia. India is one of the worst affected with a high malnutrition burden. The IFPRI report also points out that current political and economic commitments to end world hunger do not match the need.

An approach to overcoming micronutrient malnutrition has been the production and consumption of biofortified crops. To highlight the benefits of increasing the intake of biofortified crops, the 2016 World Food Prize has been awarded to Maria Andrade, Robert Mwanga, Jan Low of the International Potato Research Centre, Peru and Howarth Bouis of HarvestPlus of CGIAR. They were recognized for the development and consumption of orange-fleshed sweet potato rich in vitamin A. The high vitamin content was achieved through a breeding programme based on conventional genetics. The impact of the vitamin A-rich sweet potato has been widespread covering such diverse countries such as Mozambique, Tanzania, Kenya, Uganda, China and the US. The HarvestPlus programme of CGIAR coordinated by Howarth Bouis has led to the development of zinc-rich rice and wheat, iron-rich beans and pearl millet, vitamin A-rich sweet potato, cassava and maize and several other crops of importance to human health.

For achieving the challenge of freedom from hunger and malnutrition, the

strategy should be three dimensional. First, undernutrition or calorie deprivation has to be overcome through social support programmes. India, for example, has a National Food Security Act (2013) which makes it legally obligatory to provide the needed calories to over 70% of the country's population of 1.25 billion. The second aspect relates to fighting protein hunger, the year 2016 has been declared as the International Year of Pulses. There are considerable opportunities for improving the production of grain legumes or pulses through better agronomic management and seed production and distribution. Protein hunger can also be addressed through higher consumption of dairy and poultry products as well as meat and fish. The third area requiring attention is hidden hunger caused by the deficiency in the diet of micronutrients such as vitamin A, vitamin B12, vitamin C, iron, iodine and zinc. Even vitamin D is becoming deficient due to life cycle changes which reduce exposure to sunlight. Hidden hunger can be reduced by the consumption of crops rich in critical micronutrients.

There are three methods of promoting the cultivation and consumption of biofortified crops. First, is naturally biofortified crops, a good example of which is *Moringa oleifera* (Drumstick). Second, increasing micronutrient content through normal Mendelian breeding. This is what has been achieved by the 2016 World Food Prize Laureates in the case of sweet potato. In many other crops, breeding for nutritive properties is based on the screening of germplasm collections, and genetic recombination. A good example in India is iron-rich pearl millet and in Bangladesh zinc-rich rice. The third method is genetic modification as was done in the case of 'Golden Rice' which is rich in vitamin A. Genetically modified crops however require conformity to national regulatory policies and in

several countries they are not the preferred crops. In fact in the Philippines Golden Rice varieties were uprooted by environmentalists. Therefore, biofortified crops, either naturally occurring or which have been bred by conventional breeding methods are preferred.

In order to mainstream nutrition in the farming system, it is important to promote nutrition literacy among both producers and consumers. One method of promoting an understanding of the nutritive value of different varieties in food crops is the establishment of Genetic Gardens of Biofortified Crops. Such genetic gardens should have different sections based on particular micronutrients. Thus, there will be a vitamin A section, iron and iodine section, etc. This will be a new kind of botanical garden with emphasis on biofortified genetic resources. By walking through the garden, farmers can identify the crops they can introduce in their farming system to address specific micro-nutrient deficiencies.

There have been many efforts in the past on how to overcome malnutrition and thereby provide every child an opportunity for a productive and healthy life. Still malnutrition prevails on an unacceptable scale. One of the most efficient and economic methods is the promotion of biofortified crops. This is why I commend the establishment of a Global Grid of Genetic Gardens of Biofortified crops to serve both as educational tools and facilitators of nutrition security. This is also the pathway to achieving Goal 2 of the UN Sustainable Development Goals, namely 'End hunger, achieve food security and improved nutrition and promote sustainable agriculture'.

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