

## Biofortification, a cost-effective intervention for micro-nutrient deficiency

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Despite intensive traditional interventions, micro-nutrient deficiency takes a daily toll of ca. 6' 000 lives. With the concept of **biofortification** an alternative, novel, and complementing approach is under development. This strategy uses the **power of genetics** to improve the **micro-nutrient content in crop plants**, especially those used as major food source by micro-nutrient deficient populations in developing countries. Genetic improvement is possible via traditional breeding or **genetic engineering**. The first and most advanced example on these lines is a genetically modified rice which provides sufficient amounts of **provitamin A** from standard daily diets of rice-dependent societies, to prevent vitamin A-malnutrition – "**Golden Rice**". The activation of the biochemical pathway leading to synthesis and accumulation of provitamin A in the starch-storing tissue of the seed was only possible via genetic engineering. The Golden Rice project was from the onset, and still is a **humanitarian project of the public domain**. It is not, as the GMO opposition likes to pretend, a PR plot of the agbiotech industry. Product (variety) development and deregulation and final release to the public is under the control and guidance of an **NGO** – the **Humanitarian Golden Rice Board**. Development of agronomically superior and locally adapted varieties is under development in **public rice research institutes** in developing countries. For reasons of regulatory costs all different national varieties are developed via traditional breeding from one single selected transgenic event. Once deregulated the local varieties will be handed out to subsistence farmers by public seed boards at no extra costs. **All technology is contained in the seed**. The farmers will use part of their harvest for the next sowing, and they will use the technology **free of any licence fee** within the framework of a **humanitarian licence** signed by the national public rice institutions. There are **two limitations**: the farmer or trader must not make a **profit** from Golden rice **beyond USD 10' 000 per year** and **export is not permitted**. These conditions enable free use for the target population of the project, and they are a consequence of the fact, that because of lack of support from the public domain, the humanitarian project required support from the private sector. Due to GMO-regulations Golden Rice will not be available before 2012. **Ex ante studies** predict a substantial impact of Golden Rice on health and economy. A Worldbank study (1) published in 2005 calculates a yearly benefit for Asia of ca. USD 15.2 billion and a study specifically for India (2) predicts that up to **40' 000 lives per year** could be saved with strong support from the government. As the costs per life year saved are USD 3 compared to USD 156 costs of the, so far, most efficient alternative intervention (free distribution of vitamin A capsules) biofortification is the **most sustainable intervention**. This first example of vitamin A-biofortification in rice is now followed by biofortification for **iron, zinc, vitamin E, and essential amino acids**, in **rice, manioc, sorghum, and banana** (Bill&Melinda Gates Foundation **Grand Challenges in Global Health No.9**

- (1) GM Rice Adoption: Impact for Welfare and Poverty Alleviation. K Andersen, LA Jackson, CP Nielson. J. Economic Integration 20, 2005
- (2) Genetic Engineering for the Poor: Golden Rice and Public Health in India. A.Stein, HPS Sachdev, M Qaim. World Development 36, 144-158 (2008)
- (3) [www.goldenrice.org](http://www.goldenrice.org)