Biofortification, an agricultural micronutrient intervention: its potential impact and cost-effectiveness in India*

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Background: Through biofortification the micronutrient levels in staple foods can be increased, making this a potentially good agricultural approach to control micronutrient malnutrition. No biofortified crop is currently widely consumed on a regular basis and a comprehensive evaluation of the potential economic costs and benefits of this new approach is missing.

Aims: To project the impact of biofortification on the disease burden due to micronutrient deficiencies and to estimate their cost-effectiveness relative to other public health measures.

Methods: Individual intakes of Fe, Zn, and vitamin A (VA) were computed using the 1999/2000 Indian national household food consumption survey (30-day recall, n=119,554) and adult equivalent weights. Micronutrient intake levels were linked to the incidence rates for relevant health outcomes using dose-response or cumulative distribution functions, and the current burden of each deficiency in terms of "disability-adjusted life years" (DALYs) lost was calculated. Simulations were run to determine the impact of consuming iron-rich rice and wheat, zinc-rich rice and wheat, and beta-carotene-rich "Golden Rice" (GR) on the incidence of diseases and the DALYs lost for each deficiency using optimistic and pessimistic scenarios for attained micronutrient content in the biofortified crop. Development and dissemination costs for the biofortified crops were obtained from plant breeders. Cost-effectiveness was calculated as US$/DALY saved. The results were compared with those of other interventions and international benchmarks. The robustness of the model was tested through sensitivity analyses.

Results: The annual burden of Fe, Zn, and VA deficiency (VAD) in India is estimated to be 4.0 million, 2.8 million, and 2.3 million DALYs lost, respectively. Fe biofortification of wheat and rice may reduce this burden by 19-58%, saving 0.8-2.3 million DALYs each year. Likewise Zn biofortification of these crops may reduce the burden by 16-55%, saving 0.5-1.6 million DALYs each year. GR may reduce the burden of VAD by 9-59%, saving 0.2-1.4 million DALYs each year. Saving one healthy life year through Fe biofortification of wheat and rice would cost US$ 0.46 and US$ 5.39 under the optimistic and pessimistic assumptions. Corresponding values for Zn biofortification of wheat and rice are US$ 0.68 and US$ 8.80, respectively, and for GR US$ 3.06 and US$ 19.40, respectively.

Conclusion: By World Bank and WHO standards, biofortification appears to be an economically viable and efficient intervention that may complement the existing mix of strategies to control micronutrient malnutrition.

Literature:

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