Biofortification Prioritization Index

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Biofortification could prove to be a cost-effective and sustainable strategy for alleviating micronutrient deficiencies in rural areas of developing countries, where the majority of households' diets are comprised of staple foods and where access to food supplements and commercially marketed fortified foods is limited. Research evidence to date suggests that biofortification is an efficacious and cost-effective public health intervention.

As evidence builds in favor of biofortification, stakeholders are increasingly interested in investing in this intervention as a cost-effective means for reducing micronutrient deficiency. These stakeholders need evidence-based information on where to target specific biofortified crops to achieve the highest nutrition, and hence health, impacts in a cost-effective manner. The Biofortification Prioritization Index (BPI) contributes to closing this information gap by generating country-crop-micronutrient specific indices, ranking countries globally and within regions (Africa, Asia, and Latin America and the Caribbean [LAC]) according to their suitability for investment in biofortification interventions.

The BPI is calculated using secondary, country-level data compiled from various sources, including the Food and Agriculture Organization (FAO) of the United Nations, the World Health Organization (WHO), and the United States Department of Agriculture (USDA). Similar to the Human Development Index (HDI) and Global Hunger Index (GHI), a heuristic approach is used to generate the BPI using three subindices: one each for the consumption and production of the crop and one for the micronutrient deficiency. The consumption subindex measures the intensity of consumption of the specific crop, adjusted for the share of the crop's total national consumption that is imported. The production subindex measures the national intensity of production by considering both per capita area harvested and national land area allocation to the crop, while adjusting for exports. Finally, the micronutrient deficiency subindex measures the extent of deficiency of the micronutrient in question within the country. These consumption, production, and micronutrient deficiency subindices are then combined using a geometric mean to create the overall BPI.

The unweighted BPI is calculated by giving each country equal weights. However two "weighted" versions of the BPI were also generated that take into account either the country's (i) share of the target population (children age 6–59 months and women of childbearing age) in the global target population or (ii) the share of cultivated land area for a specific crop in the global cultivated land area for that crop. Both weights implicitly consider cost aspects, since fixed investments in biofortification for a given country can either benefit more people or be planted on more land. The weighted BPIs are meant to serve as *complementary* tools for specific stakeholders. The population-weighted BPI could be used by stakeholders whose mandate is to reach as many beneficiaries as possible, whereas the area-weighted BPI could benefit those whose aim is to maximize area allocated to biofortified crops. It is highly recommended that the weighted BPIs not be considered in isolation when making investment decisions, but rather, in tandem with the unweighted BPI.

The table below presents the top 15 global rankings for the unweighted BPI. The results show that among the 127 countries included in the analysis, African countries rank highest for vitamin A biofortified crops, including maize, cassava, and sweet potato, and Asian countries rank highest for zinc biofortified cereals, including wheat and rice. For rice, Africa also offers some suitable countries that could generate high levels of impact. For iron biofortified beans, several countries in Africa and some in LAC have high potential. For iron biofortified pearl millet, both Africa (especially West Africa) and South Asia constitute suitable candidate sites for investment. Several of the findings are in line with HarvestPlus's currently implemented and planned biofortification interventions, while others suggest new avenues for expansion. Although results of the weighted BPI are not presented here, comparison of the unweighted and the weighted BPIs suggest that the three kinds of BPI could be useful for stakeholders seeking to achieve different objectives.

Global BPI Ranking of Top 15 Countries, by Crop

Global Rank	Cassava (Vitamin A)	Maize (Vitamin A)	Sweet Potato (Vitamin A)	Beans (Iron)	Pearl Millet (Iron)	Rice (Zinc)	Wheat (Zinc)
1	Mozambique	Malawi	Angola	Rwanda	Niger	Cambodia	Tajikistan
2	Angola	Benin	Burundi	Benin	Gambia	Bangladesh	Turkmenistan
3	Ghana	Zambia	Uganda	Tanzania	Burkina Faso	Laos	Azerbaijan
4	Liberia	Kenya	Mozambique	Burundi	Chad	Myanmar	Afghanistan
5	Benin	Mozambique	Rwanda	Myanmar	Senegal	Viet Nam	Pakistan
6	Central African Republic	Angola	Tanzania	Togo	Nigeria	Indonesia	Kazakhstan
7	Democratic Rep. Congo	Burkina Faso	Sierra Leone	Haiti	Namibia	Sierra Leone	Uzbekistan
8	Sierra Leone	Zimbabwe	Madagascar	Uganda	Guinea-Bissau	Madagascar	Turkey
9	Côte d'Ivoire	Timor-Leste	Guinea	Angola	Uganda	Sri Lanka	India
10	Zambia	Mali	Haiti	Kenya	Nepal	Philippines	Iraq
11	Malawi	Togo	Kenya	Brazil	India	Nepal	Nepal
12	Congo	Tanzania	Mali	Cameroon	Ghana	North Korea	Morocco
13	Togo	Ghana	Laos	Nicaragua	Togo	Liberia	Syria
14	Madagascar	Gambia	Benin	Chad	Sierra Leone	Guinea	Egypt
15	Guinea	Lesotho	Timor-Leste	Malawi	Myanmar	Guyana	Iran

The BPI should not be used as a one-stop shop for making decisions on biofortification investment decisions because it has several limitations. The main limitation is that the data are at a national level, i.e., at the highest level of aggregation for each country; therefore, the BPI may overlook important within-country information. Another key limitation is the potential biases that may arise as a result of the aggregated consumption figures. It is likely that the national-level consumption figures are downward biased for rural households that are more likely to consume more staple crops than their urban counterparts. By the same token, it is also possible that consumption figures are upward biased because the target populations (especially children age 6–59 months) consume less than the average person. Moreover, the BPI does not take into account differences in costs of breeding and delivery of biofortification programs across countries.

Some of these shortcomings will be addressed in future research. For now, the BPI is a useful tool for highlighting those countries that may benefit from significant reductions in micronutrient deficiencies through biofortification of staple crops.

To access the full BPI working paper, see:
http://www.ifpri.org/sites/default/files/publications/harvestpluswp_11.pdf.