A Global Roadmap for Mainstreaming Biofortification into CGIAR Breeding Programs
Why are Mineral and Vitamin Deficiencies Such A Significant Public Health Problem?
Percent Changes in Cereal and Pulse Production and in Population Between 1965 and 1999

Cereals

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>150</td>
</tr>
<tr>
<td>Pakistan</td>
<td>225</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>115</td>
</tr>
<tr>
<td>Developing</td>
<td>200</td>
</tr>
</tbody>
</table>

Pulses

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>India</td>
<td>15</td>
</tr>
<tr>
<td>Pakistan</td>
<td>50</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>120</td>
</tr>
<tr>
<td>Developing</td>
<td>5</td>
</tr>
</tbody>
</table>

Population

<table>
<thead>
<tr>
<th>Country</th>
<th>Percent Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>100</td>
</tr>
<tr>
<td>Developing</td>
<td>90</td>
</tr>
</tbody>
</table>
Figure 2. Price Indices By Food Group for India, 1970-2016, Deflated by Non-Food Price Index

Source: Personal Communication, JV Meenakshi, Delhi School of Economics
Figure 2. Price Indices By Food Group for India, 1970-2016, Deflated by Non-Food Price Index

Three-Year Averages

Source: Personal Communication, JV Meenakshi, Delhi School of Economics
Share of Energy Source & Food Budget in Rural Bangladesh

- **Energy Source**
  - Staple foods: 70%
  - Non-Staple plants: 30%
- **Food Budget**
  - Staple foods: 60%
  - Non-Staple plants: 40%
Consequences Mineral & Vitamin Deficiencies

Vitamin A deficiency
- Supplements reduced child mortality by 23%
- 375,000 children go blind each year

Iron deficiency
- Impaired cognitive abilities that cannot be reversed
- 82% of children < 2 years in India are anemic

Zinc deficiency
- increased incidence/severity diarrhea/pneumonia; stunting
- 2 billion people at risk; 450,000 deaths per year
A Primary Role of Agriculture Is To Provide Nutrients for Healthy Populations

Supplementation And Fortification

Unreached Populations

Supply of Nutrients From Agriculture

Present
8 BILLION VITAMIN A CAPSULES

Each silhouette represents 100 million capsules

Thanks to a donation programme financed by the Government of Canada and implemented through the Micronutrient Initiative, UNICEF has received more than 8 billion capsules since 1998, which, when combined with programme financing, have been critical to maintaining strong Vitamin A supplementation programmes.

4 MILLION

The Micronutrient Initiative estimates that more than 4 million deaths have been averted during this time.

Cost Per Vitamin A Capsule $US 0.50-1.25 World Bank (2007)
Cost-effective: central one time investment
A Primary Role of Agriculture Is To Provide Nutrients for Healthy Populations

Supplementation And Fortification

Nutrient Gap

Supply of Nutrients From Agriculture

Unreached Populations

Present

Future
Biofortified crops released in **30 countries**
In-testing in another **30 countries**

- Rice
- Wheat
- Maize
- Pearl Millet
- Sorghum
- Cassava
- Orange Sweetpotato
- Potato
- Banana Plantain
- Lentil
- Beans
- Cowpea
Nutritious crops released in 30 countries; in testing in another 30
Efficacy trials with provitamin A, iron, and zinc biofortified crops have also shown improved functional outcomes:

- Improved cognitive function (iron)
- Better work performance (iron)
- Better sight adaptation to darkness (provitamin A)
- Reduced morbidity (zinc)
HarvestPlus Delivery Goals

Globally By 2030
• One billion people will be benefitting from biofortified nutritious foods.

Short-Term Goal By 2020
• 100 million people in farm households will be growing and consuming biofortified nutritious food crops

By the End of 2016
• 20 million people in farm households
Severity of Micronutrient Deficiencies: Vitamin A, Iron, and Zinc

Source: World Health Organization (WHO) children under 5 prevalence data
<table>
<thead>
<tr>
<th>Crop</th>
<th>Africa</th>
<th>South Asia</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice</td>
<td>125,124</td>
<td>1,130,648</td>
<td>2,006,869</td>
</tr>
<tr>
<td>Wheat</td>
<td>107,419</td>
<td>987,887</td>
<td>1,547,872</td>
</tr>
<tr>
<td>Maize</td>
<td>256,286</td>
<td>67,481</td>
<td>581,532</td>
</tr>
<tr>
<td>Cassava</td>
<td>174,719</td>
<td>16,263</td>
<td>259,271</td>
</tr>
<tr>
<td>Groundnut</td>
<td>49,335</td>
<td>6,595</td>
<td>227,864</td>
</tr>
<tr>
<td>Millet</td>
<td>82,889</td>
<td>81,977</td>
<td>167,885</td>
</tr>
<tr>
<td>Sorghum</td>
<td>104,694</td>
<td>59,129</td>
<td>164,842</td>
</tr>
<tr>
<td>Potato</td>
<td>13,464</td>
<td>46,465</td>
<td>122,764</td>
</tr>
<tr>
<td>Beans, dry</td>
<td>39,258</td>
<td>26,384</td>
<td>116,246</td>
</tr>
<tr>
<td>Barley</td>
<td>14,771</td>
<td>7,037</td>
<td>100,192</td>
</tr>
<tr>
<td>Plantain</td>
<td>36,424</td>
<td>19</td>
<td>92,109</td>
</tr>
<tr>
<td>Banana</td>
<td>6,751</td>
<td>11,345</td>
<td>57,811</td>
</tr>
<tr>
<td>Yam</td>
<td>42,787</td>
<td>0</td>
<td>42,966</td>
</tr>
<tr>
<td>Sweetpotato</td>
<td>23,789</td>
<td>3,008</td>
<td>36,478</td>
</tr>
<tr>
<td>Lentils</td>
<td>603</td>
<td>11,589</td>
<td>12,999</td>
</tr>
</tbody>
</table>

Note: Total = All Developing Countries; Source = FAO, 2002-2004
How to Get the Job Done by 2030

**Big Push!**
$160m

Ensure that an on-going supply of germplasm is available of the right quality, nutritional value and most desired traits

Role: CORE
No change
Renew focus on Mainstreaming Rice, Maize, Wheat

**Hub & Spoke Scale Up**
$410m

Ensure biofortification is embedded into national and international policy, and implemented across the supply chain through Technical Assistance in 30 Countries

Role: CORE
No change
Scale Up from 8 to 30 countries
Create Knowledge hubs
Research & Technical assistance
Education & Extension Services

**Big Pull!**
$20m

Generate global demand for biofortified foods & ingredients by partnering with public & private sectors to develop sustainable procurement policies

Role: DIFFERS MARKET BY MARKET:
Public Private Partnerships
Sustainable Inclusive Biz models
Capability Building
HarvestPlus in Bangladesh

GO - 5
NGO - 25
PS - 2 associations
(300 seed companies)
**Additional Crop in Cropping Pattern**

**Before**

- **Aman**
  - Sharna
  - (155 days)

- **Fallow**
  - (70 Days)

- **Boro**
  - BRRI dhan28
  - (140 days)

**Now**

- **Aman**
  - BRRI dhan62
  - (100 days)

- **Fallow**
  - Mustard/ lentil/ vegetables
  - (125-130 days)

- **Boro**
  - BRRI dhan64/ BRRI dhan28
  - (135- 140 days)