Using Agriculture to Improve Nutrition: Evidence and Progress for Biofortification Under HarvestPlus

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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

The graph shows the percent changes in cereal and pulse production and in population between 1965 and 1999 for various regions, including India, Pakistan, Bangladesh, and the Developing World. The data is presented for cereal and pulse production as well as population changes, allowing for a comparison of growth trends in these areas.
Figure 2. Price Indices By Food Group for India, 1970-2016, Deflated by Non-Food Price Index

- **Pulses**
- **Vegetables**
- **Fruits**
- **Eggs, Meat & Fish**

Source: Personal Communication, JV Meenakshi, Delhi School of Economics
A Primary Role of Agriculture Is To Provide Nutrients for Healthy Populations

Present

Supply of Nutrients From Agriculture

Future

Supplementation And Fortification

Unreached Populations

Nutrient Gap

Unreached Populations
Zinc Deficiency and Stunting

- Zinc deficiency harms physical growth and brain development, lowers immunity, and increases risk of diarrheal disease and respiratory infections
- 33.4% of Filipino children under age 5 are stunted; The Philippine Plan of Action on Nutrition 2017-2022 aims to reduce this to 21.4% by 2022
- Stunting can be prevented by improving nutrition of pregnant women and young children, as well as improving sanitation
## Per Capita Energy Intakes Per Day for Bangladesh and Philippines By Income Group

<table>
<thead>
<tr>
<th></th>
<th>Lower Income</th>
<th>Middle Income</th>
<th>Higher Income</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Food Staples</strong></td>
<td>1816</td>
<td>1848</td>
<td>1876</td>
</tr>
<tr>
<td><strong>Non-Staple Plant Food</strong></td>
<td>339</td>
<td>427</td>
<td>474</td>
</tr>
<tr>
<td><strong>Fish and Animal Foods</strong></td>
<td>47</td>
<td>59</td>
<td>92</td>
</tr>
<tr>
<td><strong>All Food Groups</strong></td>
<td>2201</td>
<td>2334</td>
<td>2442</td>
</tr>
</tbody>
</table>

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<thead>
<tr>
<th></th>
<th>Poorest</th>
<th>Middle</th>
<th>Richest</th>
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</thead>
<tbody>
<tr>
<td><strong>Food Staples</strong></td>
<td>1271</td>
<td>1254</td>
<td>1146</td>
</tr>
<tr>
<td><strong>Non-Staple Plant Food</strong></td>
<td>249</td>
<td>287</td>
<td>351</td>
</tr>
<tr>
<td><strong>Fish and Animal Foods</strong></td>
<td>137</td>
<td>261</td>
<td>465</td>
</tr>
<tr>
<td><strong>All Food Groups</strong></td>
<td>1657</td>
<td>1802</td>
<td>1962</td>
</tr>
</tbody>
</table>

### Bangladesh

### Philippines

8th NNS (FNRI-DOST, 2013)
### Per Capita Zinc Intakes (mg/day), Rural Bangladesh 2005, By Income Group

<table>
<thead>
<tr>
<th>Food Group</th>
<th>Lower Income</th>
<th>Middle Income</th>
<th>Higher Income</th>
</tr>
</thead>
<tbody>
<tr>
<td>Food Staples</td>
<td>5.9</td>
<td>6.4</td>
<td>6.9</td>
</tr>
<tr>
<td>Non-Staple Plant Food</td>
<td>1.8</td>
<td>2.1</td>
<td>2.4</td>
</tr>
<tr>
<td>Fish and Animal Foods</td>
<td>0.6</td>
<td>0.8</td>
<td>1.5</td>
</tr>
<tr>
<td>All Food Groups</td>
<td>8.3</td>
<td>9.3</td>
<td>10.8</td>
</tr>
</tbody>
</table>

Estimated Average Requirement $\approx 13 \text{ mg Zn/day}$

$15 \text{ mg/kg Zn} \times 400 \text{ g rice intake/day} = 6 \text{ mg Zn/day}$
Cost-effective: central one time investment
Biofortified crops released in **30 countries**
In-testing in another **25 countries**
>150 Varieties Released Across 12 crops

NUTRITIOUS STAPLE FOOD CROPS: WHO IS GROWING WHAT?

Nutritious crops released in 30 countries; in testing in another 25
• Efficacy trials with provitamin A, iron, and zinc biofortified crops have also shown improved functional outcomes:
  – Improved cognitive function (iron)
  – Better work performance (iron)
  – Reduced morbidity (zinc and provitamin A)
  – Better sight adaptation to darkness (provitamin A)
### Effect of High Zinc Wheat on Morbidity Indicators Among Children in India

<table>
<thead>
<tr>
<th></th>
<th>HZn</th>
<th>LZn</th>
<th>RR</th>
<th>95 % CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Days with Diarrhea</td>
<td>126</td>
<td>119</td>
<td>1.05</td>
<td>0.82-1.35</td>
</tr>
<tr>
<td>Days with pneumonia</td>
<td>203</td>
<td>244</td>
<td>0.82</td>
<td>0.68-0.99 *</td>
</tr>
<tr>
<td>Days with fever</td>
<td>934</td>
<td>960</td>
<td>0.96</td>
<td>0.88-1.06</td>
</tr>
<tr>
<td>Days with Vomiting</td>
<td>60</td>
<td>99</td>
<td>0.60</td>
<td>0.44-0.83 *</td>
</tr>
<tr>
<td>Days with Ear Discharge</td>
<td>72</td>
<td>87</td>
<td>0.82</td>
<td>0.60-1.12</td>
</tr>
</tbody>
</table>
First Use of Zinc Rice: Bangladesh

First zinc rice varieties released in Bangladesh in 2013

- **2013**: 1,000 farming households cultivating 200 hectares of land

- **2018**: 630,000 farming households directly reached; 1.5 million households total due to farmer-to-farmer diffusion
NSIC 2016 Rc460 ‘Zinc Rice’

• Developed and tested at the International Rice Research Institute (IRRI), with funding from HarvestPlus

• Approved in 2016, by the National Seed Industry Council of the Bureau of Plant Industry of the Department of Agriculture

• Conventional crop breeding techniques used

Source: Seed Catalogue Crop Varieties C.Y. 2016, National Seed Industry Council
Agronomic Traits: Rc 460

- Yield of Rc 460 is at 4.7 ton per hectare. Average yield of the 400 series is at 5.4 ton per hectare. Early maturing variety at 115 days.

- Resistant reaction to whiteheads in PhilRice Agusan and PhilRice Isabela, intermediate reaction to deadheart, brown planthopper and green leafhopper.

- Premium milling (72.1%) and head rice (58.1%) recovery and fair (78.7%) brown rice.

- Long (7.2 mm) and slender (3.3 mm) grain shape.

- High percentage acceptability both in cooked and raw forms as compared to IR64, the eating quality check.
Nutritional Content

• Increased zinc:

  Close to 50% increment

  +5 parts per million or more with the check variety across locations and seasons
What is the Way Forward? Mainstreaming
Zinc Rice in the Philippines

1. NSIC Rc 460 has been developed by IRRI and approved by the Government of the Philippines in 2016

2. Eight additional lines of Zinc rice are currently being developed and tested by IRRI (6) and PhilRice (2) using conventional crop breeding techniques.

- The objective of the development of these eight lines is to have rice varieties that are high-Zinc and high yield, ensuring mainstreaming into the rice system up to small farmers and low-income consumers.
How Do We Reach Farmers?

Partnerships:

- Government agencies on agriculture and social protection
- Local government units
- Farmer groups
- Seed companies
- Civil society organizations
- Development partners
Possible roads for Zinc rice

**Short term**
- Use of NSIC Rc 460 in public social protection programs

**Medium to long term**
- Mainstreaming of new lines of high Zinc and high yield varieties into the rice system
Integrating into National Policies

- National Development Plan
- National Agricultural Investment Plan
- National Extension Services Policy
- Social Protection Schemes
  - Philippine Plan of Action on Nutrition (including anemia and stunting policies) of the National Nutrition Council
  - RA 11148 – “Health and Nutrition of Mother and Child Act” (Signed 29 Nov 2018)
  - Philippine Health Agenda of the Department of Health
  - Pantawid Pamilyang Pilipino Program, the conditional cash transfer program of the Philippine government under the Department of Social Welfare and Development.
  - School Feeding Policy of Department of Education
  - Early Childhood Development Policy of the Early Childhood Care and Development Council
Inclusion in National Budgets/Programs

- School meals and demo gardens
- Farmer input support programs
- Community health, incl. ante-and post-natal counseling; infant/young child feeding; etc.
- Fortification, subsidy and procurement programs
- Agricultural extension programs
- School and university curricula
Maraming Salamat!

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