In Honor of Per Pinstrup-Andersen:

The Micronutrient Deficiencies Challenge in African Food Systems

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Two of Per’s (many) major contributions ...

1. A holistic focus on food systems and systems-based approaches to policy analysis and design

2. Calling high-level policy and research attention to the ‘triple burden’ of malnutrition, including often-overlooked micronutrient deficiencies
Persistent, severe micronutrient deficiency

- 25% of the global population suffers from anemia
- 1/3 of school age children suffer from iodine deficiency
- 21% of children under 5 suffer from vit A deficiency
- 1/3 of the global population suffers from zinc deficiency

MN deficiencies deeply problematic b/c of irreversible cognitive/physical effects ... nutritional poverty trap
A foods systems approach

• Why do MN deficiencies decline so slowly with increasing income?
• Answer requires a food systems approach: interlinkages between producers, consumers and market intermediaries
  • Consumers: information problems, nutritional transition, urbanization, prices
  • Food market chains: perishability, food processing, fortification
  • Production: cropping choices, agricultural practices, MN deficiencies in soil, biofortification
Consumer demand patterns

• Information: mild MN deficiencies rarely manifest in obvious sensory ways
  • Does education / increased information about micronutrients decrease MN deficiency?

• Rising GNI is associated with a “nutritional transition”
  • ↓ consumption of traditional staples, ↑ consumption of refined grains
  • ↑ consumption of animal-sourced food – ↑ intake & bioavailability of zinc and iron

• Urbanization
  • Increased opportunity cost of women’s time leads to > intake of fast food, street food
  • Much of this food relies on refined wheat or rice, fats, oils, salt, sugars
The Food Value Chain (FVC)

• Perishability: foods loose vitamins over time, especially at ambient temperatures. Vitamin C & B vitamins are especially unstable.

• Increased processing of grain often removes bran and germ - including much of the Fe, Zn, Ca, vitamins, phytate, and protein

<table>
<thead>
<tr>
<th>Crop</th>
<th>Milling fraction</th>
<th>Iron (µg/g)</th>
<th>Zinc (µg/g)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maize</td>
<td>Whole grain</td>
<td>23</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>Degermed grain</td>
<td>11</td>
<td>4</td>
</tr>
<tr>
<td>Rice</td>
<td>Brown rice</td>
<td>16</td>
<td>28</td>
</tr>
<tr>
<td></td>
<td>Polished rice (90% extraction)</td>
<td>5</td>
<td>17</td>
</tr>
<tr>
<td>Sorghum</td>
<td>Whole grain</td>
<td>179</td>
<td>54</td>
</tr>
<tr>
<td></td>
<td>Refined flour (64% extraction)</td>
<td>36</td>
<td>10</td>
</tr>
<tr>
<td>Wheat</td>
<td>Whole wheat flour</td>
<td>36</td>
<td>26</td>
</tr>
<tr>
<td></td>
<td>White flour (70% extraction)</td>
<td>12</td>
<td>7</td>
</tr>
</tbody>
</table>

Miller & Welch 2012 Food Policy, Welch & Graham 1999 Field Crops Research

• Food fortification (e.g. milk, sugar, oils, salt) can increase levels of MNs, but success depends on large processing plants, government oversight, and consumer WTP.
Producer decisions

• Micronutrient-deficient soils lead to MN-deficient crops and humans
  • Selenium deficient soils in Malawi cause low selenium intake; can be remedied with selenium-enriched fertilizers (Chilimba 2012 Field Crops Research)

• Green Revolution technologies increases cereal mono-cropping while decreasing production of iron- and zinc-rich legumes
  • South Asia experienced 200% (400%) increase in rice (wheat) production, a decline in diet iron density and a marked increase in anemic women in the 30 years following the Green Revolution (United Nations ACC SCN 1992)

• Increased fertilizer use affects micronutrient levels in plants
Producer decisions

• Biofortification targets poor, agrarian populations. Success depends on adoption, marketability, & longevity of MN density.
Looking forward

The stubborn persistent of micronutrient deficiencies clearly arises at multiple levels of food systems.

Forward-looking policy research and action must:

• Identify where MN deficiencies are severe and widespread
• Determine the root sources of those deficiencies for distinct groups
• Evaluate the cost-effectiveness of options comparatively, across the food system
• Develop useful rules of thumb for targeting interventions to those groups
Thank you, Per (and all)