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Agriculture and Nutrition Global Learning and Evidence Exchange

(AgN-GLEE)

held in Bangkok, Thailand from March 19-21, 2013.

For additional presentations and related event materials, visit: http://spring-nutrition.org/agnglee-asia
Agriculture and Nutrition Working Together to Improve Nutritional Outcomes: The Global Landscape

Patrick Webb

Feed the Future Collaborative Research: Nutrition Innovation Laboratory

Asia Glee
Bangkok, Thailand, March 2013
“Improved health and nutrition are...a critical dimension of, and pathway to, resilience.”

USAID RFP March 2013
“Globally, more than one third of child deaths are attributable to undernutrition”
Source: CHERG 2012

"Maternal undernutrition, leading to fetal growth restriction, accounts for almost a third of stunting in children”
Source: Lancet Nutrition Series (forthcoming June 2013) Paper 2, draft

One third of current stunting could be averted using evidence-based interventions.
Source: Lancet Nutrition Series (forthcoming June 2013) Paper 2, draft
Stunting, Developing Countries

Source: Stevens et al. (2012) Trends (Lancet)
Source: Herforth et al. (2013)
Improving Nutrition through Multisectoral Approaches
<table>
<thead>
<tr>
<th>Country</th>
<th>Percentage Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vietnam</td>
<td>-59%</td>
</tr>
<tr>
<td>Malaysia</td>
<td>-57%</td>
</tr>
<tr>
<td>Maldives</td>
<td>-51%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>-49%</td>
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<tr>
<td>Bhutan</td>
<td>-49%</td>
</tr>
<tr>
<td>India</td>
<td>-42%</td>
</tr>
<tr>
<td>Indonesia</td>
<td>-40%</td>
</tr>
<tr>
<td>Cambodia</td>
<td>-38%</td>
</tr>
<tr>
<td>Nepal</td>
<td>-38%</td>
</tr>
<tr>
<td>The Philippines</td>
<td>-32%</td>
</tr>
<tr>
<td>Timor Leste</td>
<td>-8%</td>
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<tr>
<td>Papua NG</td>
<td>+8%</td>
</tr>
<tr>
<td>Micronesia</td>
<td>+16%</td>
</tr>
<tr>
<td>Marshall Islands</td>
<td>+31%</td>
</tr>
</tbody>
</table>

Source: Stevens et al. (2012) Trends *Lancet*
Agriculture and Nutrition Working Together?

“How?"

“Poor-quality evaluations prevent firm conclusions on the impact of agriculture programs on nutrition.”

Lancet coordinators meeting (Paper 3) March 2013
“The link between income and health is not reliably mechanical.”

“The relationship between population heights and income is inconsistent and unreliable.”

Angus Deaton (2007)
Height, health and development. *PNAS*
New crop technology

Higher productivity

Male take-over of crop with higher productivity

Higher household income, sales, consumption

Women and children eat more and better

Dispossession (women lose crop, income, status?)

Actually, women gain higher income from non-food crops

Child nutrition improves...
Child nutrition improved, but could have been higher

10% rise in income = 4.8% rise in calories

10% rise in calories = 2.4% rise in nutrition

Net return/day of labor $\times 3$

Net rise in real income 13%/hh

Net gain of 47% calories

Higher productivity

Higher household income, sales, consumption

Transfer of labor and inputs

New crop technology

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New crop technology
(i.e. **doubling** per capita income through agriculture associated with 15-21% point decline in stunting.)
“Agricultural development programmes... are by themselves often not enough to accelerate reductions in hunger and malnutrition.

Similarly, direct reductions in ... poverty and improved purchasing power do not generally result in proportional reductions in malnutrition.”

Thompson and Meerman (2010)
“Children from villages with unclean drinking water—that is, where a high bacteria count was found in the water sample—were significantly more stunted.”

**Table 55—Determinants of nutritional status**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Weight-for-Age Z-Scores of Children Aged 7-120 Months&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Height-for-Age Z-Scores of Children Aged 7-120 Months</th>
<th>Weight-for-Height Z-Scores of Children Aged 7-120 Months</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Parameter</td>
<td>t-Value</td>
<td>Parameter</td>
</tr>
<tr>
<td>CAL</td>
<td>0.0091559</td>
<td>2.713</td>
<td>9.314474E-03</td>
</tr>
<tr>
<td>DIAR</td>
<td>-2.50525</td>
<td>-2.690</td>
<td>-4.05504</td>
</tr>
<tr>
<td>WATER</td>
<td>-0.01006</td>
<td>-2.248</td>
<td>-0.02183</td>
</tr>
<tr>
<td>SIZE</td>
<td>-0.71560</td>
<td>-1.826</td>
<td>0.62056</td>
</tr>
</tbody>
</table>

“Chronic malnutrition rates have not declined significantly over the years despite increased income from high value crops.

New approach to resolution of problem is required.”
Agriculture mechanisms for enhancing nutrition

1. Rapid **productivity** growth (staple food supply, income, value-chain development)

2. Enhanced **consumption** of nutrient-rich/animal source foods; agricultural vehicles for nutrients

3. Entry point for women’s **empowerment** (control over resources, management responsibilities, own health)

4. Reduced exposure to **toxins/diseases** (enhanced storage, food safety, vector control, environmental enteropathy)

5. **Platforms** for nutrition/health services or resource delivery
### Sample of 700 farm households from Indonesia (Sumatra)

<table>
<thead>
<tr>
<th></th>
<th>Calorie intake</th>
<th>Iron intake</th>
<th>Zinc Intake</th>
<th>Vitamin A intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of all crop/animal species produced</td>
<td>0.15**</td>
<td>0.12**</td>
<td>0.13**</td>
<td>0.12**</td>
</tr>
<tr>
<td>Number of food crop/animal species produced</td>
<td>0.05</td>
<td>0.02</td>
<td>0.03</td>
<td>0.04</td>
</tr>
</tbody>
</table>

### Sample of 400 farm households from Kenya

<table>
<thead>
<tr>
<th></th>
<th>Calorie intake</th>
<th>Iron intake</th>
<th>Zinc Intake</th>
<th>Vitamin A intake</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of all crop/animal species produced</td>
<td>-0.06</td>
<td>-0.10**</td>
<td>-0.08</td>
<td>-0.14**</td>
</tr>
<tr>
<td>Number of food crop/animal species produced</td>
<td>-0.05</td>
<td>-0.10*</td>
<td>-0.07</td>
<td>-0.14**</td>
</tr>
</tbody>
</table>

Source: Matin Qaim (March 2013) *Presentation at Hidden Hunger Congress, Stuttgart*
“Cowpea enriched porridge provides another opportunity for value addition that can significantly improve infant and child nutrition.”

But can it?
Micronutrient deficiency
Low bioavailability
Binding/adverse interactions
Toxins/Parasites/diseases
Nutrient deficiencies
Nutrient imbalances
Nutrient malabsorption
Vitamin C?
Maternal diet?
Food Processing?
Pigeon pea?
Deworming? Bednets?
Iron deficiency anemia
Poor diet quality
Few nutrient dense foods consumed
Antinutrients in diet
Unsafe foods consumed
Unsafe foods consumed
Low bioavailability
Binding/adverse interactions
Parasites/diseases
Vitamin C?
3 iron absorption studies, 61 Rwandese women with low iron status.

“Iron absorption from the high [polyphenol] bean 27% lower (P<0.01) than from low [polyphenol] bean.”

“Iron absorption from high [biofortified] iron bean 40% lower (P<0.001) than normal iron bean (equal amounts iron absorbed).

When beans combined in multiple meals, iron absorbed from biofortified beans no higher than normal beans, “indicating that efficacious iron biofortification may be difficult to achieve in beans rich in [phytates and polyphenols]”.

Entry barriers; opportunity costs of time; understanding

Gendered control of income by setting, seasonality

Processed foods in diet, alcohol, tobacco, sugar and energy drinks

Participation in the programme → Technology adoption

household income → food expenditure

Diet composition → Caloric, protein and micronutrient intake

Nutritional status

Anti-nutrients in diet, toxins, food safety, food processing/storage

Mediating factors (diarrhea, gut biome, fever, caring practice, sanitation)

Source: Massett et al. (2011)
50% of cereal-cultivated soils have Zn deficiency = impaired crop yields and grain nutritional quality.

Source: Alloway 2008

Zinc deficient soils

Zinc deficient diets

Source: Wessells et al. (2012)
Innovations within agriculture?

- Foliar spraying of zinc (Turkey)
- Iodized salt licks for livestock (Austria)
- Selenium in fertilizer (Finland)
- Iodine in irrigation water (China)
- Promoting high-iron water consumption (Bangladesh)

- Platforms for service delivery
“Poor-quality evaluations prevent firm conclusions on the impact of agriculture programmes on nutrition.”

Lancet Paper 3 (planned for June 2013)
But can relatively more be done for nutrition by enhancing food ‘utilization’ than by pushing supply and access?

- Aflatoxins and mycotoxins
- Phytates, polyphenols and other anti-nutrients
- Gut enteropathy
- Open defecation
“Aflatoxin alone modulates >40% of burden of disease in developing countries.”

“Chronic aflatoxin exposure associated with suppressed immunity,...opportunistic infections (TB RR >3), adverse pregnancy and childhood growth faltering [i.e. stunting].”

Source: Williams, T (2012) LCIRAH seminar on Mycotoxins as factors in Africa's Health, Trade and Development
Review of >150 studies

“Among the risk factors associated with growth impairment, aflatoxin emerges as playing a potentially important contributory role.

Source: Khlangwiset et al. (2011) Aflatoxins and growth impairment (Crit Revs Toxicol.)
Lunn et al (1991) found that 43% of stunting in The Gambia ascribed to environmental enteropathy.
Faeces

Fingers
Flies
Fields
Fluids

Foods

Faeces

Source: Adapted from Howard and Bartram (2003)
International variation in height explained by sanitation

Source: Spears (2013)
Iron in Groundwater in Bangladesh

Map: British Geologic Survey 2001

1Dr. Marie Vahter, Personal communication, May 2007
Groundwater Iron Intake Associated with Women’s Iron Status, Gaibandha, Bangladesh

**Interpretation:**

For every 10 mg/day increase in iron intake through water, ferritin concentration is expected to be 6% higher (95% CI 4% to 8%)

Merrill RD et al J Nutr 2011
The gut microbiome is key to malnutrition. So is diet, not just individual foods.

- Loss of nutrients to gut disorders little known.
- Nutrients interaction with medicines *in vivo* (incl. antimalarials, ARVs) little known.
- Environmental enteropathy requires nutrition researchers to work more closely with agriculture, health, WASH
Enhancing nutrition through agriculture...

...not just food supply, income growth, home gardens, biofortification or promotion of one ‘nutritious’ food.
Conclusions

1. Consider all potential pathways (not just income/gardens)
2. Innovations may exist for nutrition beyond value chains
3. Platforms for delivery may offer huge synergies

4. Focus on 1,000 days remains crucial, but not exclusive
5. Impacts on nutrition *may* be higher from ‘utilization’ side than supply side in the short run.

6. Health and agric./rural dev. must work together
7. Spatial (geographic) integration needed
8. Programmatic integration needed
Pathways to enhanced nutrition mediated by agriculture

1. Rapid **productivity** growth (staple food supply, income, value-chain development).

2. Enhanced **consumption** of nutrient-rich/animal source foods; possible buffer against volatility and shocks.

3. Entry point for women’s **empowerment** (control over resources, management responsibilities, own health).

4. Reduced exposure to **toxins/diseases** (enhanced storage, food safety, vector control, environmental enteropathy).

5. **Platform** for nutrition/health services or resource delivery.
Source: Lancet (2012) special series on global burden of disease
Togo and Benin, 480 children 9m-59m old

- Detected aflatoxinalbumin adducts in 99% samples.
- Mean concentration of 33 pg/mg albumin.
- Aflatoxinalbumin concentration increased up to 3 years.
- Stunted children 30-40% higher mean aflatoxinalbumin concentrations.

Whether association between aflatoxin exposure and impaired growth is direct result of aflatoxin toxicity or consumption of fungus affected food of poor nutritional quality cannot be confirmed from the cross sectional design.

Source: Gong et al. (2012) Dietary aflatoxin exposure (BMJ.)
<table>
<thead>
<tr>
<th>Rank</th>
<th>Condition</th>
<th>DA-YL Rank</th>
<th>Notes</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Lower</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Diarrhoea</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Preterm birth complications</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Ischaemic heart disease</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Stroke</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>COPD</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Malaria</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Tuberculosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Protein-energy malnutrition</td>
<td>1990</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Neonatal encephalopathy*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Low back pain</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Road injury</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Congenital anomalies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Iron-deficiency anaemia</td>
<td></td>
<td></td>
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<tr>
<td>15</td>
<td>Major depressive disorder</td>
<td></td>
<td></td>
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<tr>
<td>16</td>
<td>Measles</td>
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<tr>
<td>17</td>
<td>Neonatal sepsis</td>
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<tr>
<td>18</td>
<td>Meningitis</td>
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<tr>
<td>19</td>
<td>Self-harm</td>
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<tr>
<td>20</td>
<td>Drowning</td>
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<tr>
<td>21</td>
<td>Diabetes</td>
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<td>22</td>
<td>Falls</td>
<td>2010</td>
<td></td>
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<tr>
<td>23</td>
<td>Protein-energy malnutrition</td>
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<tr>
<td>24</td>
<td>Lung cancer</td>
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<tr>
<td>25</td>
<td>Neck pain</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusions (ii)

1. Real Dangers:
   - Leaving the job only *half* done.
   - Underfunding actions needed to *keep it* done.

2. Current knowledge of what works is weak
   - Opportunity for USAID to lead as knowledge generator
   - Much more attention needed to mechanisms/pathways

3. Keep eyes on the (moving) ball
   - FTF explicitly focuses on people in need/vulnerable
   - Global emphasis should not always determine local emphasis (past successes ‘reduce’ relative contribution to global burdens, but not always locally applicable).
Crop/animal productivity → Higher per capita food consumption

Women's Diet Diversity Index improved → Higher maternal BMI/less Low Birth Weight

Home gardens/Small ruminants → Staple foods

Staple foods → Commercialization/value chain

Nutrient density/disease environment → Protein quality

Prevalence of anemia among women of reproductive age → Reduced neonatal complications/ reduced wasting/ reduced

Aflatoxin exposure
Groundwater Iron Intake Associated with Women’s Iron Status, Gaibandha, Bangladesh

Interpretation:
For every 10 mg/day increase in iron intake through water, ferritin concentration is expected to be 6% higher (95% CI 4% to 8%)
1 million child deaths per year linked to severe wasting

10-15% of children do not respond to treatment

Children at risk of bacterial infection. “Inclusion of antibiotics as part nutritional therapy is warranted.”

Treatment saw 24.5% reduction in treatment failure rate with amoxicillin; 38.9% reduction with cefdinir.

Source: Trehan et al. (2013) Antibiotics as part of the management of severe acute malnutrition (NEJM)
World Bank

1. Explicitly incorporate nutrition into design of projects
2. Integrate nutritional considerations as *elements of investments*
3. Minimize unintended consequences
4. Support nutritional technical capacity within countries
5. Measure (M&E) nutrition impacts with appropriate indicators

Source: Herforth et al. (2013)
Improving Nutrition through Multisectoral Approaches
Successes

- GDP growth rate sustained at 5-6% over decade
- Rice production tripled over last 30 years
- Fertility rates reduced from over 6 to under 3 children/woman over past 30 years
- Poverty rate declined by 10% over past decade
- Title II Food Aid programs reduced stunting in targeted areas by 33% (2005-2010)

Source: USAID Country X
Feed the Future Implementation Strategy (FY 2010)
Nutrient-pharmacology interactions

Chloroquine, amodiaquine, quinine and mefloquine all interfere with haemoglobin digestion in the food vacuole.

The folate pathway. Sulfadoxine-pyrimethamine and the newer combination chlorproguanil-dapsone are competitive inhibitors of key enzymes in the folate pathway.

Khoo et al. (2005) in AIDS
# Nutrient-pharmacology interactions

<table>
<thead>
<tr>
<th>Medication</th>
<th>Category</th>
<th>Interaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tetracycline</td>
<td>Antibiotic</td>
<td>Calcium may interact with the effectiveness of the antibiotic. Avoid dairy products for two to three hours before and after taking the medicine.</td>
</tr>
<tr>
<td>Lipitor/Zocor</td>
<td>Statins (cholesterol-lowering drugs)</td>
<td>Antioxidants (Vitamin A, C, E, B, folic acid) may interact with the drug by reversing its effect.</td>
</tr>
<tr>
<td>Dilantin</td>
<td>Anticonvulsant (anti-seizure)</td>
<td>Vitamin D and folic acid levels in the body are decreased by the taking of these types of drugs.</td>
</tr>
<tr>
<td>Norvasc</td>
<td>Antihypertensive (for high blood pressure)</td>
<td>Consuming foods high in sodium (i.e., licorice, processed meats, canned foods) will decrease the effectiveness of the drug.</td>
</tr>
</tbody>
</table>

[http://www.faqs.org/nutrition/Met-Obe/Nutrient-Drug-Interactions.html#ixzz2MbHqrL5D](http://www.faqs.org/nutrition/Met-Obe/Nutrient-Drug-Interactions.html#ixzz2MbHqrL5D)
“We echo the findings of Berg (1981) and Reutlinger and Selowsky (1976), who note that malnutrition would persist in the face of rapid income growth in the absence of additional measures to address malnutrition directly.”

Gambia, 138 children at birth, 1 year follow-up

“Strong effect of maternal aflatoxin exposure during pregnancy on growth in the first year of life.”

Reduction of maternal AF-alb from 110 pg/mg to 10 pg/mg would lead to 0.8 kg increase in weight and 2cm increase in height within the first year of life.

Source: Turner et al. (2005) Aflatoxin exposure in utero (Intl;. Jou. Epi.)
Benin, 8-month longitudinal study, 200 children

“Strong negative correlation ($p < 0.0001$) between AF-alb and height increase over 8-months.

Highest quartile of AF-alb was associated with 1.7 cm reduction in growth over 8 months compared with lowest quartile.”

Source: Gong et al. (2004) Post-weaning exposure to aflatoxin (Env Health Pers.)
472 Gambian children 6–9 years old

“AF-alb adducts were detected in 93% of the children.”

sIgA [immune parameter] was markedly lower in children with detectable AF-alb compared with those with non-detectable levels [$p < 0.0001$].”

Source: Turner et al. (2003) Modification of Immune Function through Exposure to Dietary Aflatoxin (Envir. Health Pers.)
(b) Deflated by GDP/capita

Source: Dorward (2013) Food Policy
“Our review of agricultural programs concludes that evidence of the impact of these programs on child status is scant.”

Leroy et al. (2008) *Impact of multisectoral programs focusing on nutrition.*

We need to “improve understanding of the "disconnect“ between economic and agricultural growth and nutrition outcomes.”

<table>
<thead>
<tr>
<th>Pathway</th>
<th>Strength of pathway</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Increasing overall macroeconomic growth</td>
<td>modest effect</td>
</tr>
<tr>
<td>2) Increasing access to food by higher production and decreased food prices</td>
<td>modest effect</td>
</tr>
<tr>
<td>3) Increasing household income through the sale of agricultural products</td>
<td>variable effects</td>
</tr>
<tr>
<td>4) Increasing nutrient dense food production for household consumption</td>
<td>some evidence</td>
</tr>
<tr>
<td>5) Empowering women through targeted agricultural interventions</td>
<td>strong evidence</td>
</tr>
</tbody>
</table>

Source: Herforth et al. (2013)
Improving Nutrition through Multisectoral Approaches
2007-2009 food price crisis = 105 million new people ‘into poverty’
2010/11 crisis = 44 million people ‘kept in poverty’

Estimated poverty impacts of the 2010/11 food price crisis

<table>
<thead>
<tr>
<th>Poverty change</th>
<th>Millions of people</th>
</tr>
</thead>
<tbody>
<tr>
<td>Short-run impact</td>
<td>48.6%</td>
</tr>
<tr>
<td>Medium-run impact</td>
<td>45.5%</td>
</tr>
<tr>
<td>Long-run impact</td>
<td>34.1%</td>
</tr>
</tbody>
</table>

Indonesia price crisis (1997-2000)

Source: Block, Kiess, Webb et. al. 2004
Welfare impact of 10% rice in price of food staples

Welfare change (%)

Expenditure quintiles: Poorest 20% 2 3 4 Richest 20%

Welfare defined as income needed to restore consumption level to pre-shock level

Source: FAO/WFP (2008) State of Food Insecurity
(a) Nominal & deflated by US CPI

Grains price index, deflated by US CPI, 2005 =100
Nominal grains price index, 2005 = 100

Source: Dorward (2013) Food Policy
Share of food categories in per capita spending

- Prepared foods
- Fruits and Vegetables
- Meat, eggs, fish and dairy
- Beverages and other foods
- Cereals and tubers

Source: Mazzocchi et al. (2012) FAO report (from WDR 2008/9)
Asian Countries Currently Fortifying Foods

Pakistan
Micronutrient(s): Vitamin A, Iron
Vehicle(s): Hydrogenated Fat, Flour

Mongolia
Micronutrient(s): Thiamin, Riboflavin, Folic Acid, Niacin, Zinc, Iron
Vehicle(s): Flour

China
Micronutrient(s): Vitamin A, Thiamin, Vitamin B, Riboflavin, Folic Acid, Niacin, Iron, Calcium, Nicotinamide
Vehicle(s): Wheat Flour, Soy Sauce, Peanut Oil

Vietnam
Micronutrient(s): Thiamin, Riboflavin, Folic Acid, Niacin, Zinc, Iron
Vehicle(s): Wheat Flour

India
Micronutrient(s): Vitamin A
Vehicle(s): Hydrogenated Fat

Bangladesh
Micronutrient(s): Vitamin A, Thiamin, Riboflavin, Folic Acid, Niacin, Iron, Zinc
Vehicle(s): Vegetable Oil, Yogurt

Indonesia
Micronutrient(s): Thiamin, Riboflavin, Folic Acid, Zinc, Iron
Vehicle(s): Flour

Philippines
Micronutrient(s): Vitamin A
Vehicle(s): Wheat Flour

*Countries included have mandatory, voluntary, proposed, or pilot project fortification programs.

Sources: Global Alliance for Improved Nutrition (2007); UNICEF Progress of Nations, 1996; WHO/FAO, Guidelines for Food Fortification, 2007; Flour Fortification Initiative

Map by Jesse C. McIntee
<table>
<thead>
<tr>
<th></th>
<th>Deaths</th>
<th>Percentage of deaths in children under 5 years</th>
<th>Disease burden (1,000 DALYs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wasting</td>
<td>1,509,236</td>
<td>14.6%</td>
<td>64,566</td>
</tr>
<tr>
<td>Stunting</td>
<td>1,491,188</td>
<td>14.5%</td>
<td>54,912</td>
</tr>
<tr>
<td>Low birth weight</td>
<td>337,047</td>
<td>3.3%</td>
<td>15,536</td>
</tr>
<tr>
<td>Vitamin A deficiency</td>
<td>667,771</td>
<td>6.5%</td>
<td>22,668</td>
</tr>
<tr>
<td>Zinc deficiency</td>
<td>453,207</td>
<td>4.4%</td>
<td>16,342</td>
</tr>
<tr>
<td>Iron deficiency</td>
<td>20,854</td>
<td>0.2%</td>
<td>2,256</td>
</tr>
<tr>
<td>Iodine deficiency</td>
<td>3,619</td>
<td>0.03%</td>
<td>2,614</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>4,482,922</strong></td>
<td><strong>43.53%</strong></td>
<td><strong>178,894</strong></td>
</tr>
</tbody>
</table>

DALY = Disease Adjusted Life Years

Source: European Communities 2011, Addressing Undernutrition in external assistance, report.
Moral of this story?

- Investments in agriculture work; they matter, they help.
- Gains in productivity, commercialization, value chains all increase income (mainly used for food), higher consumption.
- Higher food supply and income improve nutrition outcomes (a little...15-25 percentage points)
- Other nutrition/health actions needed to increase, sustain nutrition gains
International variation in height explained by sanitation

Source: Spears (2013)