Agenda

1. What is the food system?
2. My perspective
3. Food Security, Yield Gap, Ag & GEC, Sustainable Ag
4. Solutions Pathways
5. Group Activity
6. Report-outs
Sustainable Food Systems

September 17, 2018
What are the parts of the food system?
Who are the PEOPLE in the food system?
What is Food System Sustainability?

1. Food security for growing population
2. Increased food production
3. Adaptation to climate change
4. Mitigation of climate change
5. Conservation of ecosystems
6. Improve livelihoods

• Complex: nonlinear, positive & negative feedbacks
• Multifunctional
• Transcend spatial, temporal and sectoral boundaries

Food Security

- Globally we produce more food than we consume, **enough to provide everyone 2,700 calories/day** (FAO, 1996)
- “more than **one in seven people today** still do not have access to sufficient protein and energy from their diet, and even more suffer from some form of micronutrient malnourishment” (Godfray et al., 2010)
- **Obesity related diseases** are increasing in poor and rich countries alike

U.S. households by food security status, 2017

- Food-insecure households: 11.8%
- Households with low food security: 7.3%
- Households with very low food security: 4.5%

Worldwide Food Insecurity

*Projected values, illustrated by dotted lines and empty circles. SOURCE: FAO.*
Poverty Trap

**Food Insecurity**
- Uncertain access to food at the household or individual level

**Food Consumption**
- Quantity
- Quality
- Continuity

**Inadequate infant and child feeding**
- Insufficient intake of calories, protein, vitamins, and minerals
- Metabolic adaptations to food deprivation

**Multiple forms of malnutrition**
- **Child stunting and wasting**
- **Micronutrient deficiencies**
- **Overweight and obesity**

- Anxiety, stress, depression
- Disordered patterns of eating

**Undernutrition pathway**

**Obesogenic pathway**

(Source: Created by FAO Statistics Division for this report.)
Food Security

• **Food security** exists when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food which meets their dietary needs and food preferences for an active and healthy life. (FAO)

Food Sovereignty

• **Food sovereignty** is the right of peoples to healthy and culturally appropriate food produced through ecologically sound and sustainable methods, and their right to define their own food and agriculture systems. (Via Campesina)
How to Feed 9 Billion People?

Green Revolution (50s and 60s)
- Dr. Norman Borlaug
- Green Revolution: “Produce more food cheaper”
- Haber-Bosch process – N fertilizer
- Hybrid F1 seeds – high yield
- Ag Extension, Ford & Rockefeller Foundation

New/Second Green Revolution
- Population growth in Global South
- Projections are 70% - 100% more food by 2050 (Tilman)
- “Land sparing”
- Favor ‘intensification’ – increasing the productivity of land already in production – over ‘extensification’—bringing more land into agriculture
- Declaration of the World Summit on Food Security, 2009: “Produce more food cheaper with less ecological externalities”
Figure 1. Proportion of global plant-based calories consumed by humans as a function of various plant sources. Sugar is derived from multiple plant sources, including sugar beets and sugarcane. The vast majority of domesticated plant species play a very small role on the global plate. Data are drawn from Colin K. Khoury, et al., “Increasing Homogeneity in Global Food Supplies and the Implications for Food Security,” Proceedings of the National Academy of Sciences 111, no. 11 (March 18, 2014): 4001–6.

Yield Gap

• “The difference between realized productivity and the best that can be achieved using current genetic material and available technologies and management.” (Godfray et al., 2010)

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<thead>
<tr>
<th>Constraints</th>
<th>Farm</th>
<th>Regional</th>
<th>Global</th>
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<tr>
<td>Technical</td>
<td>Access to inputs</td>
<td>Access to know-how</td>
<td>Imported pests</td>
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<tr>
<td>Economic</td>
<td>No $ to invest</td>
<td>Access to markets</td>
<td>Imports outcompete</td>
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• Closing the yield gap is important but may result in negative environmental “externalities” related to food production
Farm Economics
How does the food system contribute to GEC?
Agriculture and GEC

• Externalities not reflected in cost of food

• Single largest driver of Global Environmental Change
  • Methane (cattle), NO2 (synthetic fertilizer, livestock manure) – more potent greenhouses gases than CO2
  • Water – uses 70% fresh water
  • Nitrogen and Phosphorous cycles – global supply chains, pollution
  • Carbon
  • Energy – cultivation, refrigeration, transport
  • Loss of biodiversity

• Climate change harms and helps
  • Crop and marine productivity patterns
  • CO2 levels actually increase some plant growth
  • Dry areas drier, wet areas wetter
10.15 The nitrogen cascade
Ag Land

• Loss to salinization, erosion, urbanization
• Land security: disincentivize investment, global land grabbing
• Also no new fisheries, max harvest reached

Fig. 2. An example of a major successful sustainable agriculture project. Niger was strongly affected by a series of drought years in the 1970s and 1980s and by environmental degradation. From the early 1980s, donors invested substantially in soil and water conservation. The total area treated is on the order of 300,000 ha, most of which went into the rehabilitation of degraded land. The project in the Illera district of Niger promoted simple water-harvesting techniques. Contour stone bunds, half moons, stone bunding, and improved traditional planting pits (zai”) were used to rehabilitate barren, crusted land. More than 300,000 ha have been rehabilitated, and crop yields have increased and become more stable from year to year. Tree cover has increased, as shown in the photographs. Development of the land market and continued incremental expansion of the treated area without further project assistance indicate that the outcomes are sustainable (51, 52).

(Godfray et al., 2010)
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10.18 The risks of business as usual

Food System Globalization

- Allows for regional specialization
- Protect against shocks (conflict, environmental events, epidemics)
- Creates disincentives in developing countries
- Targeted development
Sustainably Intensive Ag & Agroecology

- **Sustainably Intensive Agriculture (SI):** more food with less environmental impact (“land sparing”)
- **Agroecology:** “land sharing,” sustainability > productivity, knowledge co-production
- **Sustainably Intensive Agriculture (SIA) “...integrates the dual and interdependent goals of using sustainable practices to meet rising human needs while contributing to resilience and sustainability across scales.”** (Rockström et al., 2017)
- **Climate Smart Agriculture (CSA):** “agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes greenhouse gases (mitigation), and enhances achievement of national food security & development goals” (FAO)
Food System Sustainability

“The goal is no longer simply to maximize productivity, but to optimize across a far more complex landscape of production, environmental, and social justice outcomes.”

(Godfray et al., 2010)

As a result of the complexity of agri-food systems, popularly-supported ‘win-win’ solutions rarely result in wholly satisfactory outcomes... Achieving positive impacts across these varied aspects of sustainability simultaneously may well not be possible. It is likely that desirable outcomes will require compromises in one or more aspects.”

(Whitfield et al., 2015)
Solution Pathways

1. You will divide into groups, each assigned a solution pathway
2. Each group will choose 2 SDGs to consider in addition to “No Poverty” & “Zero Hunger”
3. For each SDG, brainstorm ideas & discuss the potential opportunities pitfalls related to your solution pathway
4. Report out

<Assign Groups Now!>
**Solution Pathway 1:**

**Urban Agriculture**

• Mass migration: Today the majority of the world’s population lives in cities, by 2050 projected to be 65+%  

• Global south participation: 46% of urban residents in African countries, 69% in Latin American¹  

• Community agriculture, Commons  

• Vertical Farming: rooftops, indoors, living walls

Solution Pathway 2: Precision Agriculture

• Genetics:
  • Traditional plant breeding
  • Green revolution goal productivity: f1 hybrids & chemical fertilizers
  • Now goal is productivity + resilience (pests, water & nutrient utilization)
    • Gene editing
    • GE plants and animals
  • Endemic biological diversity is essential

• Aquaculture

• Remote sensing – nutrients, water

Solution Pathway 3:
Diet Change

Fig. 1. Changes in the relative global production of crops and animals since 1961 (when relative production scaled to 1 in 1961). (A) Major crop plants and (B) major types of livestock. [Source: (2)]
Solution Pathway 4: Nutrient Cycling

- Food waste
  - “30 to 40% of food in both the developed and developing worlds is lost to waste” (Godfray et al., 2010)
  - Global North, consumer/restaurant/retail
    - Labeling (“Use By” and “Best if Used By”), Seconds markets, Compost
  - Global South, food storage
    - Investment in infrastructure
- \( P, N, C \) cycles
Solution Pathway 5: Aquaculture

- Aquatic products provide nearly 3 billion people with at least 15% of their animal protein intake
- Almost all ocean stocks are harvested at full capacity
- Inland capture fisheries water vulnerability