Sustainable Food Systems and Diet Sustainability Indicators and Metrics: What do we really need?

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Transition toward Sustainability after 15 Years: Where Do We Stand in Advancing the Scientific Foundation, January 15, 2016

Assigned topics for this presentation:
In the area of **Sustainable Food Systems and Diet**

1. What are the major *advances in sustainability science, remaining gaps, and critical barriers to progress* since Our Common Journey was released in 1999?

2. What progress has been made in *establishing sustainability indicators*, what are the remaining gaps, and what have been critical barriers to progress?

6. What new efforts might be needed to address the range of needs and opportunities related to sustainability?

Key Conclusions from Our Common Journey

- A *primary goal* of a transition to sustainability is to *meet the needs of a much larger but stabilizing human population*, including substantially reducing hunger and poverty
- Board believes that a *successful transition toward sustainability is possible* over the next two generations [roughly by 2050].
- *Developing an integrated and place-based understanding of threats* and the options for dealing with them *is a central challenge* for promoting a transition toward sustainability.

1. What are the major advances in sustainability science since Our Common Journey was released in 1999?

Understanding the issues

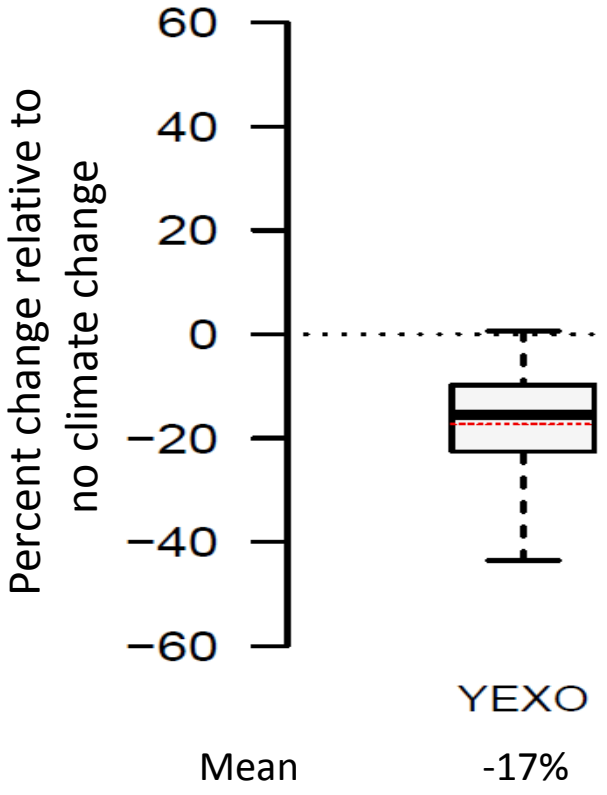
- What it got right
  - Agricultural demand will double by 2050, driven by population and income growth
  - Agricultural supply has kept up so far and could meet 2050 demands
    - Slowing but still positive area expansion
    - Slowing yield growth
    - Continued, but slowing, intensification of agriculture in land use, but with greater water use and soil degradation
    - Both result in stresses on biodiversity and on ecological systems without the right policy environment
- What it missed
  - Increasingly strong evidence of climate change effects from changes in weather means; especially heat
  - Likely strong effects of increasing weather variability
  - Obesity as an issue in developing countries
  - Consequences of changes in our microbiome (antibiotics, diet, others)
  - Big data availability (But do we have the right data to manage?)

Sustainability science research to address the issues

- Enormous growth in use of ag biotech for some major (and some minor) crops with important sustainability benefits
    - Pest management (e.g. Roundup ready and *Bt* corn, soybeans, and cotton; ringspot virus resistant papaya)
    - Drought resistance
- Potential for major scientific advances
    - CRISPR technology for gene editing to accelerate biotech advances
    - Microbiome research to address multiple human health issues
- Major improvements (from a low base) in modeling to incorporate biophysical and socioeconomic interactions

Integrating socioeconomics and biophysical effects in food system modeling

Assessing the *global* effects of climate change in 2050



Nelson, et al., PNAS 2014

What are the remaining gaps for sustainability science?

- A data collection and modeling system to *identify* 21st century challenges
- Funding research (esp. on nascent CRISPR and microbiome technology) for the key sustainability threats
- Improved understanding of climate change effects beyond yield changes
  - On yields and area from variability of weather
  - On nutrient composition of plants
  - On pest and disease pressure
- Developing, *and making useful to different audiences*, integrated and place-based understanding of threats, and potential solutions

What have been critical barriers to progress?

- Complacency brought on by the success of the Green Revolutions
  - Reduced funding for agricultural research almost everywhere
  - Stalled efforts to develop more open trading regimes for developing countries and agriculture (Doha WTO Round)
- Disciplinary and institutional silos in the research communities
- Rise of regional powers
  - Makes world negotiations (trade, exchange of genetic material, GHG mitigation) more challenging
- Growing income and asset inequality across the globe
- Data collection is not sexy

2. What progress has been made in establishing sustainability indicators?

Issues with sustainability indicators

- Indicators of what?
- Target(s) are needed, based on goals. Who sets the goals?
- Are the data available?
- If not, are alternatives available?

Observations from Our Common Journey

- No consensus on the appropriateness of current sets of indicators or scientific basis for choosing among them – *still true. An explosion of efforts to generate indicators. Many different goals.*
- Human welfare is now being monitored by quantitative indicators that are appropriate in concept but implemented with inadequate coverage and frequency. – *still true*
- Critical zones of human-environment vulnerability at regional scales are being identified *(not sure how much progress)*, but there is not a single set of indicators that can monitor the combination of social and natural factors that lead to irreversible damage. – *too much to expect*
- Inventories of ecosystems will assist conservation at local scales. Protected areas, managed to enable their biota to persist indefinitely, are being identified on a place-by-place basis, rather than through a consistent set of appraisals of their long-term sustainability. – *still true*

Changing perspectives on goal development: The MDGs and the SDGs

- MDGs – deadline of 2015
  - Created by handful of experts
  - 8 goals, 18 targets, 48 technical indicators
- SDGs – deadline of 2030
  - Created in an arduous process over several years with input from many
  - 17 goals, 169 targets, indicators to be determined

The Growing Business of Sustainability Indicators

- Future Earth - http://www.futureearth.org
- Global Reporting Initiative - https://www.globalreporting.org/Pages/default.aspx - corporate sustainability reporting
- UN Global Compact (UNGC) - https://www.unglobalcompact.org
- World Business Council for Sustainable Development (WBCSD)
- UN Sustainable Development Solutions Network indicators report - http://unsdsn.org/resources/publications/indicators/
  - 100 Global Monitoring Indicators, accompanied by suggestions for Complementary National Indicators

6. What new efforts might be needed to address the range of needs and opportunities related to sustainability?

Recognize there is no single indicator set

- Different audiences have different goals and need different indicators
  - By purpose of activity– business, public, NGO
  - By sector – industry, agriculture, etc.
  - By spatial reach – global, regional, local
- Identify and collect missing data; lots of low hanging fruit
- Develop tools to ease indicator development

Provide guiding principles for monitoring indicators

1. Determined by (agreed, clearly specified, consistent) goal set
2. Each is a good proxy for (specified) broader issues or conditions
3. Limited in number and orthogonal in measure
4. Harmonized with international standards and global system-based information
5. Simple indicators with straightforward [policy], linear implications
6. Can be monitored at appropriate frequency

Source: Modified from UN Sustainable Development Solutions Network, Ten Principles for Global Monitoring Indicators

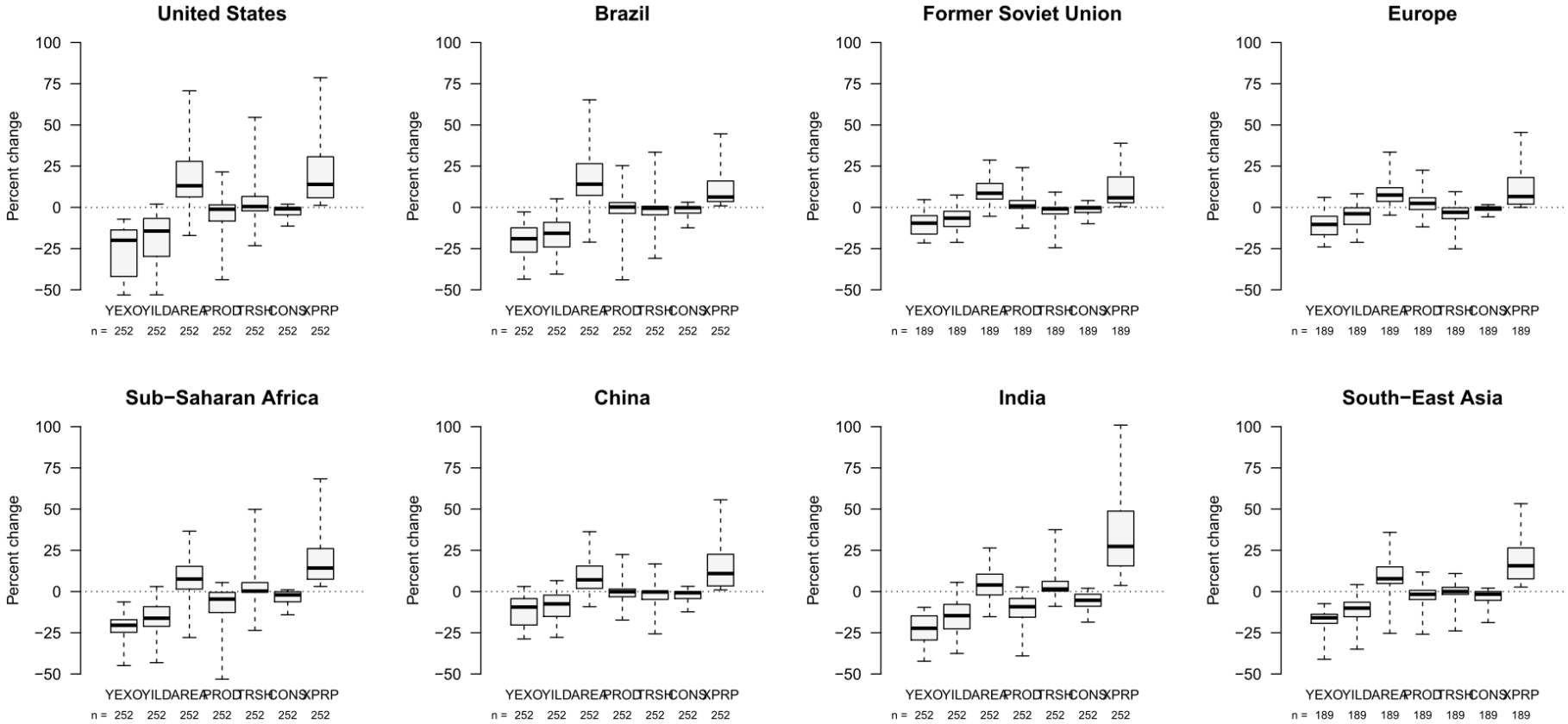
Improved data collection needs. Some examples

- Lab research
  - How do crops respond in the lab to changes from global warming
- Field research
  - How do crops respond in the field to changes from global warming
- Remote sensing
  - Regular repeated observations at appropriate frequency and open source
- Encourage data collection standards
  - Frequency
  - Units
  - Methods
- Simplify standardized reporting

Tools to ease indicator creation

- Make it easy to
  - Repurpose results from scientifically accepted modeling
  - Develop indicators for different scales
  - Link from simplified indicators to underlying data
- Think 21st century
  - Virtual reality
  - Cell phone apps

Integrating socioeconomics and biophysical effects in food system modeling: Results by region



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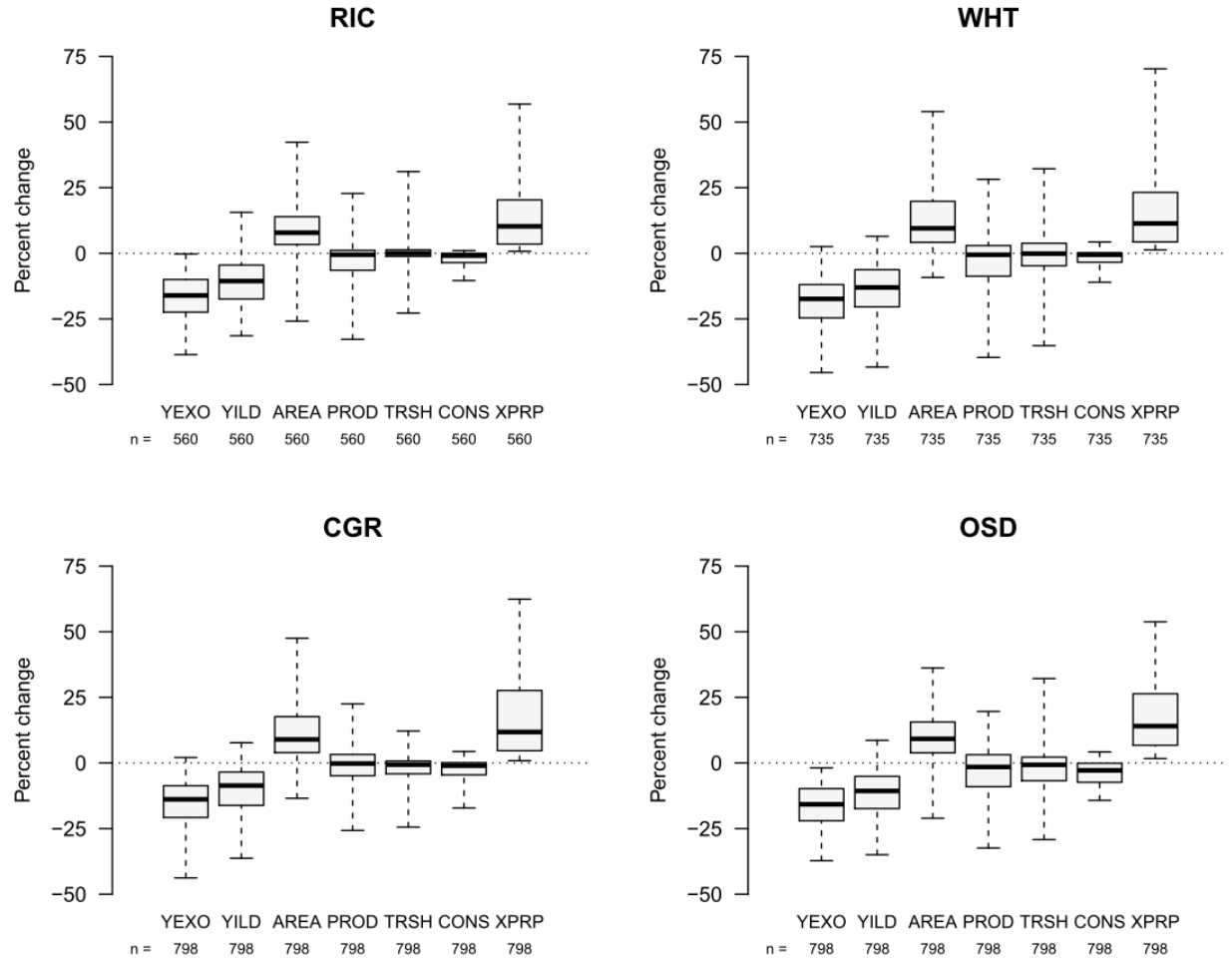
Integrating socioeconomics and biophysical effects in food system modeling: Global results by crop



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Integrating socioeconomics and biophysical effects in food system modeling: Global results by model