FARM D

Forum for Agricultural Risk Management in Development

WEBINAR SERIES WITH

International Life Science Institute (ILSI) Research Foundation

By Dr. Morven McLean & Dr. Dave Gustafson

Washington DC, United States, May 6th , 2015

ILSI Research Foundation

Morven A. McLean, PhD
Executive Director

ILSI™
Research
Foundation

International Life Sciences Institute (ILSI)

- ILSI is a nonprofit, worldwide organization with a mission to provide science that improves human health and well-being and safeguards the environment
- Multisectoral and collaborative
  - Outcomes are more impactful when informed by the international expertise and experience of scientists from government, private sector, academia and NGOs
- ILSI is a proven leader in fostering effective public-private partnerships worldwide

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ILSI is an International Federation

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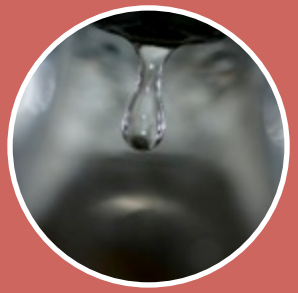
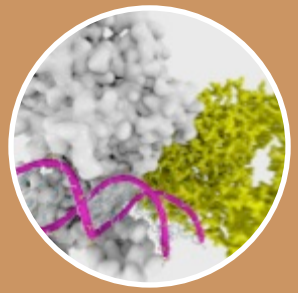
ILSI's Thematic Areas



Food & Water Safety



Toxicology & Risk Science

Nutrition, Health & Wellness

Sustainable Agriculture & Nutrition Security

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ILSI Research Foundation

Mission: Improving environmental sustainability and human health by advancing science to address real world problems

- A distinct, complementary, non-membership component of the ILSI network
- Funded through grants and donations from public and private sector sources
- We use the same global, multi-sectoral approach as ILSI's other entities to advance our mission

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How we are organized

cimsans

Center for Environmental Risk Assessment

Center for Safety Assessment of Food & Feed

Other Programs

ILSI Research Foundation

How we work

The ILSI Research Foundation is:

- A leader of collaborative research in a carefully curated portfolio of scientific areas.
- A convener to address immediate or longer term scientific issues of importance.
- A facilitator that helps build bridges between organizations to work collectively on scientific topics that warrant action.

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Food System Metrics for the Assessment of Sustainable Nutrition Security

6 May 2015

Dave Gustafson
Director, CIMSANS
ILSI Research Foundation

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CIMSANS Mission

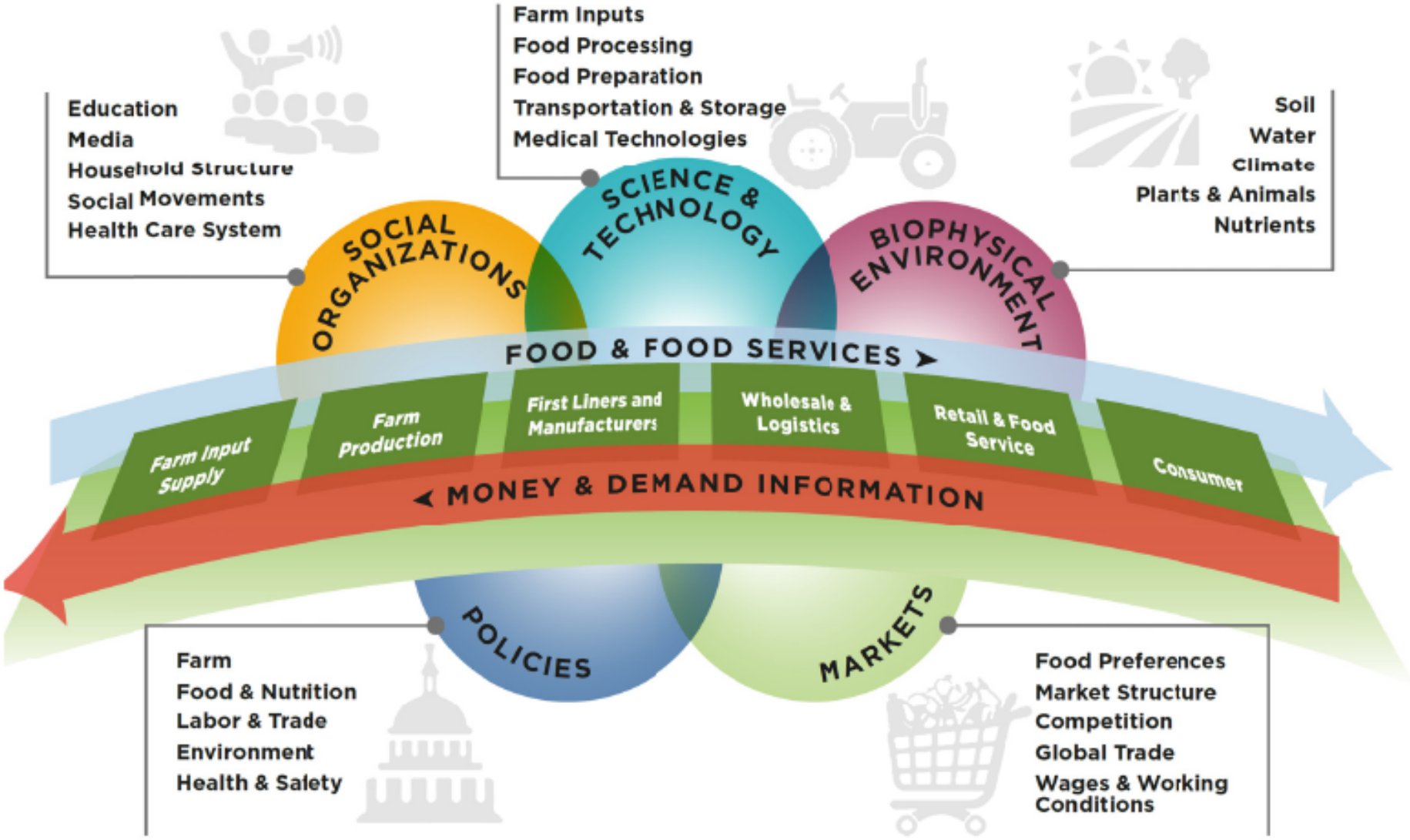
Foster new public/private partnerships on novel food system modeling methods, better informing adaptation to the increasing impacts of climate change and resource scarcity on sustainable nutrition security.

- Employs a “tri-partite” approach

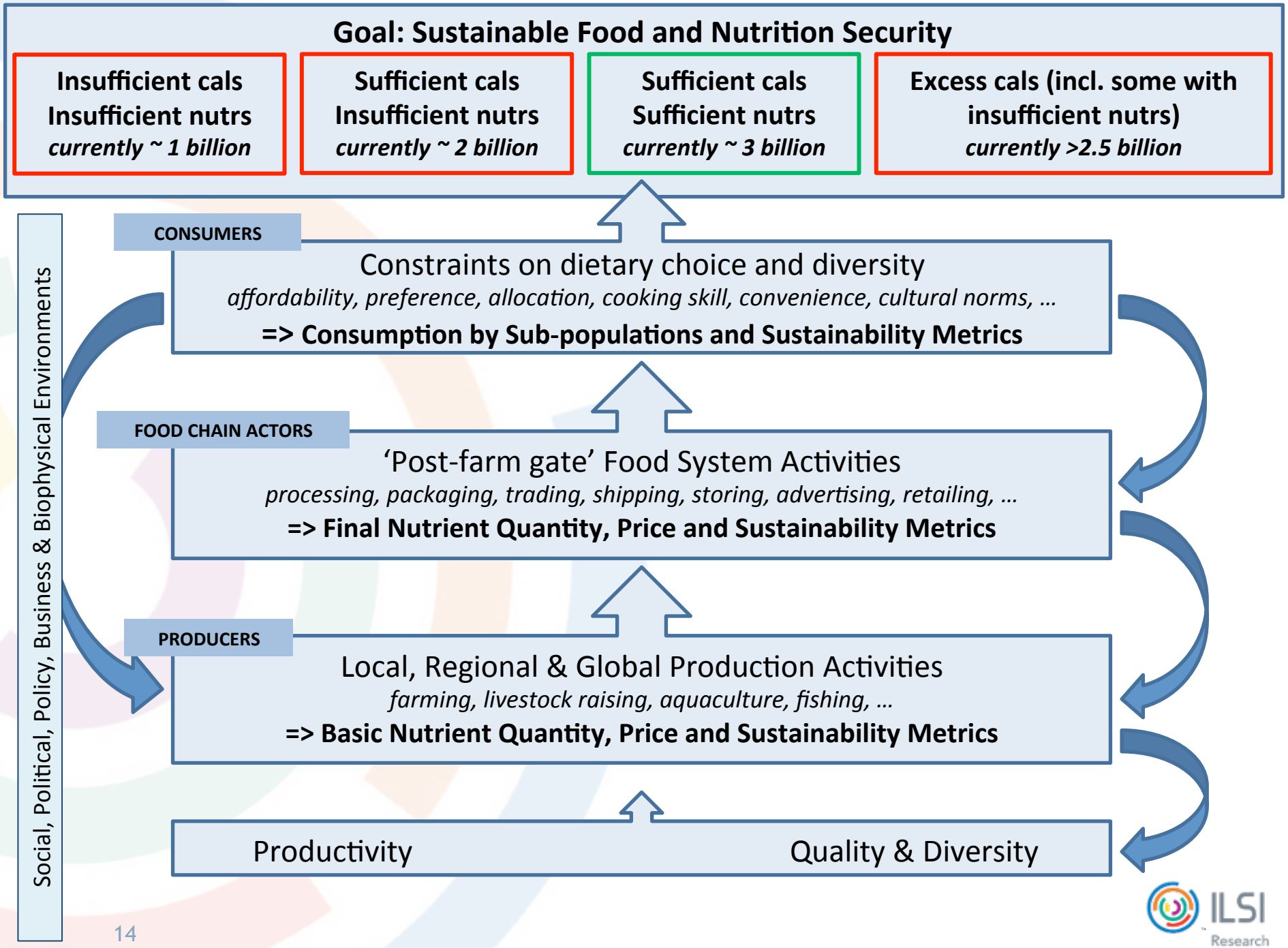
Outline

- Sustainable nutrition security (SNS) – What is it?
- Food systems are challenged to deliver desirable sustainability and nutrition outcomes
- CIMSANS leading a collaboration on the application of food system metrics for SNS assessment
  - Set goals, measure progress
- Engagement opportunities

Representation of US Food System as a "Complex Adaptive System"



Source: The Institute of Medicine & The National Research Council of the National Academies, 2015



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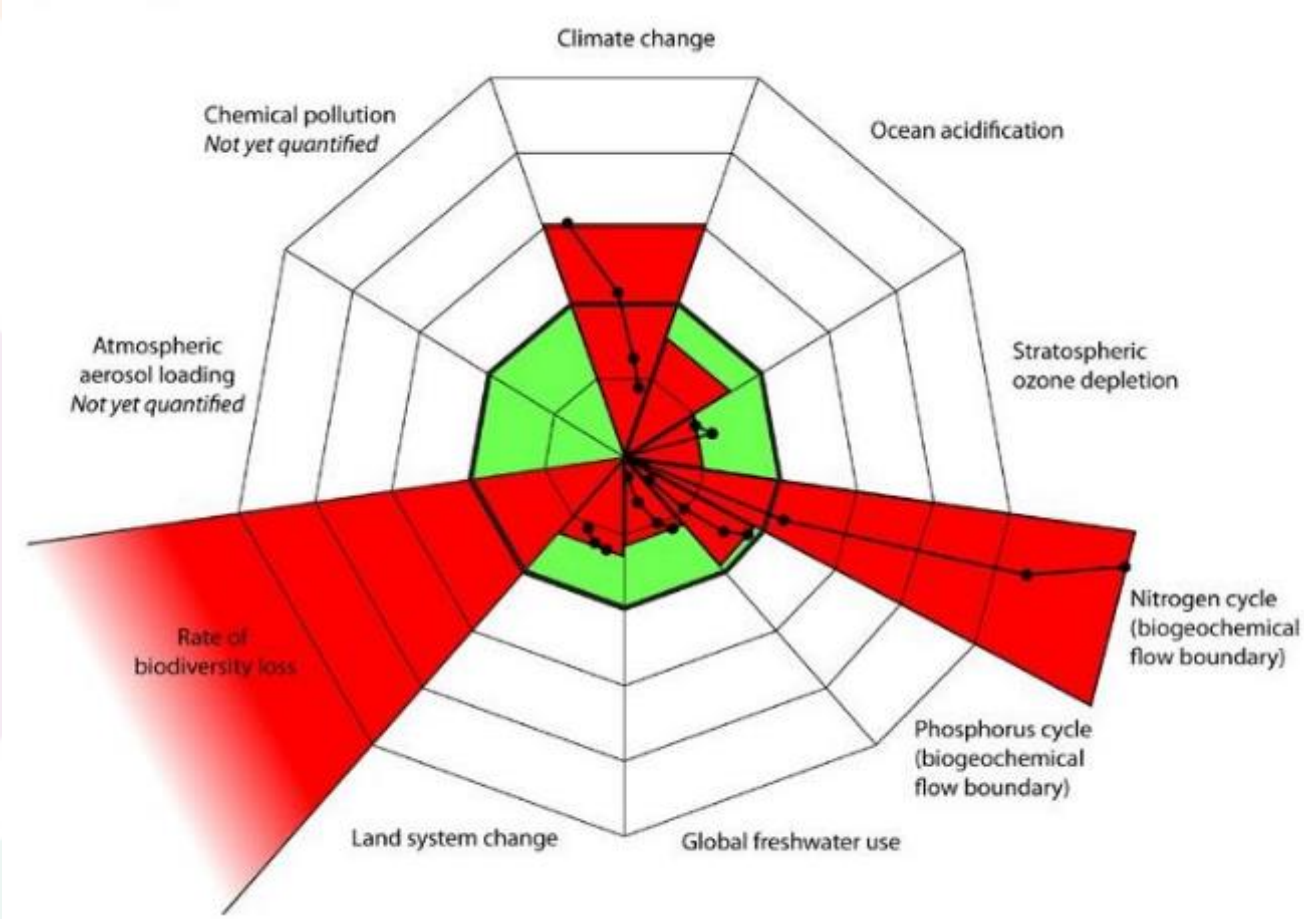
Food System Contributes to Current Violations of Planetary Boundaries



source: Rockström, et al., 2009. Planetary boundaries: exploring the safe operating space for humanity. Ecology and Society 14 (2), 32.

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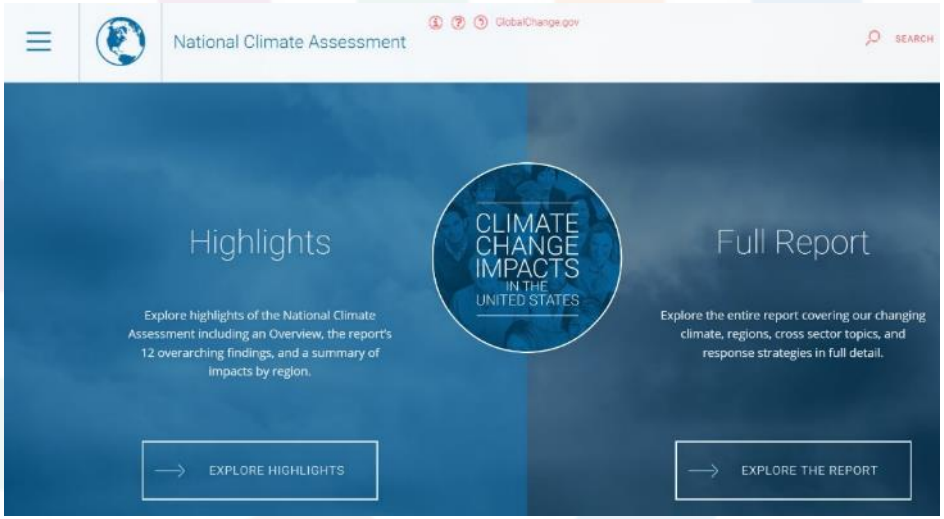
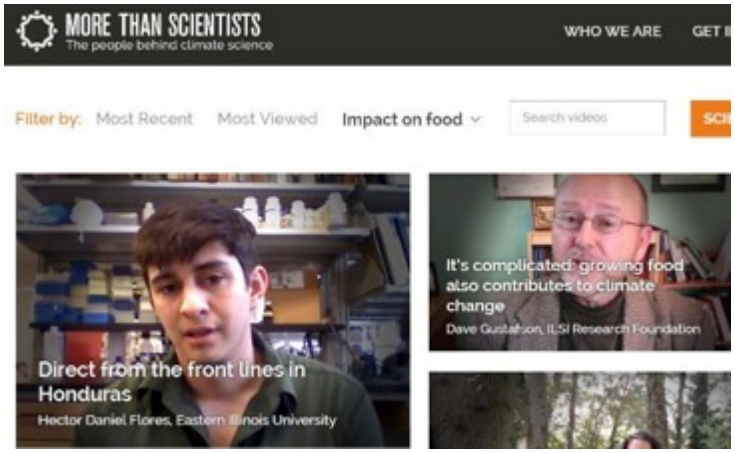
Third US National Climate Assessment

- Highlighted impacts on food systems
- Released on May 6, 2014
  - "More Than Scientists" releasing videos from NCA authors to mark this 1-year anniversary





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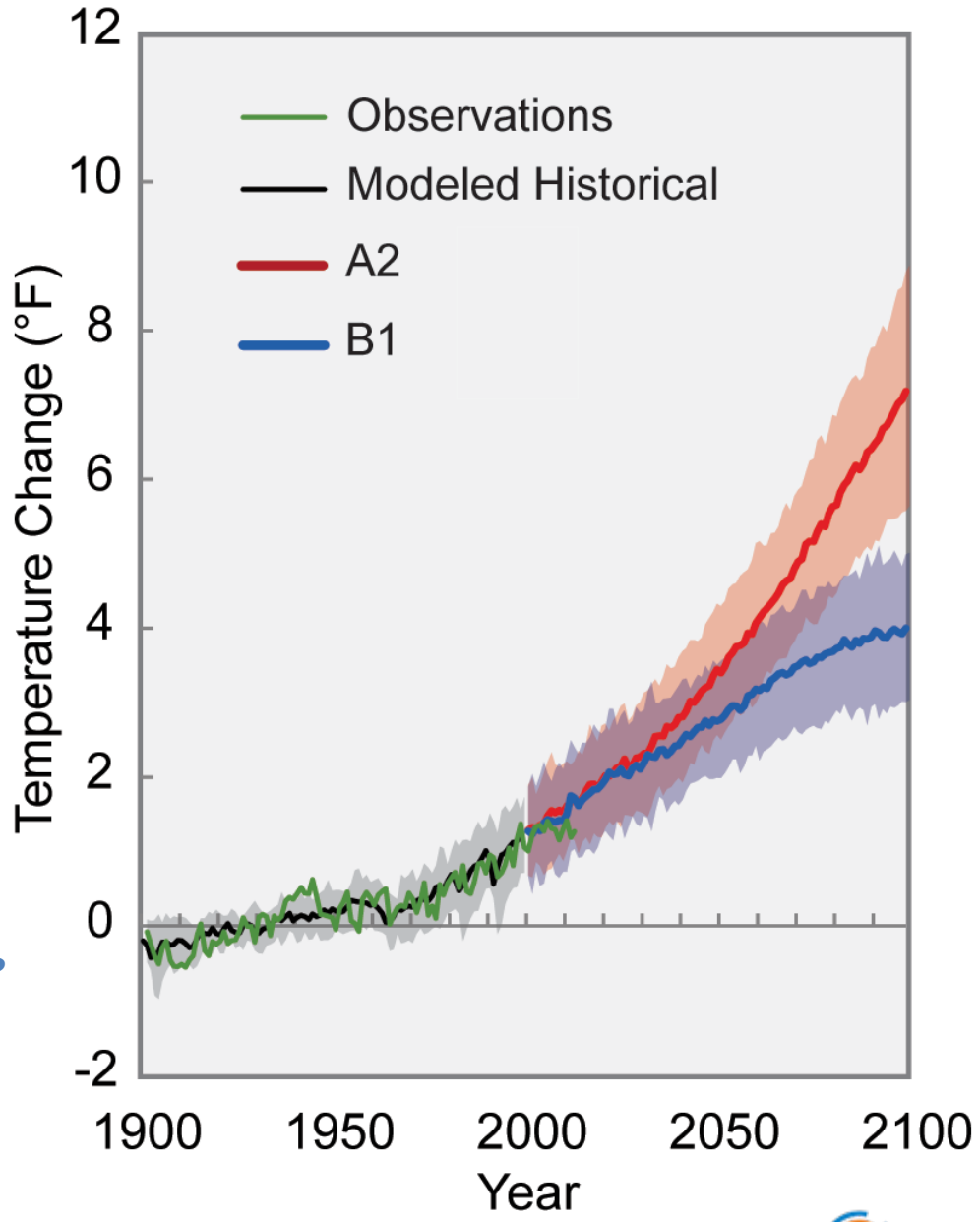
Projected Global Temperature Change



source: Third National Climate Assessment, US Global Change Research Program (2014).

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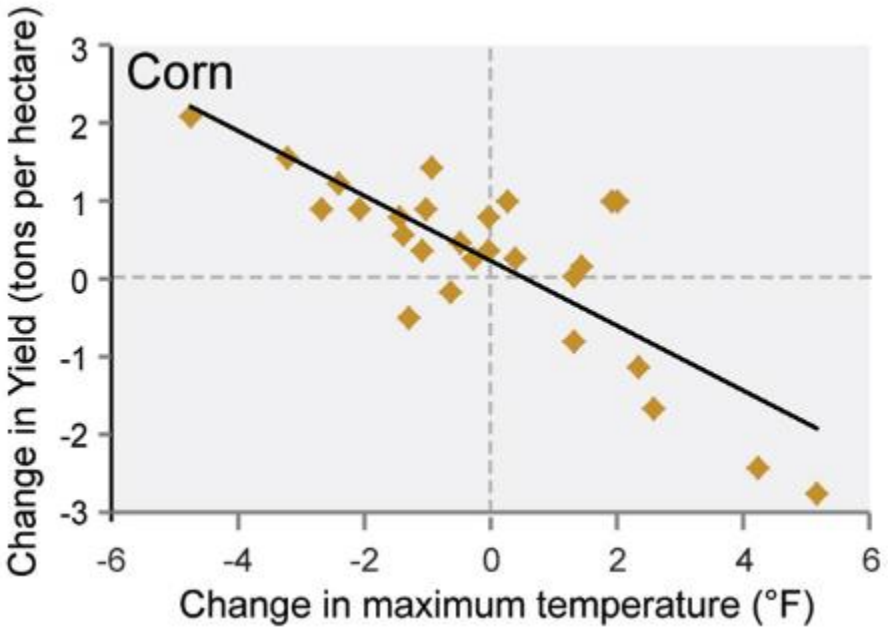
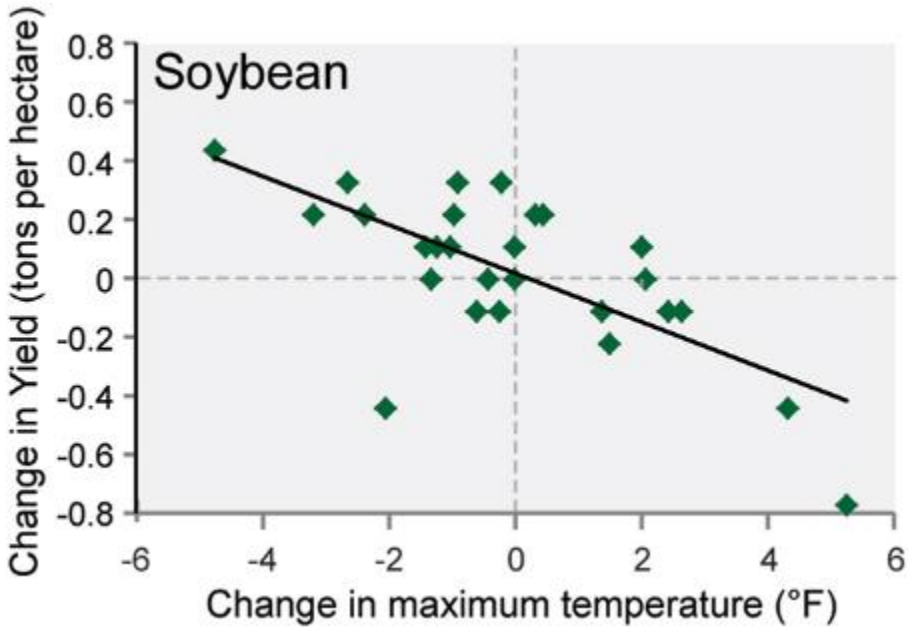
Crop Yields Decline under Higher Temperatures





source: Third National Climate Assessment, US Global Change Research Program (2014).

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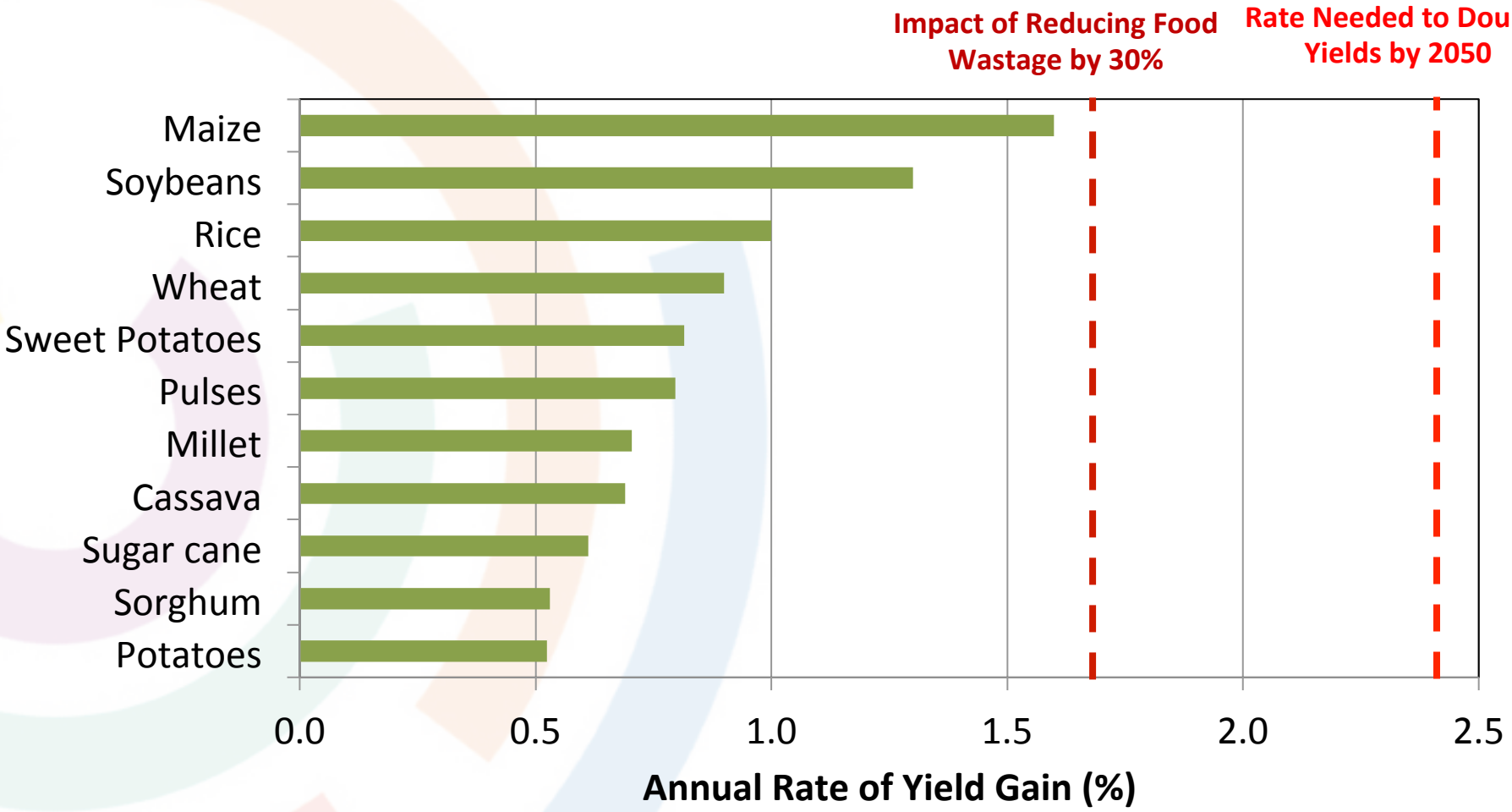
Annual Rates of Yield Increases for Food Crops Vary with Technology Investment



Global rates of yield gain (1961-2011), based on data available from FAOSTAT

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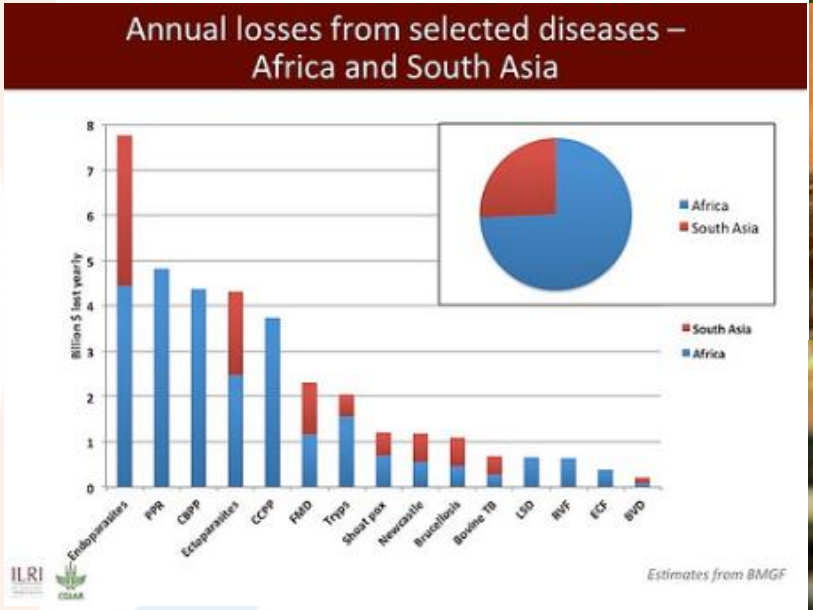
Emerging Pest & Disease Threats to Agriculture

- Livestock
  - Multiple diseases
- Rice[1]
  - False smut
- Maize
  - Stem borer
- Cassava[2]
  - Whitefly
  - Mealybug




False smut on rice, Photo credit: IRRI


Stem borer on maize, Photo credit: CYMMIT


Whitefly on cassava, Photo credit: CIAT

[1] http://www.knowledgebank.irri.org/training/fact-sheets/pest-management/diseases/item/false-smut
[2] http://www.ciatnews.cgiar.org/2013/12/03/clamp-down-launched-on-devastating-threats-to-starch-crop

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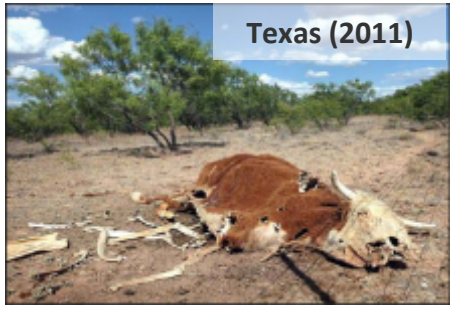
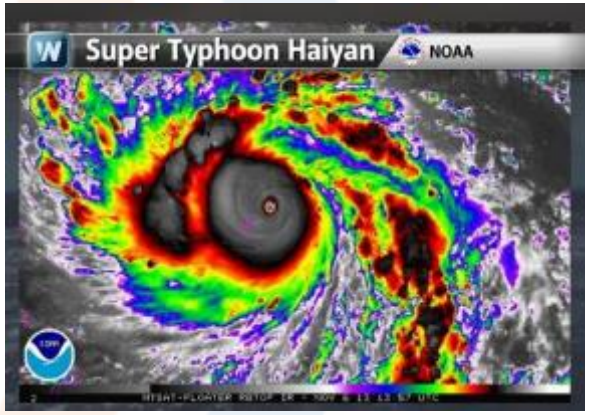
Climate Change Means Increased Frequency and Intensity of Extreme Weather Events

- Floods
- Drought
- Heat waves
- Wind-storms
- Severe t-storms
- Tropical cyclones

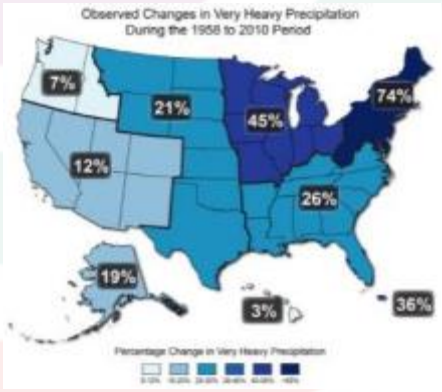

Govindghat, India (2013)


Pakistan (2010)


Texas (2011)

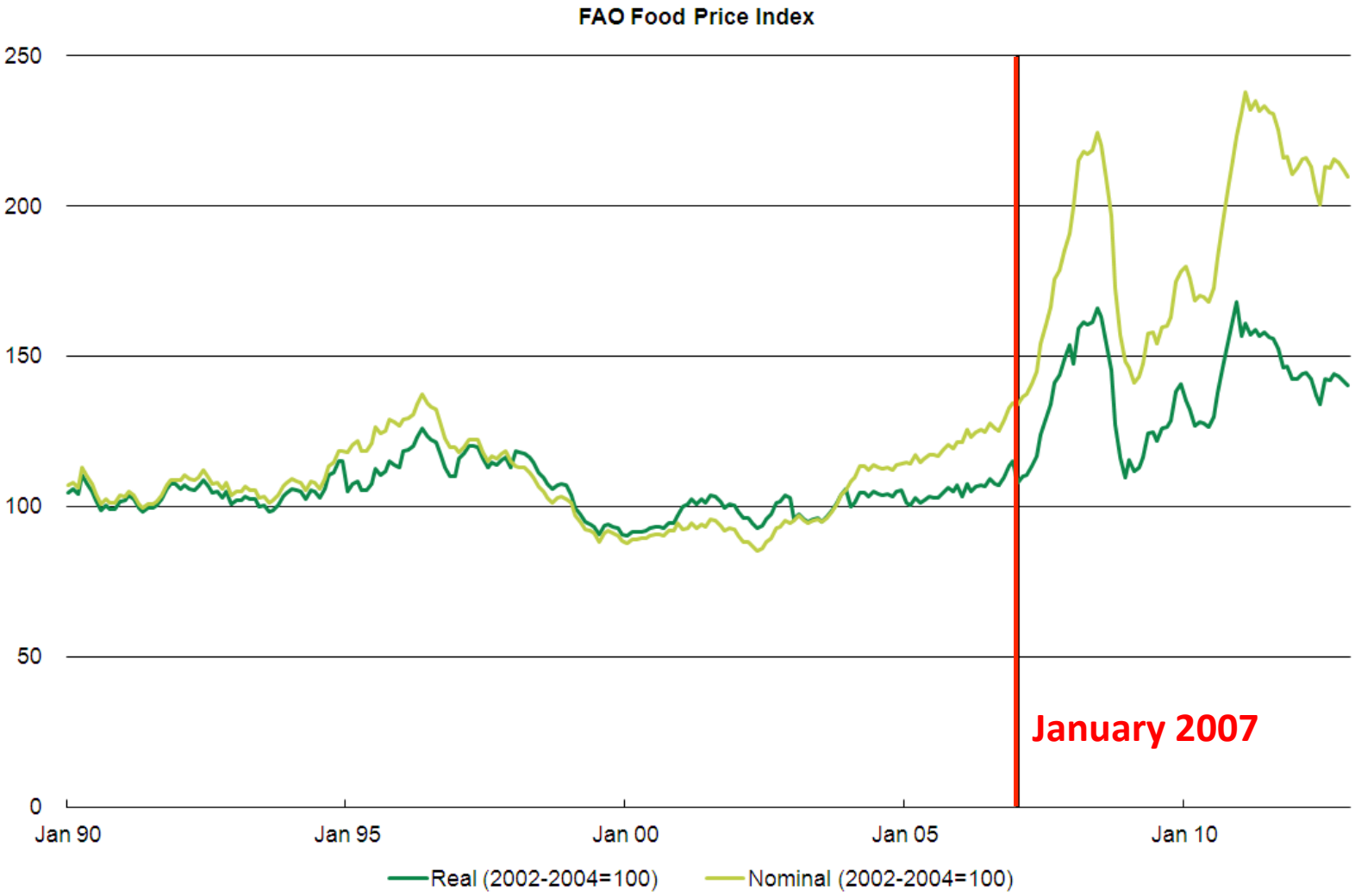



Tacloban, Philippines (2013)




Super Storm Sandy (US East Coast 2012)

Increasing Volatility in Food Prices



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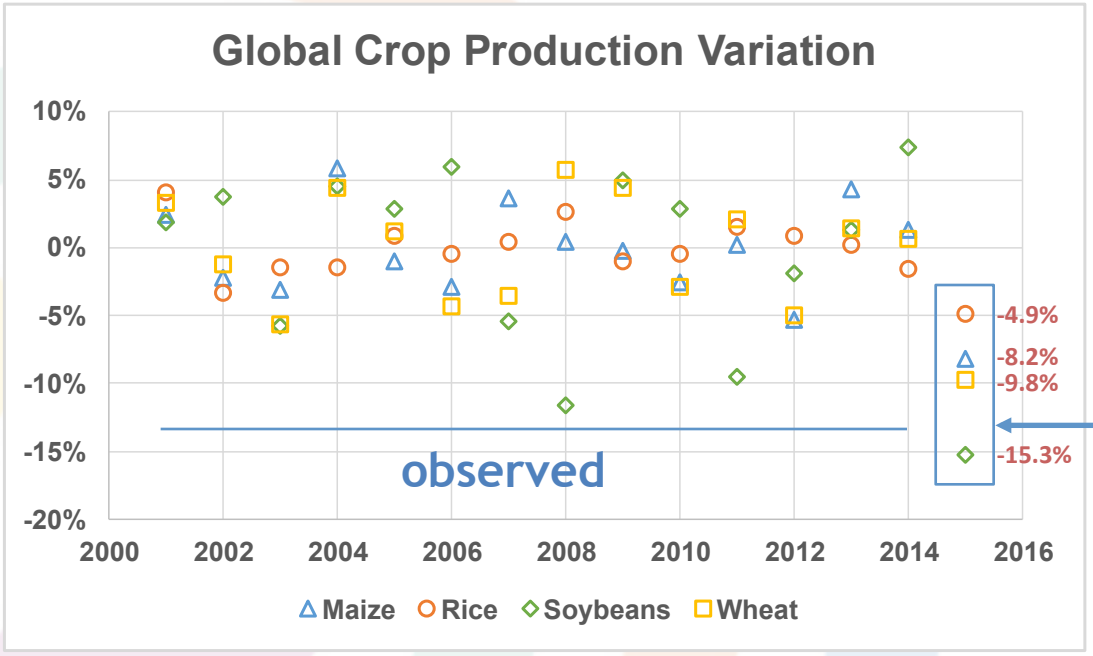
Plausible Production Shocks (2015)



P=0.005, using observed standard deviations in global production variation for each crop (assumes normality in annual variation from trend)

	Maize	Rice	Soybeans	Wheat
Maize	1	0.154	0.049	0.605
Rice	0.154	1	-0.469	0.329
Soybeans	0.049	-0.469	1	-0.019
Wheat	0.605	0.329	-0.019	1

Based on observed correlations between crops, it is unlikely for rice & soybeans to experience a large downward shock in the same year, but the three grain crops might do so

Data Source: USDA/FAS/PSD, https://apps.fas.usda.gov/psdonline/psdHome.aspx

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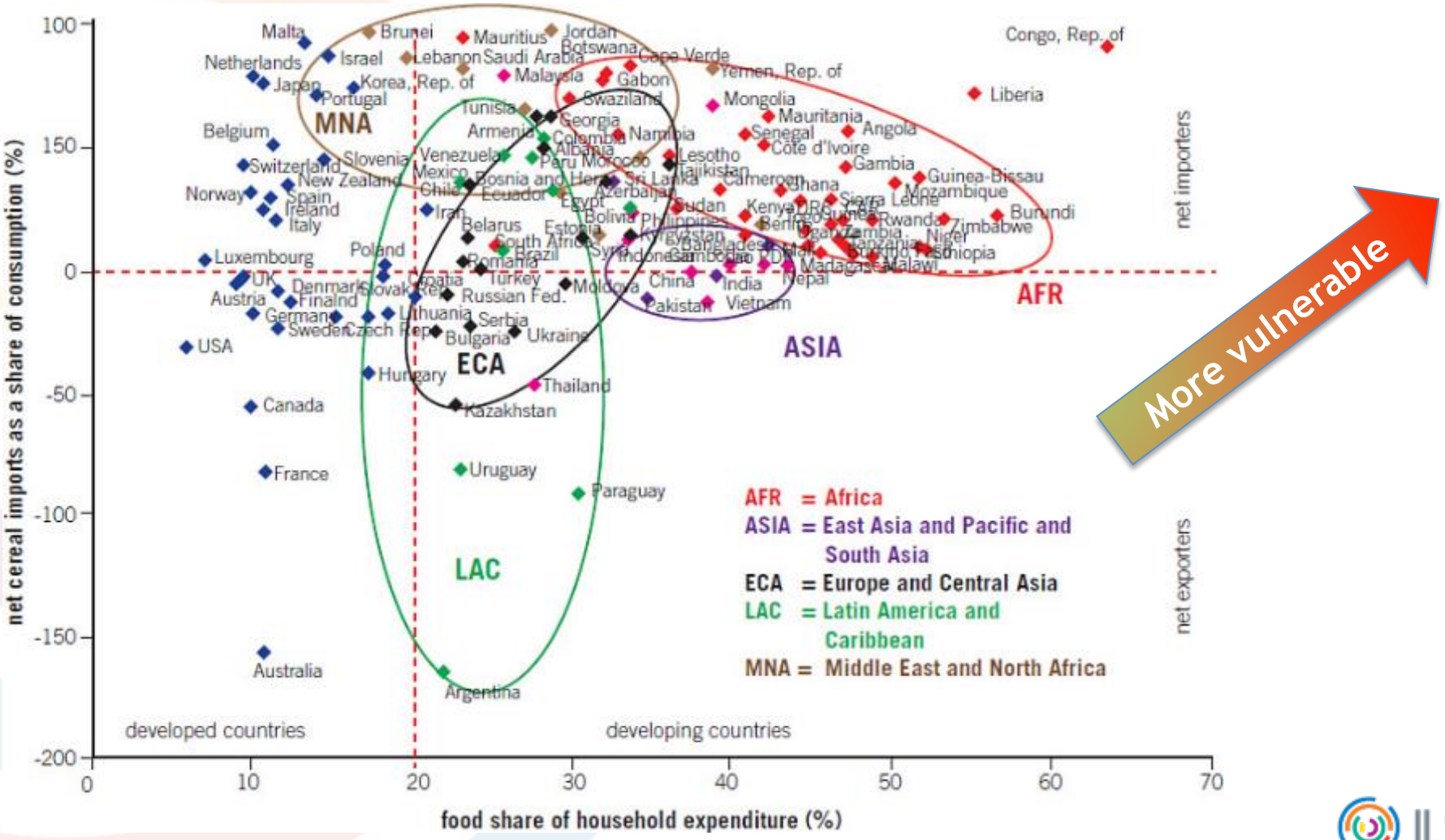
Widely Varying National Vulnerability to Global Food Price Shocks



Source: World Bank

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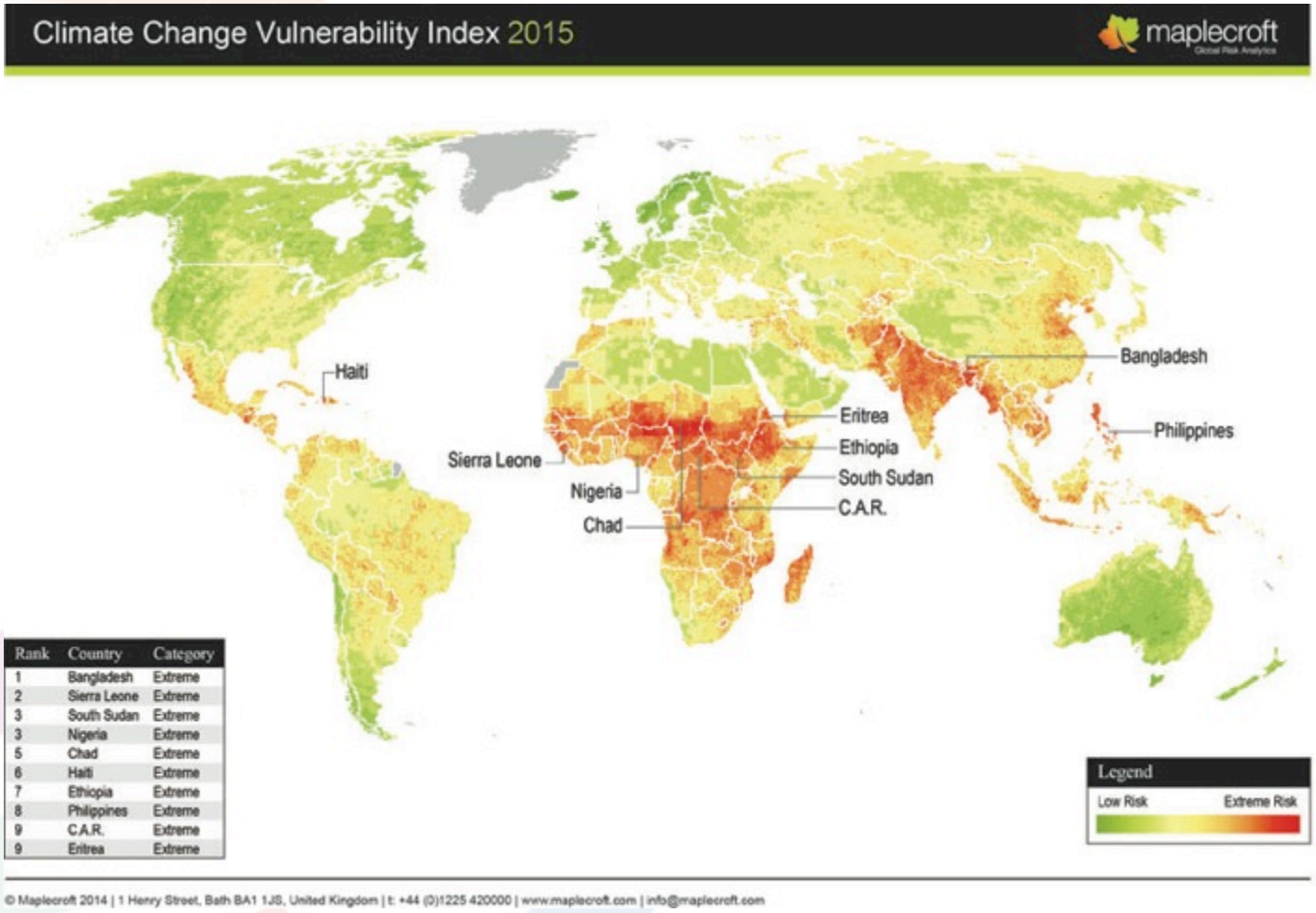
Climate-Induced Food Security Hotspots



Rank	Country	Category
1	Bangladesh	Extreme
2	Sierra Leone	Extreme
3	South Sudan	Extreme
3	Nigeria	Extreme
5	Chad	Extreme
6	Haiti	Extreme
7	Ethiopia	Extreme
8	Philippines	Extreme
9	C.A.R.	Extreme
9	Eritrea	Extreme

Source: Maplecroft (2014).

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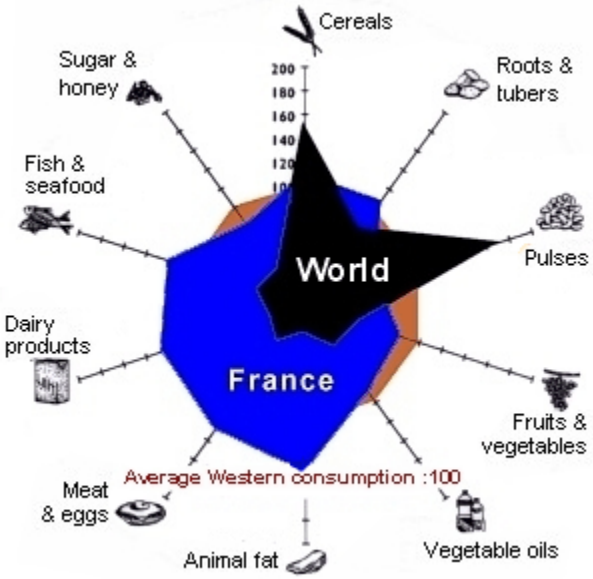
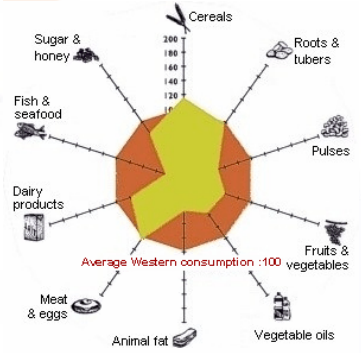
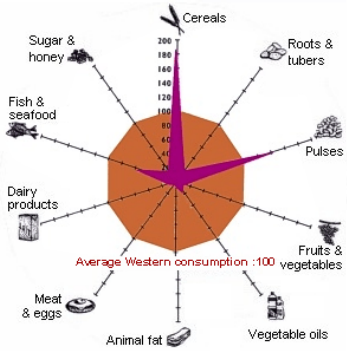
Imbalances in Global Food Consumption Patterns Directly Impact Nutrition

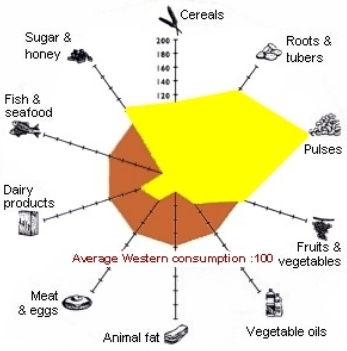




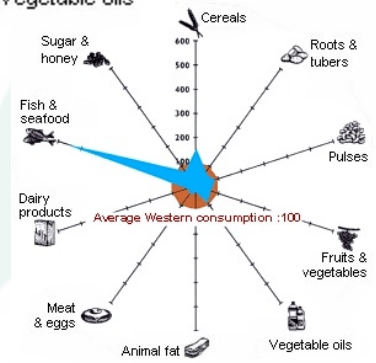
Argentina



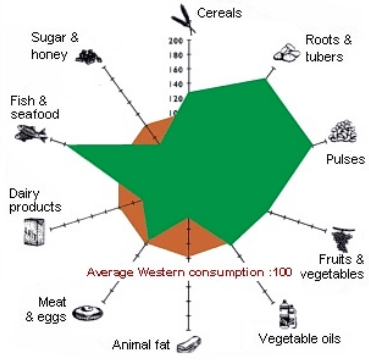
Bangladesh



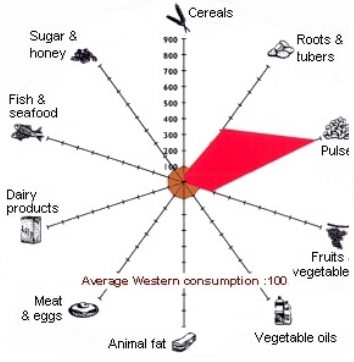
Colombia



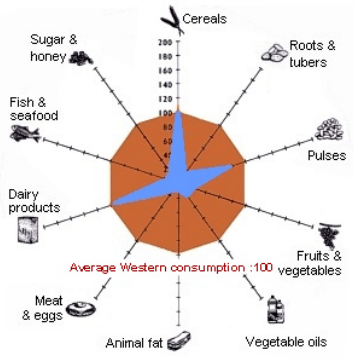
Japan



Portugal



Rwanda



Somalia

Source: "Banquet de l'Humanité" http://www.museum.agropolis.fr/english/pages/expos/banquet/modele.htm

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The Central Problem

Adaptation of Food Systems *Essential* for Achieving Sustainable Nutrition Security

- Today's food systems are challenged to provide nourishing diets due to the demands of a growing population – further complicated by climate change and reduced water availability
- Only ½ of the world consumes appropriate amounts of macro- and micronutrients – while billions consume too few or too many
- Food systems must also reduce and their environmental impact – and improve their resilience to climate change
- Even given this situation, nutrition and sustainability aspects of existing food security assessments have been limited or absent
- How can we evaluate the effectiveness and efficiency of potential food system adaptation responses intended to improve outcomes?

A Collaborative Solution

CIMSANS is convening a new Public-Private Partnership to assess Sustainable Nutrition Security (SNS)

- Announced on 29 July 2014 as part of the US President's Climate Data Initiative
- Primary partners:

- Seven SNS food system metrics:

  Dietary Adequacy - Environmental Sustainability - Affordability & Accessibility
  Cultural Appropriateness - Food Safety - Resilience - Waste & Loss Minimization

- A 3-year effort to produce the FIRST credible, comprehensive SNS assessment
  - Include relevant nutrition & sustainability endpoints
  - Improved models based on open-source coding and open data
  - All of the world's important staple and non-staple foods
  - Calibration period (2000-2015; predictions through the year 2050, high spatial resolution

Enable better decision-making to improve nutrition and sustainability outcomes

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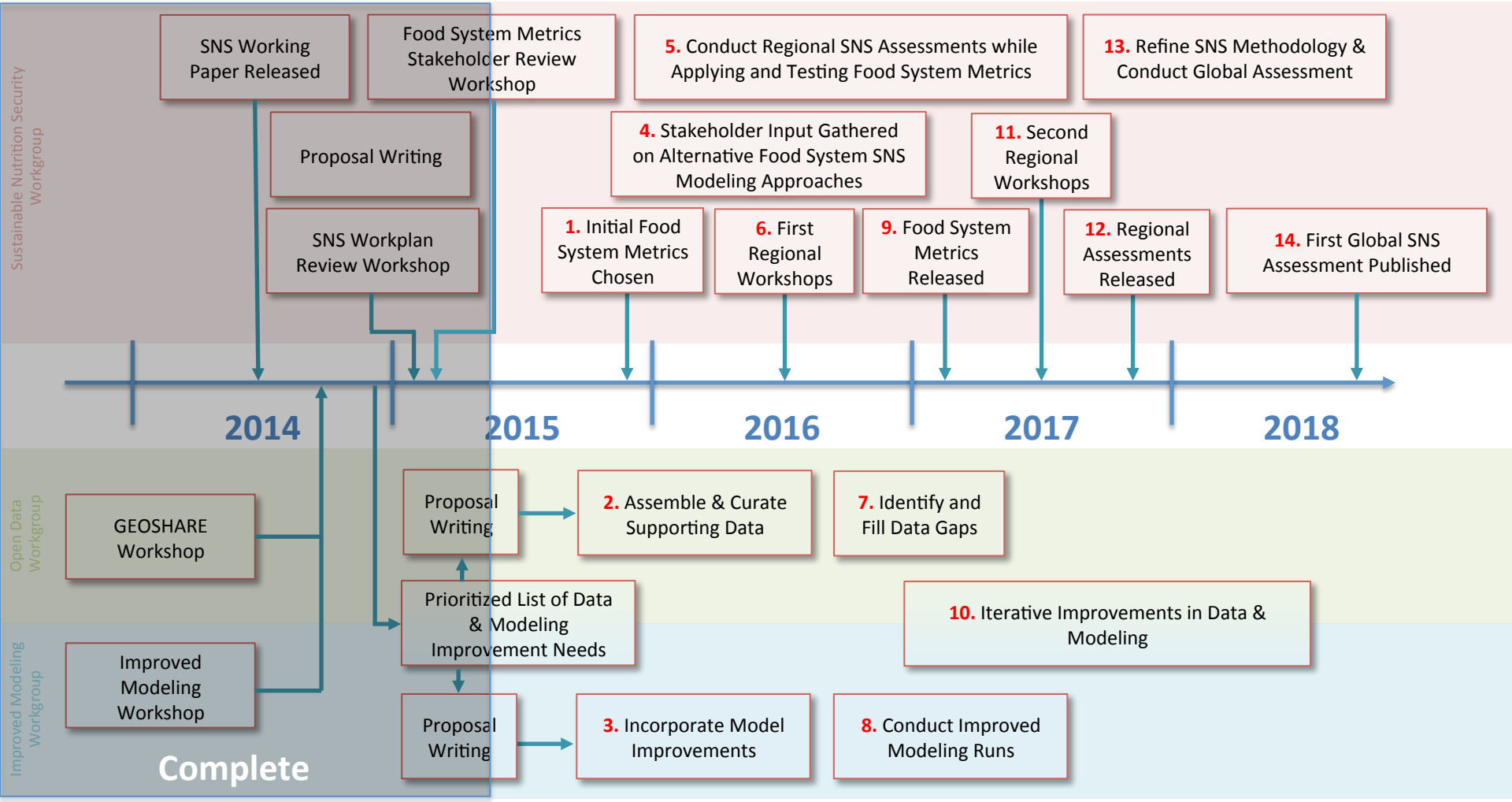
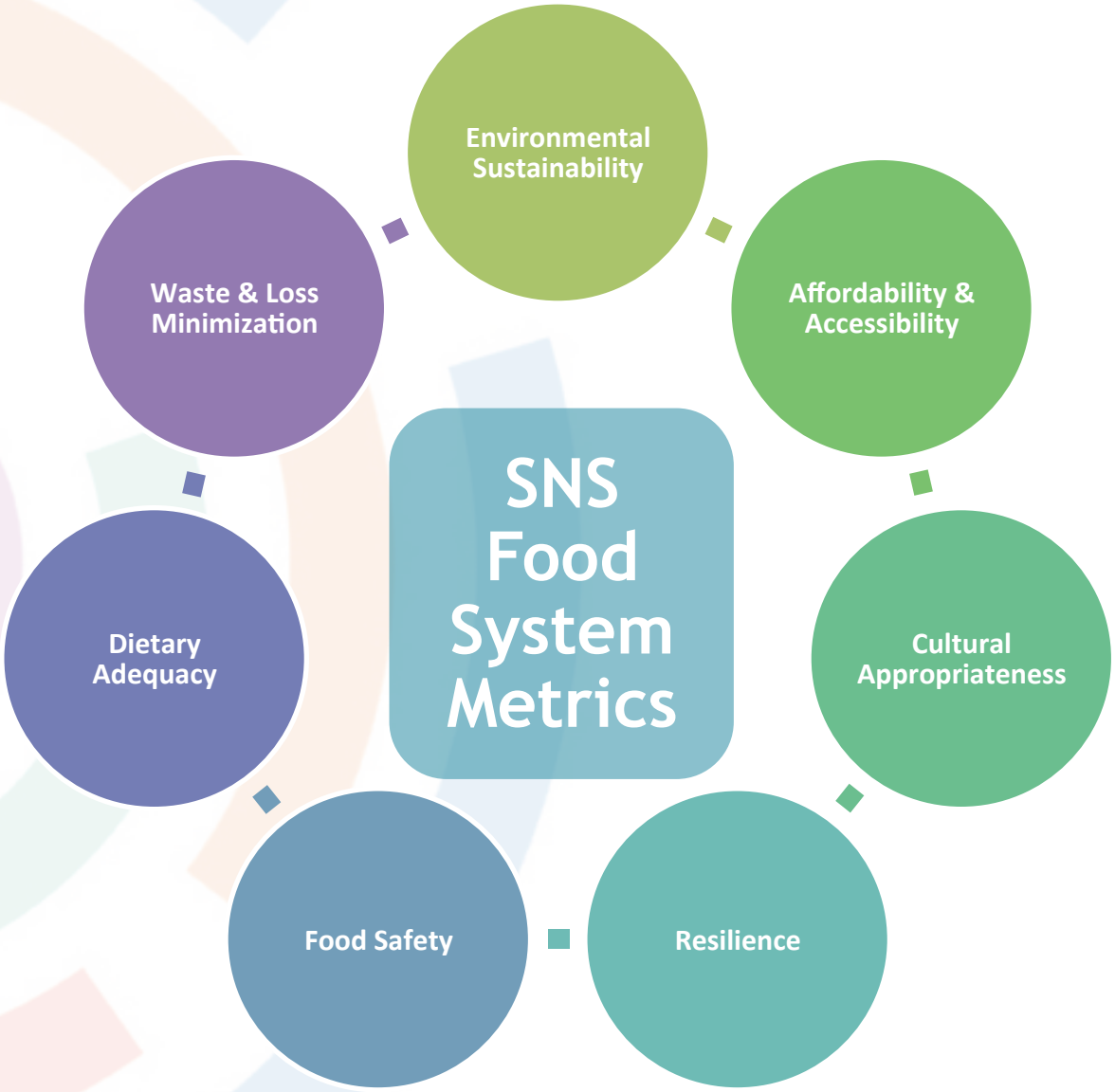
SNS Assessment Timeline



Metrics Proposed by Feb-2015 Workshop Participants



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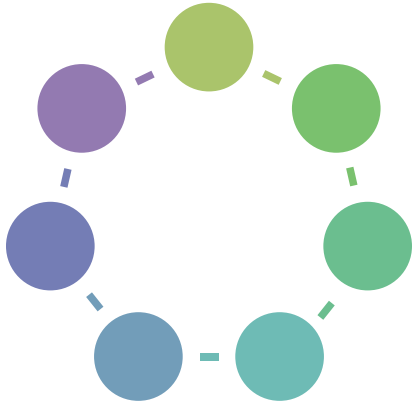
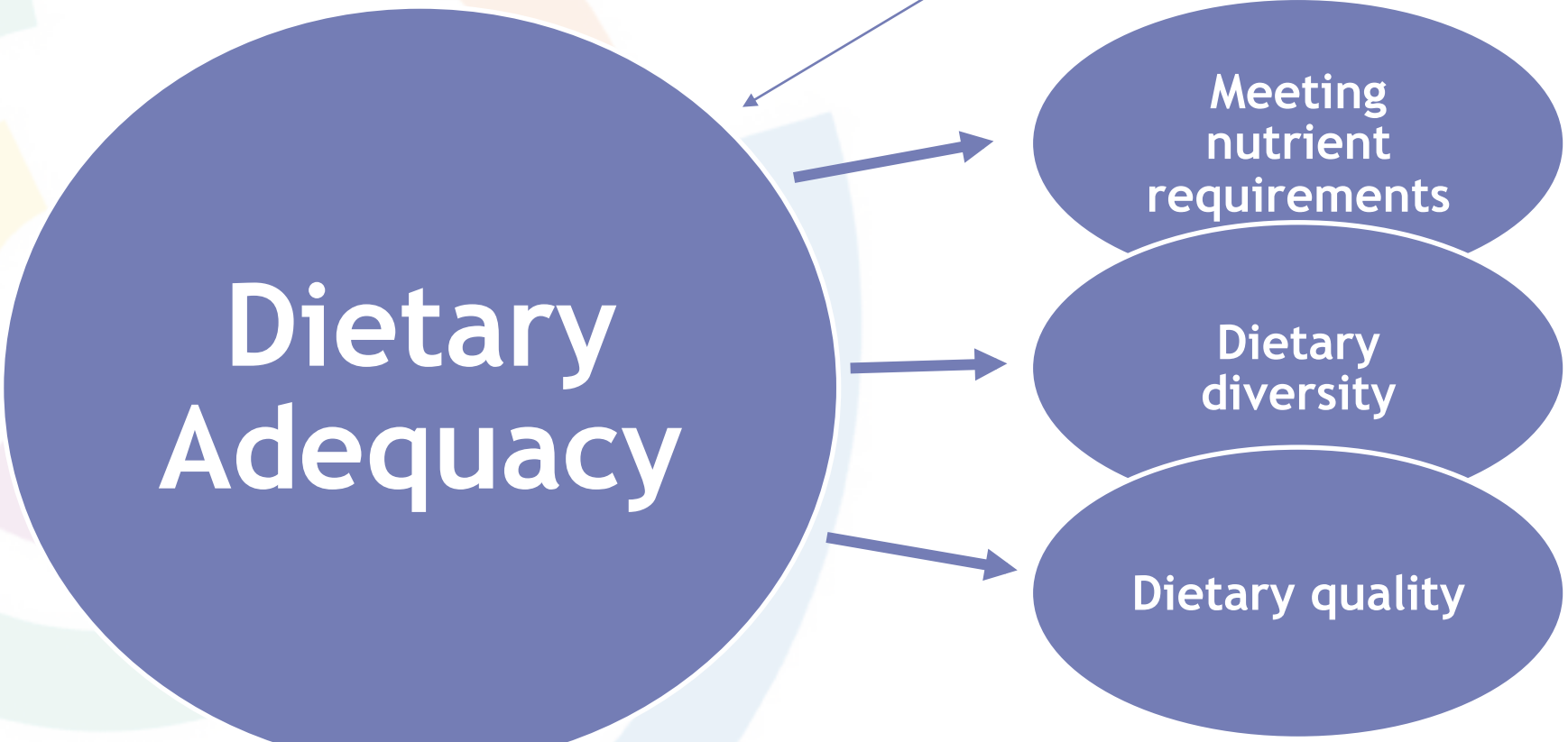
Metrics are composed of multiple components





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Dietary Adequacy Metric Under Development

Meeting Nutrient & Caloric Requirements

- Ex: Standard Gaussian distribution for the consumption of each nutritional component:

$$f(x, \mu, \sigma) = \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

- National Cancer Institute's "Healthy Eating Index (HEI)".

Dietary Diversity

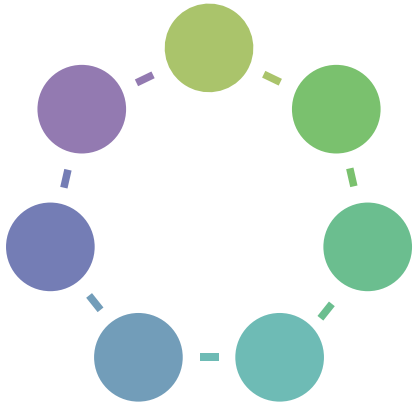
- Access to a diverse dietary mix of nutritious foods.
- Respecting cultural and social norms.
- Ex: Mathematical forms of diversity from the ecological literature could be employed, such as:

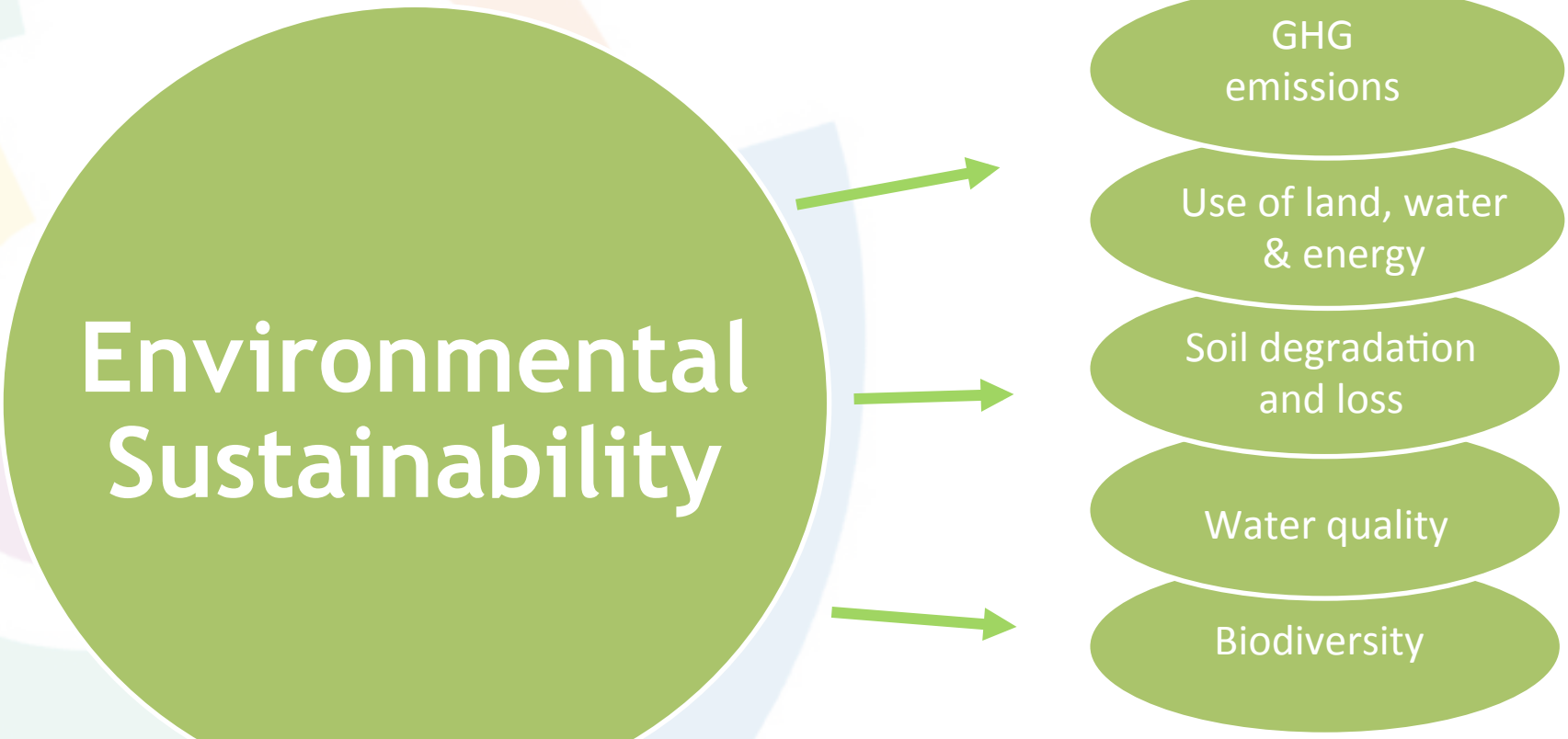
$${}^{q}D = \left(\sum_{i=1}^{S} p_i^q \right)^{1/(1-q)}$$

Dietary Quality

- Impact of crop diversity and growing conditions on nutrient content of specific crops
- Impact of post-harvest handling and processing on waste and preservation.
- Measures of nutrient density

Environmental Sustainability Metric Components (current)





adapted from *Field to Market*

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Upcoming Regional SNS Assessments

- North America:
  - Focus on fruits and vegetables to emphasize nutrition component, impact of the California drought, and potential for Southeastern US compensate

- Asia: India (three states), Bangladesh
- Latin America: Paraguay, other assessment opportunities
- Sub-Saharan Africa: Pursuing opportunities in Ethiopia, Ghana

Engagement Opportunities

- Provide feedback on the metrics
- Sign-up for our monthly newsletter
- Join a CIMSANS workgroup: Open Data, Improved Modeling, Sustainable Nutrition Security
- Become involved in one of the regional SNS assessments

Thank you!

Questions?

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WEBINAR SERIES

Q&A

Dr. Morven McLean & Dr. Dave Gustafson

Washington DC, United States, May 6th , 2015