



DIVERSITAS IGBP IHDP WCRP

Scientific updates on the socio-economic impacts of climate change with respect to food security and food systems.

***Prof. Diana Liverman,
Co-Director, Institute of the Environment, University of Arizona
Chair of the Global Environmental Change and Food Systems Project***

Climate change and food security

Food security exists when all people, at all times, have **physical and economic access** to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life

(World Food Summit 1996)

- **Food security is about much more than agricultural yields or food production**
- Climate change interacts with multiple facets of food systems – through climate impacts on food and agriculture, through emissions from food systems, and through the many policy alternatives for reducing risks and managing greenhouse gases
- Food systems not well addressed in international assessments (IPCC)



Food System ACTIVITIES

Producing food: *natural resources, inputs, markets, ...*

Processing & packaging food: *raw materials, standards, storage requirement, ...*

Distributing & retailing food: *transport, marketing, advertising, ...*

Consuming food: *acquisition, preparation, customs, ...*



Food System OUTCOMES Contributing to:

Social Welfare

- Income
- Employment
- Wealth
- Social capital
- Political capital
- Human capital



Food Security, i.e. stability over time for:

FOOD UTILISATION

- *Nutritional Value*
- *Social Value*
- *Food Safety*

FOOD ACCESS

- *Affordability*
- *Allocation*
- *Preference*

FOOD AVAILABILITY

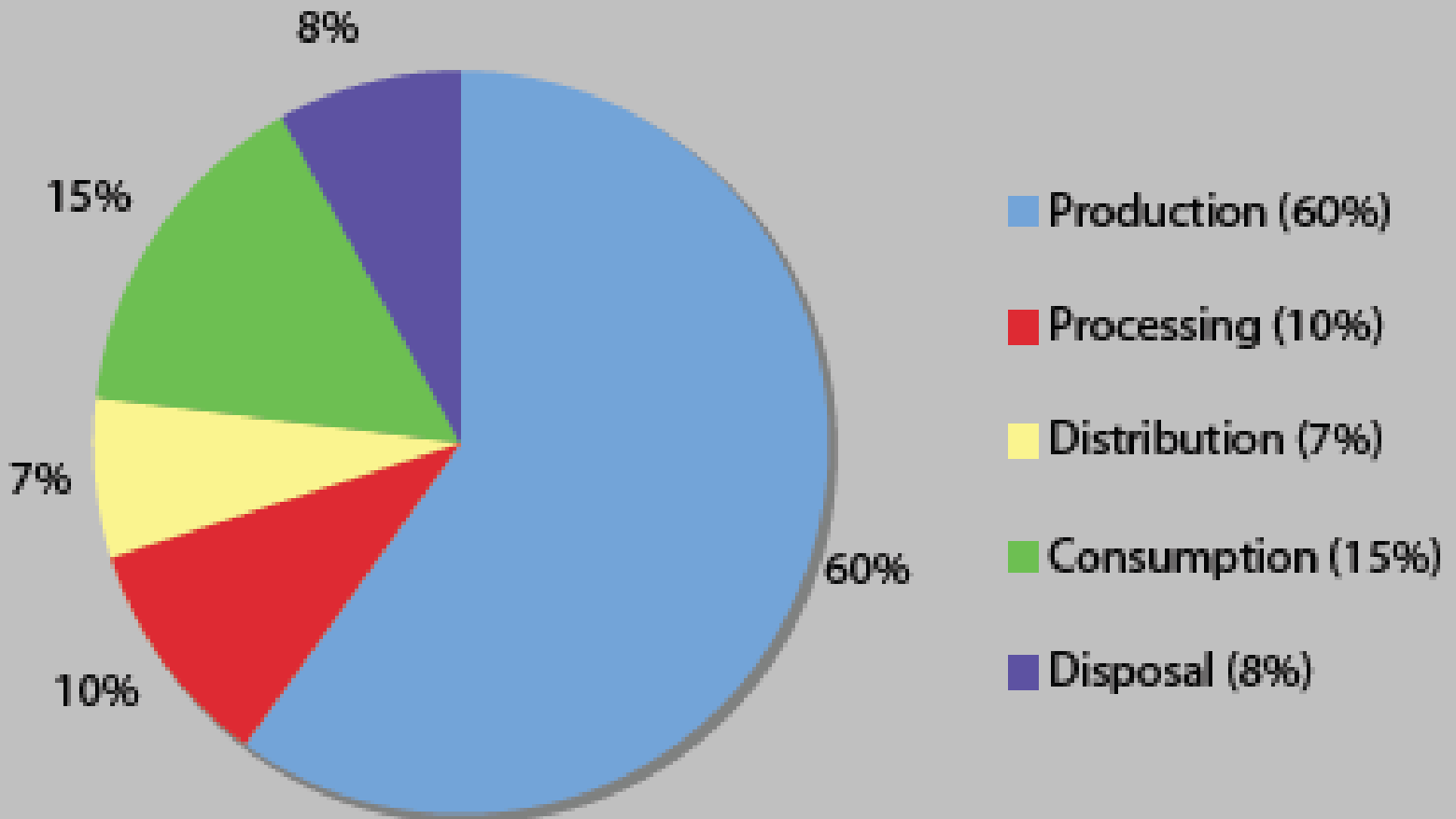
- *Production*
- *Distribution*
- *Exchange*



Environmental Welfare

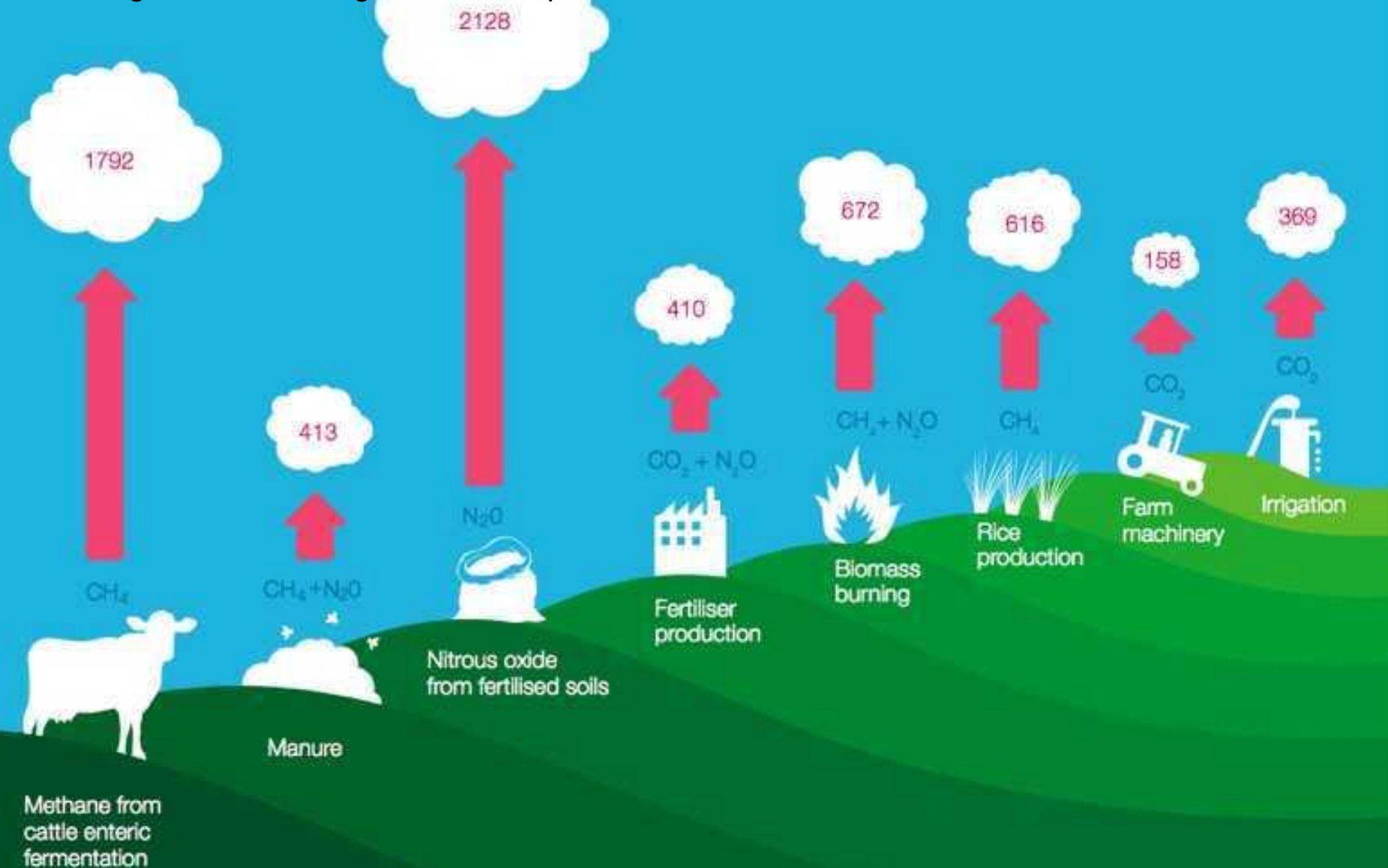
- Ecosystem stocks & flows
- Ecosystem services
- Access to natural capital

Estimated Percentage of Greenhouse Gas Contributions from U.S. Food System by Sector



Sources of agricultural GHGs

excluding land use change Mt CO₂-eq



International research programs

Global Environmental Change and Food Systems
(GECAFS) 2001 to 2011

www.gecafs.org

Earth System Governance Project

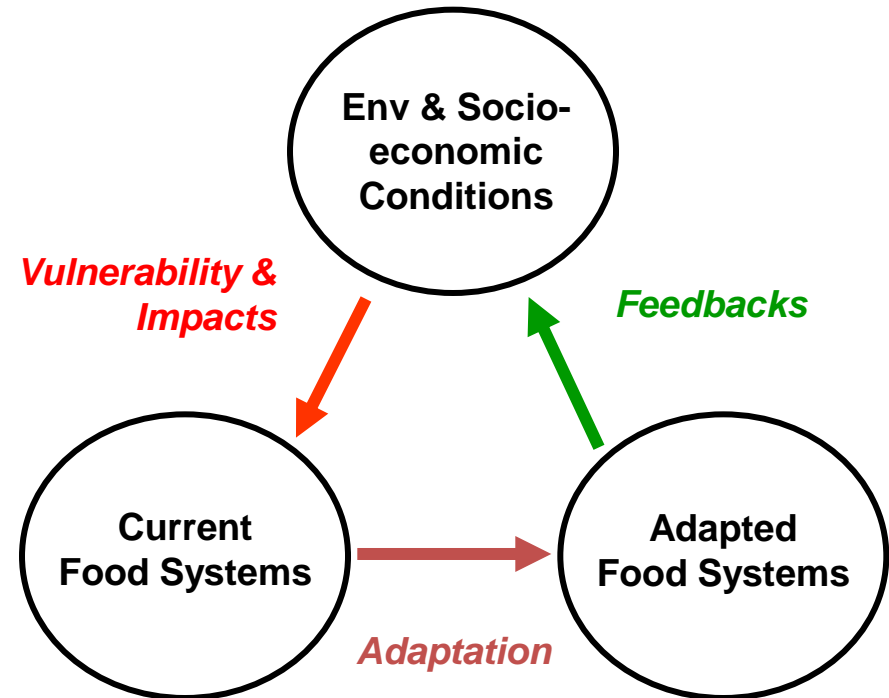
www.earthsystemgovernance.org

- *IHDP focus on the architecture, agency, allocation, accountability and adaptiveness of ways we govern global environmental issues*
- *Includes governing food in the context of global change*

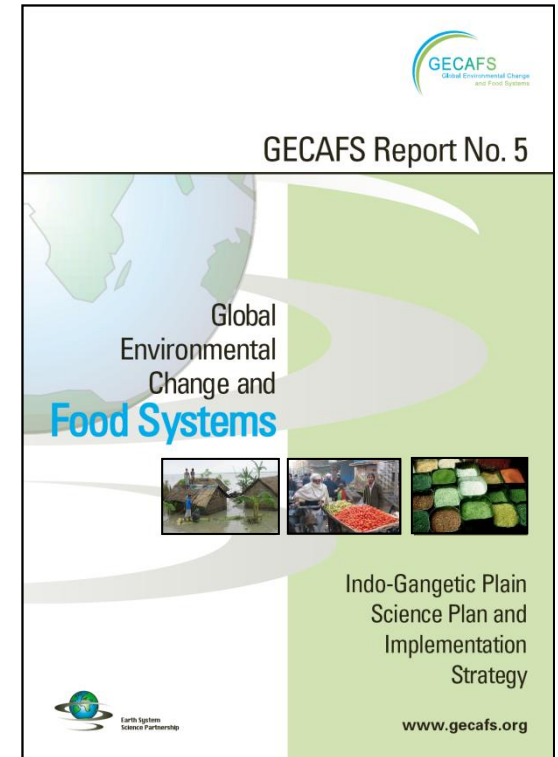
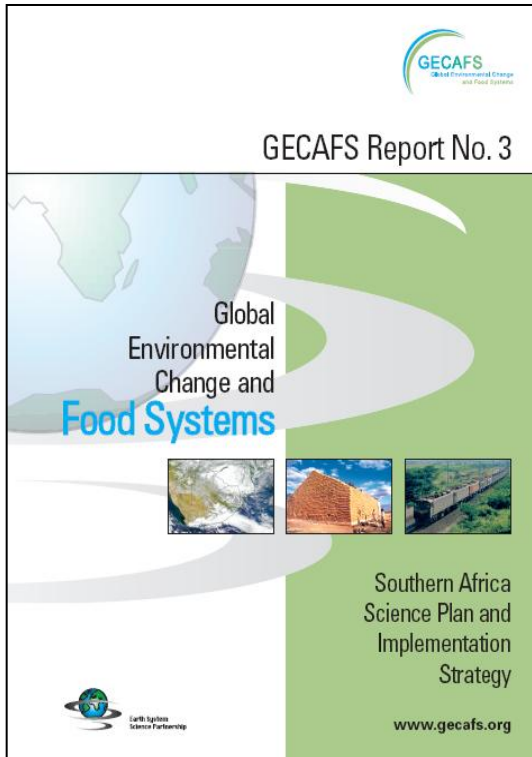
GECAFS

“Fundamental Questions”

- How will GEC affect the vulnerability of food systems in different regions?
- How might food systems be adapted to cope with GEC so as to enhance food security?
- What would be the consequences of adaptation options for environmental and socioeconomic conditions?



GECAFS Regional Science Plans



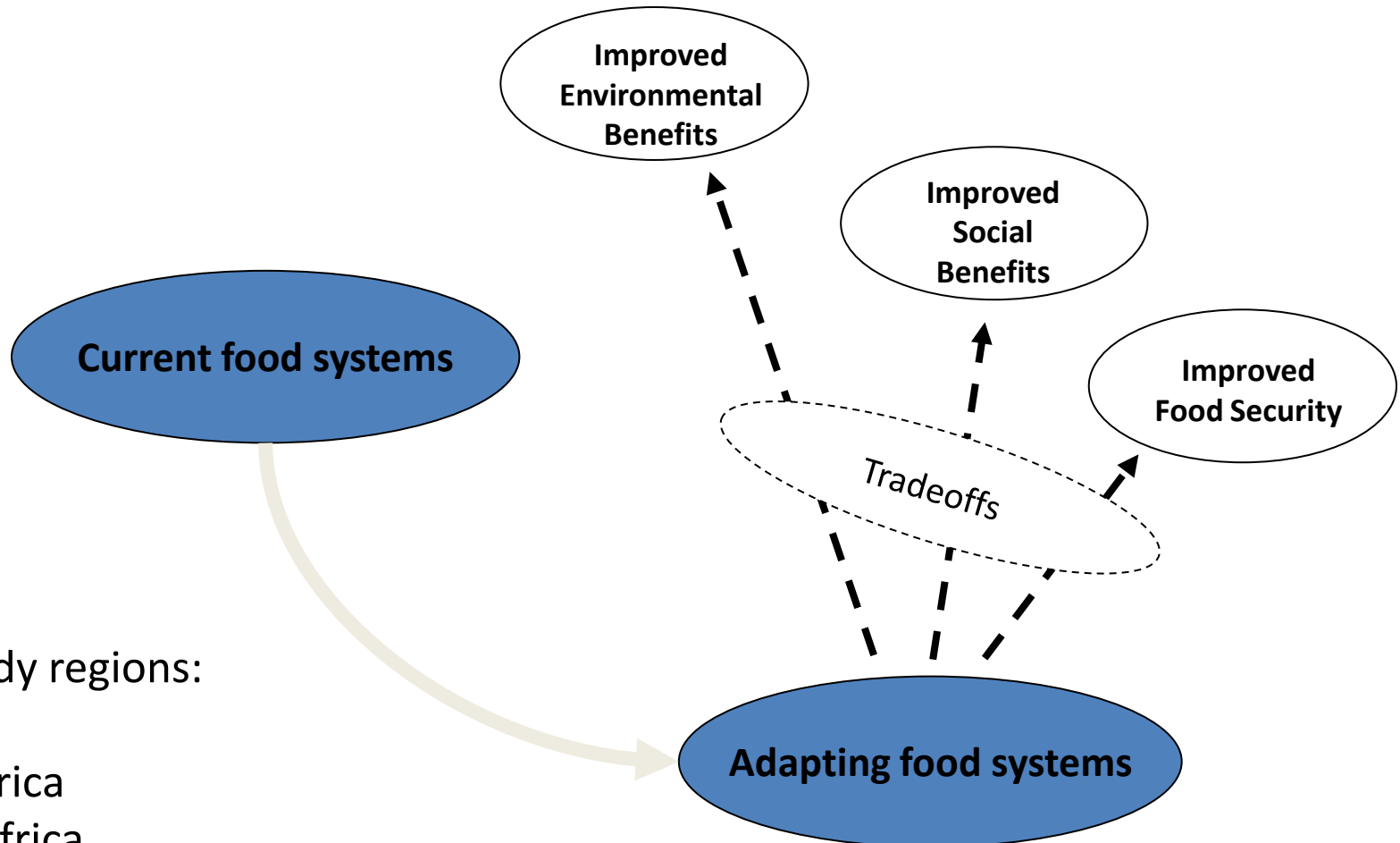
- ✓ Policy-relevant research at regional-level
- ✓ Focus on vulnerability/impacts, adaptation and feedbacks
- ✓ Based on improved conceptual understanding and methods
- ✓ Innovative research partnerships

Climate Change, Agriculture and Food Security (CCAFS)

www.ccafs.cgiar.org

CGIAR (Consortium Group on International Agricultural Research) in partnership with ESSP

- To provide diagnosis and analysis to ensure the inclusion of agriculture, livestock and fisheries in climate change policies
- To identify and develop pro-poor adaptation and mitigation practices, technologies and policies for food systems and rural livelihoods
- 10 year program (COP16 launch on Dec 4th 2010)



Initial study regions:

- ✓ East Africa
- ✓ West Africa
- ✓ Indo-Gangetic Plain

Food security concerns

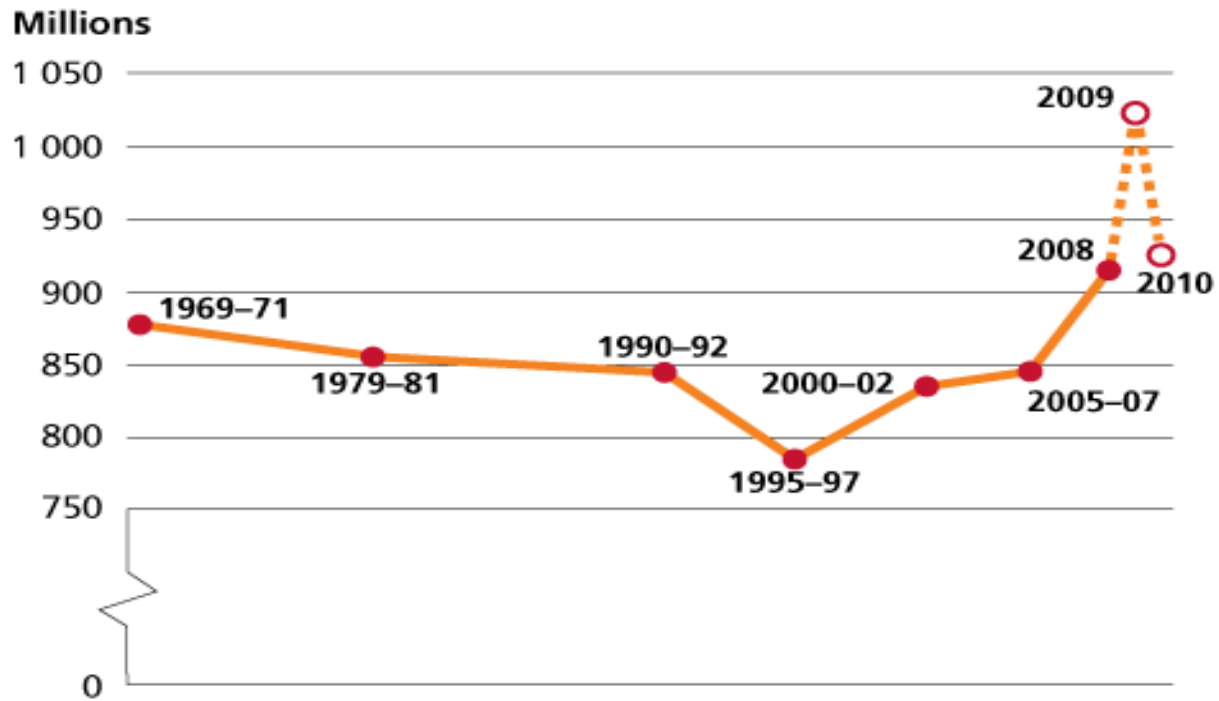
- Price increases and volatility – particular impact on poor
- Trade offs with alternative land uses – biofuels, forests, wetland ecosystems, urbanization
- Unhealthy diets
- Risks and benefits of globalized and regional food systems
- Changing governance of food systems

FAO Food Price Index

2002-2004=100



Trends in world hunger

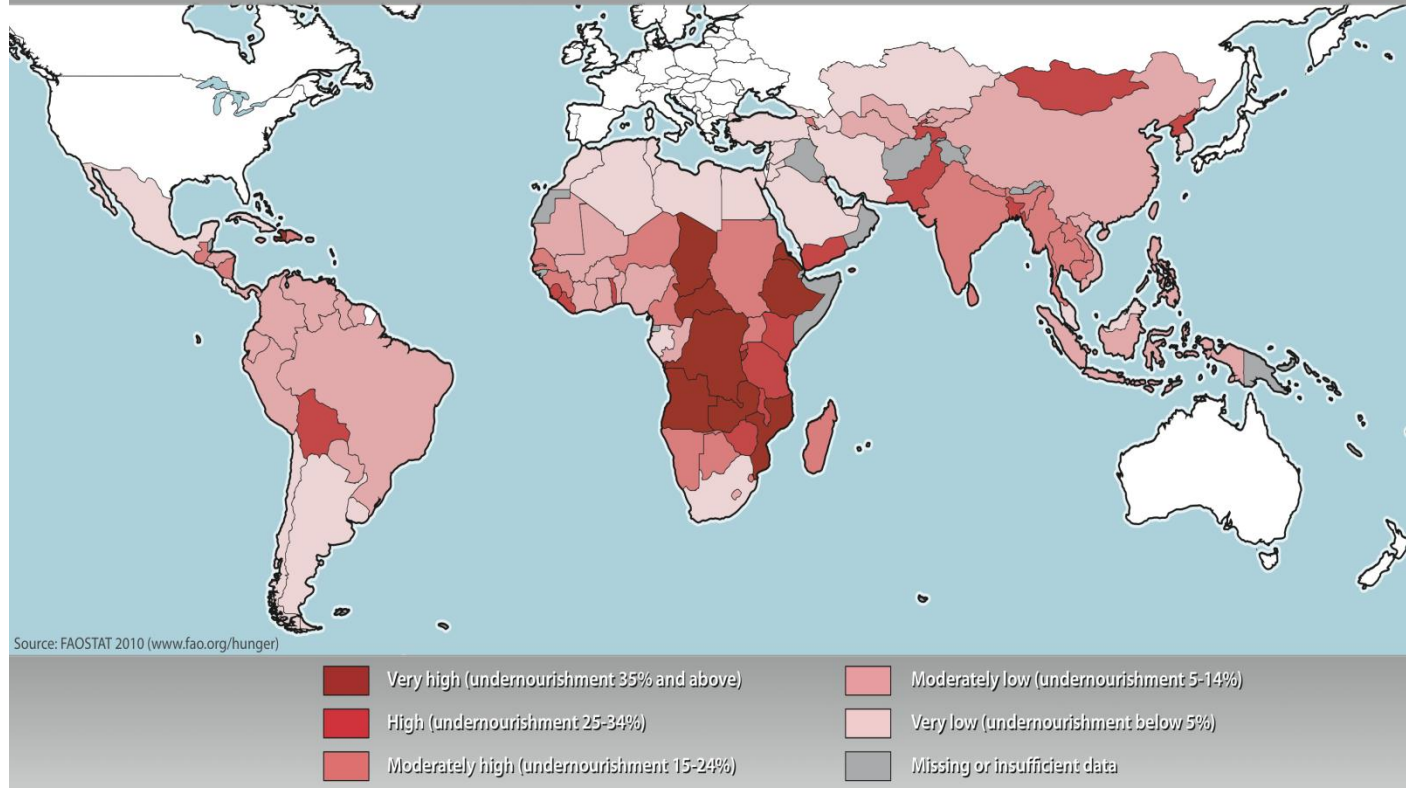


Note: Figures for 2009 and 2010 are estimated by FAO with input from the United States Department of Agriculture, Economic Research Service. Full details of the methodology are provided in the technical background notes (available at www.fao.org/publication/sofi/en/).

Source: FAO.

FAO Hunger Map 2010

Prevalence of undernourishment in developing countries



The designations employed and the presentation of material in the map(s) do not imply the expression of any opinion whatsoever on the part of FAO concerning the legal or constitutional status of any country, territory or sea area, or concerning the delimitation of frontiers.

GECAFS Synthesis Project



FOOD SECURITY AND GLOBAL ENVIRONMENTAL CHANGE

Vulnerability, resilience and adaptation in food systems

The science – policy interface

Engaging stakeholders

The value of regional food systems

Scenarios

Food wars and human rights

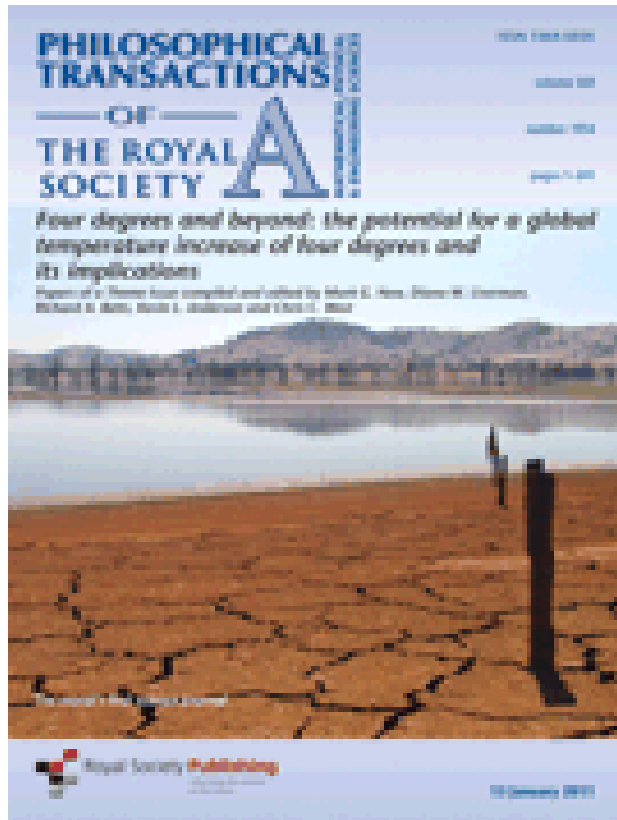
Governance beyond the state: non-state actors and food systems

Green food systems for 9 billion

Surprises and possibilities

Edited by
John Ingram, Polly Ericksen
and Diana Liverman

Four degrees and beyond: the potential for a global temperature increase of four degrees and its implications

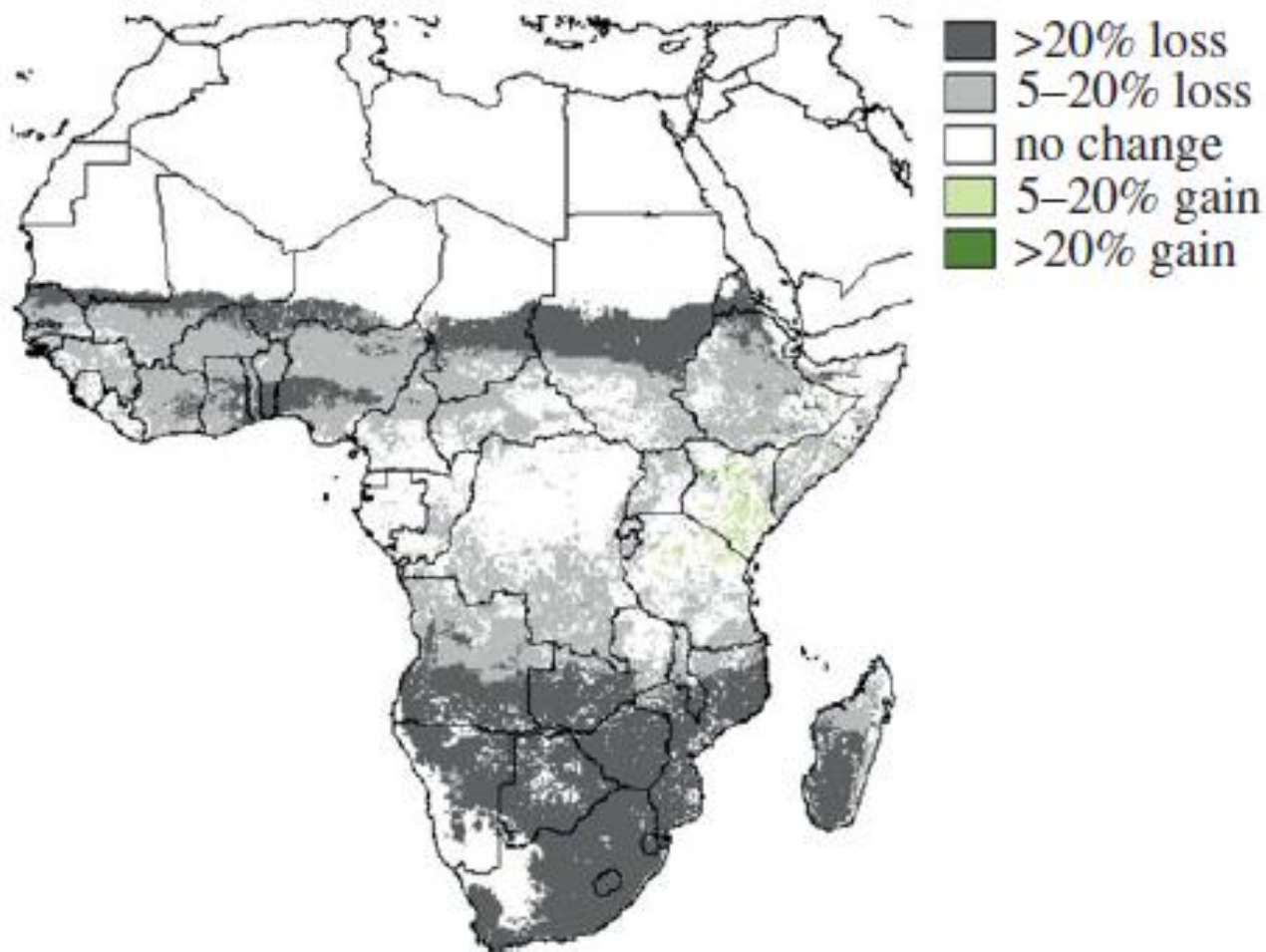


Based on an Oxford University conference the papers address the chances of reaching 4°C and the regional impacts on water, sea level, agriculture, forests, migration

<http://rsta.royalsocietypublishing.org/>

Phil. Trans. R. Soc. A (2011) **369**

Length of growing period in the 2090s compared with the present.
Mean percentage change for an ensemble of 14 GCMs



African crops at 5 degrees

	2000s yield (kg ha ⁻¹)	2090s +5°C yield (kg ha ⁻¹) ^a	mean % change in production ^a	CV of change in production % ^b
maize				
central	744	612	-13	23
east	954	689	-19	7
southern	748	612	-16	22
west	764	536	-23	23
mean	806	612	-24	19
beans				
central	666	175	-69	58
east	685	263	-47	6
southern	716	220	-68	48
west	487	63	-87	47
mean	639	182	-71	34
<i>B. decumbens</i>				
central	1493	1311	-4	3
east	1745	1570	+9	7
southern	1384	1344	+11	18
west	1498	1437	-6	27
mean	1525	1422	-7	15

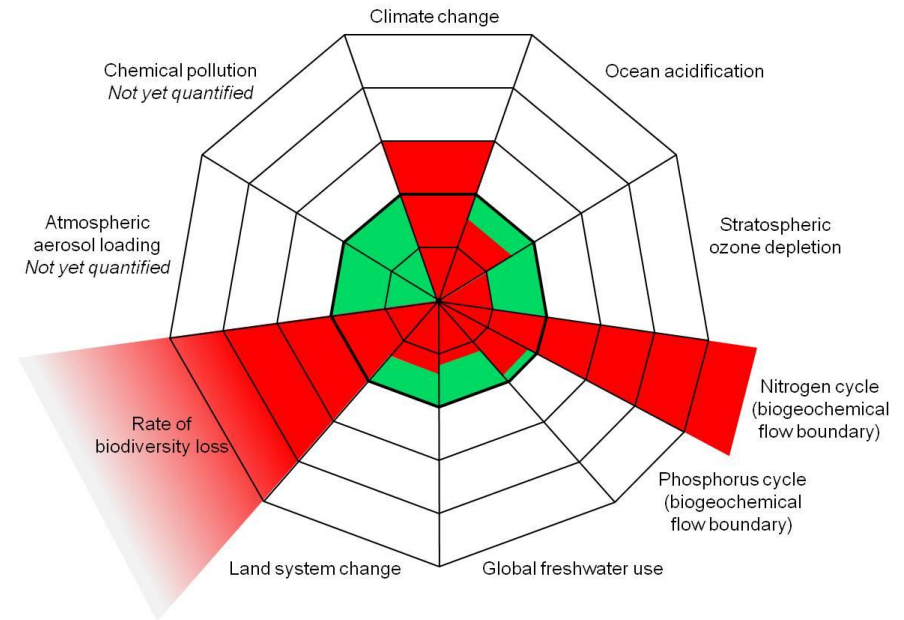
^aSimulated from the ensemble mean climate of all applicable GCMs and the three AR4 SRES scenarios.

^bCoefficient of variation ($100\sigma/\mu$) estimated from the simulated yields using the 75th percentile of the ensemble climate distribution for all GCMs and scenarios.

Food Systems and Planetary Boundaries

Food System ACTIVITIES

Producing food
Processing & Packaging food
Distributing & Retailing food
Consuming food



Johan Rockström, Will Steffen, Kevin Noone, Åsa Persson, F. Stuart Chapin, Eric F. Lambin, Timothy M. Lenton, Marten Scheffer, Carl Folke, Hans Joachim Schellnhuber, Björn Nykvist, Cynthia A. de Wit, Terry Hughes, Sander van der Leeuw, Henning Rodhe, Sverker Sörlin, Peter K. Snyder, Robert Costanza, Uno Svedin, Malin Falkenmark, Louise Karlberg, Robert W. Corell, Victoria J. Fabry, James Hansen, Brian Walker, Diana Liverman, Katherine Richardson, Paul Crutzen & Jonathan A. Foley. 2009. [A safe operating space for humanity](#). Nature 461, 472-475 (24 September 2009)

Example contributions of FSAs to PBs	Producing food	Processing & Packaging food	Distributing & Retailing food	Consuming food
Climate change	GHGs; albedo, dust	Energy	Transport and refrig. emissions	GHGs from cooking
N cycle	Eutrophic ⁿ , GHGs	Effluent	NOx from transport	Waste
P cycle	P reserves	Detergents		Waste
Fresh water use	Irrigation	Washing, heating, cooling		Cooking, cleaning
Land use change	Intensific ⁿ , soil degd ⁿ	Paper/card	Transport & retail infrastructure	
Biodiversity loss	Deforestation, soils, fishing	[Aluminium]	Invasives	Consumer choices
Atmos. aerosols			Shipping	
Chemical pollution	Pesticides	Effluent	Transport emissions	Cooking, cleaning

Challenges in modeling the impact of climate change on food systems

- Uncertainties in downscaled climate projections
- Understanding the adaptive potential and limits to adaptation in agriculture and food systems
- Production and price signals in a global systems

AGMIP (Agricultural model intercomparison project)

Value of a Food Systems approach for large-scale, interdisciplinary studies

- Identifies two-way interactions between GEC and food security
 - ✓ focuses on multiple vulnerabilities within the food system for a range of scales and levels
 - ✓ highlights underemphasised aspects of the food system such as storing, processing, packaging, trading and consuming food
 - ✓ identifies feedbacks to the earth system from the whole food system (GHG, biodiversity)
 - ✓ provides a framework for systematic adaptation planning at region-level
- Allows analysis of multiple food system outcomes
 - ✓ food security
 - ✓ ecosystem services
 - ✓ social welfare