Food Security, Farming, and Climate Change to 2050

Scenarios, Results, Policy Options

Gerald C. Nelson
Senior Research Fellow, IFPRI
Theme Leader, CCAFS

National Academy of Sciences
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Food Security Challenges are Unprecedented

- Population growth
  - 50 percent more people between 2000 and 2050
  - Almost all in developing countries
- Income growth in developing countries
  - More demand for high valued food (meat, fish, fruits, vegetables)
- Climate change – a threat multiplier
  - Reduced productivity of existing varieties and cropping systems

IFPRI 2009 results on the costs of adaptation

- Unchecked climate change will result in a 20 percent increase in malnourished children in 2050 (25 million more than with perfect mitigation)

- Public-sector agricultural productivity expenditures in developing countries of over $7 billion *per year* are needed to compensate
  - Public sector research
  - Irrigation
  - Rural roads

New messages for sustainable food security and climate change resilience

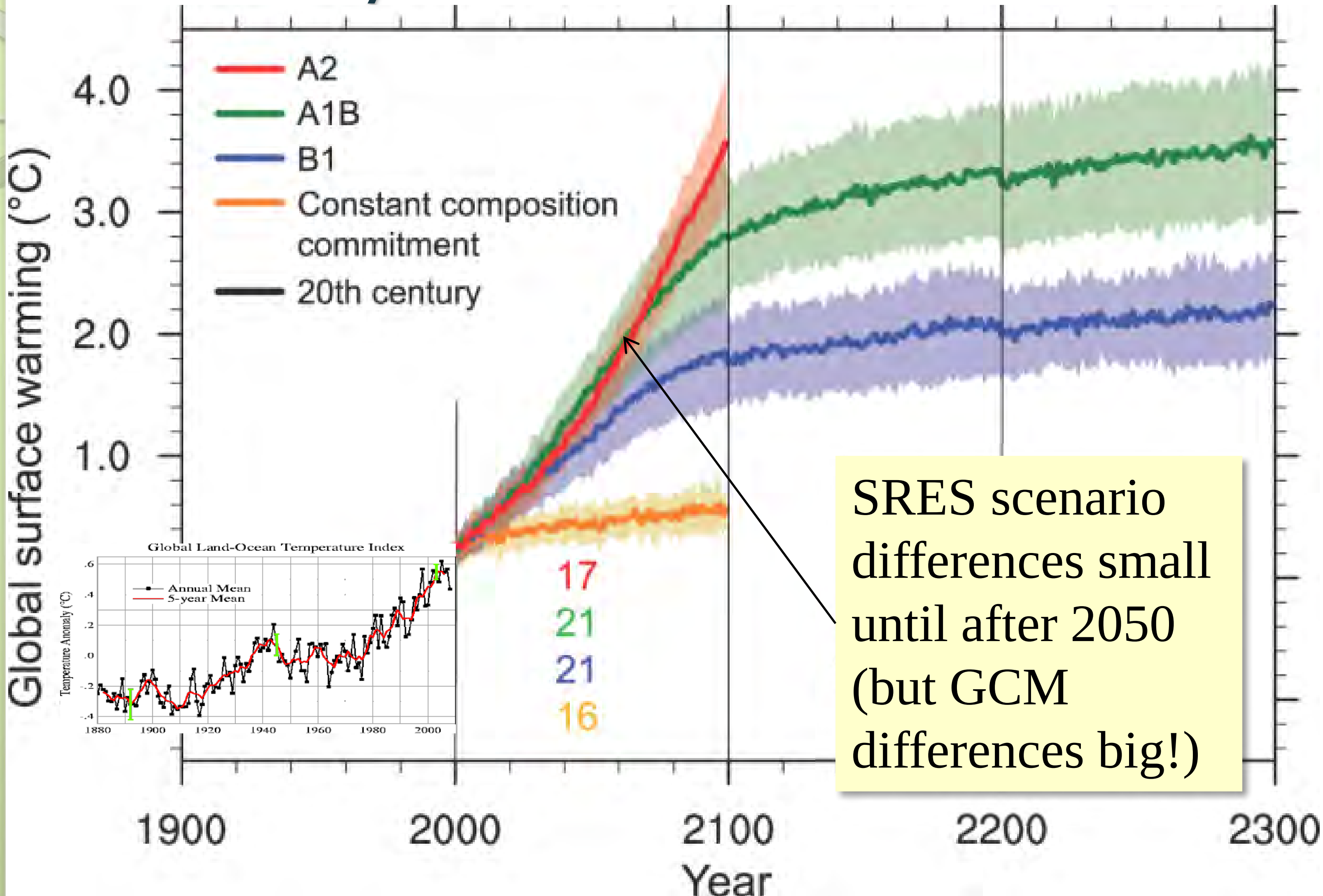
- Address poverty *and climate change resilience* with broad-based income growth
- Invest in specific kinds of agricultural productivity
- Strengthen international trade agreements

Outline

- Climate change basics
- Impacts: crop yields, supply, demand, and trade
- Assessing the food security challenge with and without climate change

CLIMATE CHANGE BASICS

Average temperatures could increase substantially



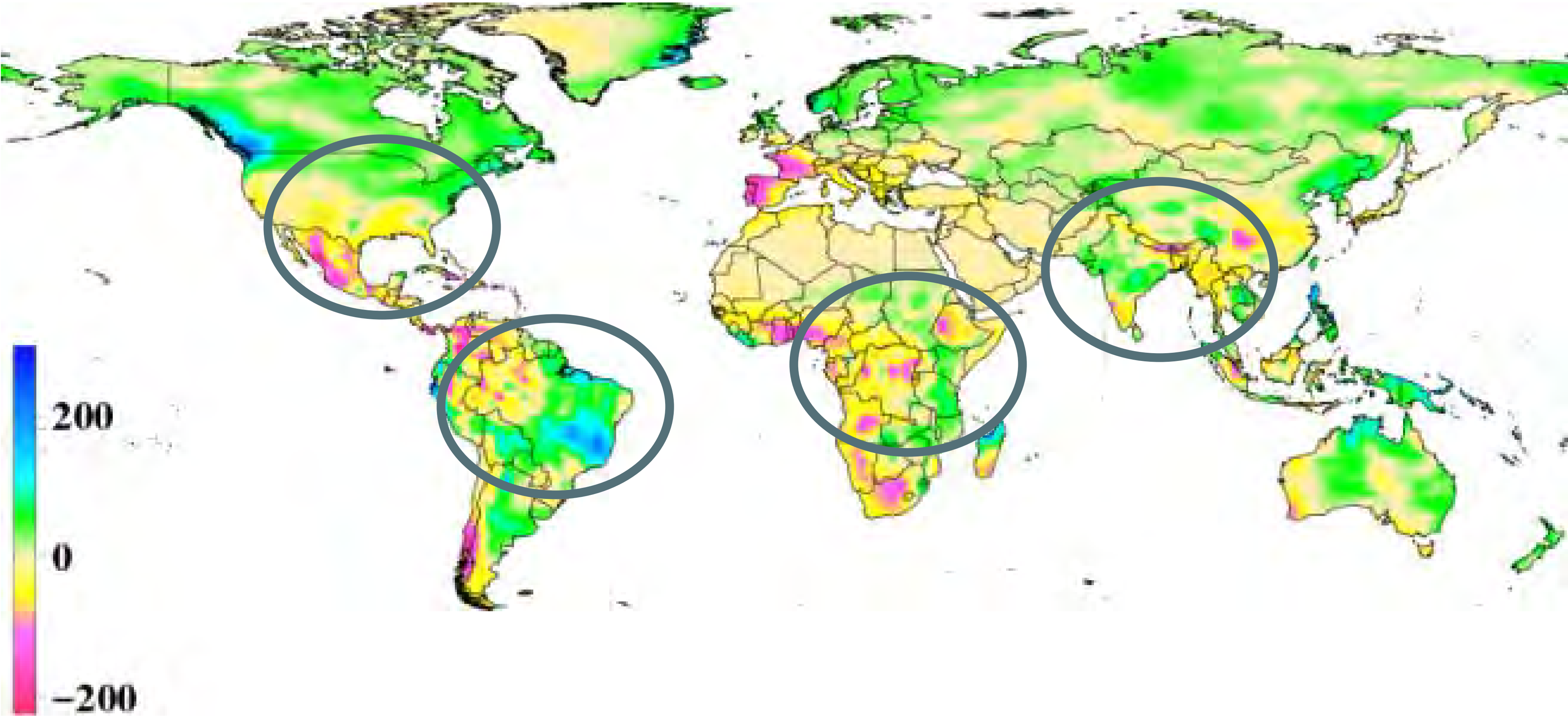
SRES scenario differences small until after 2050 (but GCM differences big!)

Source: Figure 10.4 in Meehl, et al. (2007)

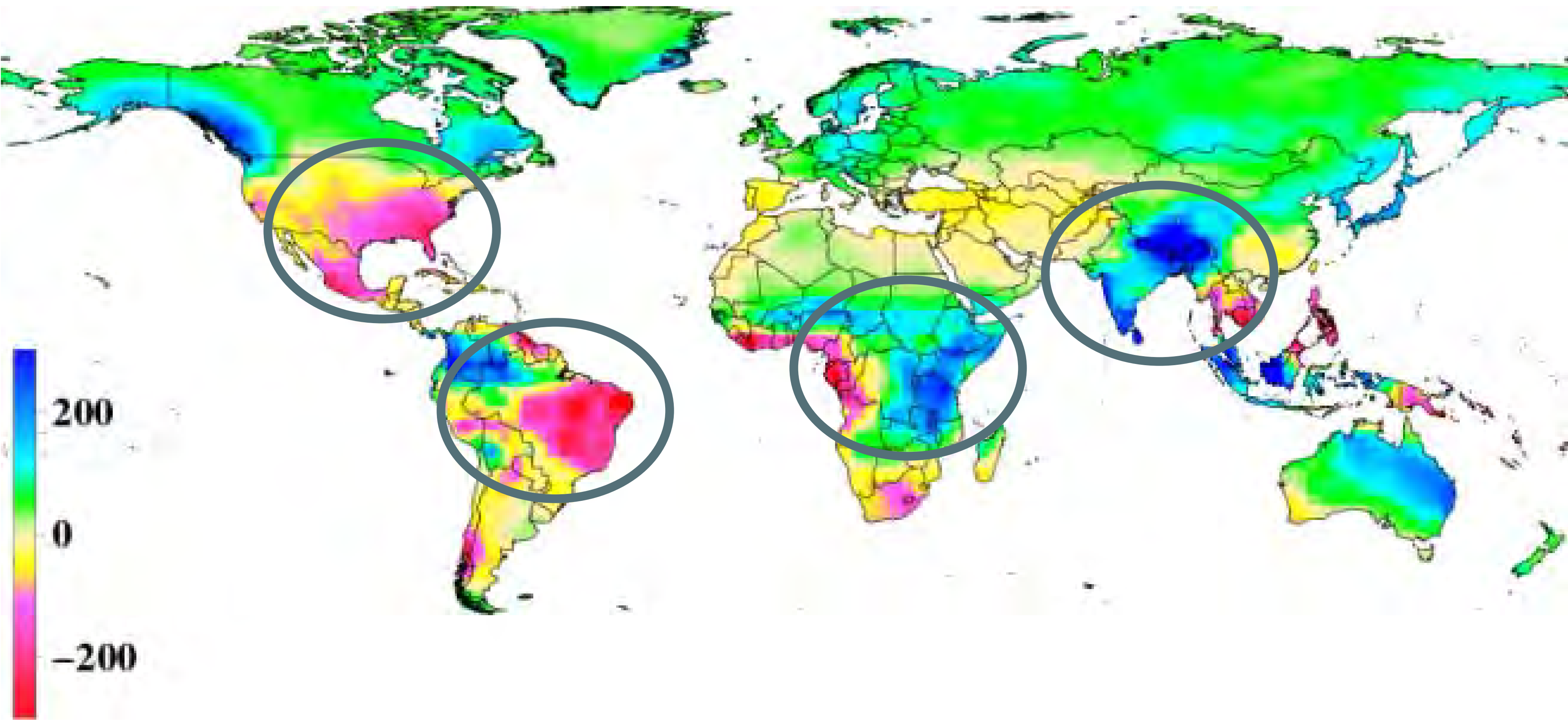
DIFFERENCES IN PRECIPITATION CHANGES BY GCM ARE LARGE

Watch Sub-Saharan Africa, the Amazon, the U.S. and South Asia

Change in average annual precipitation, 2000-2050, CSIRO GCM, A1B (mm)



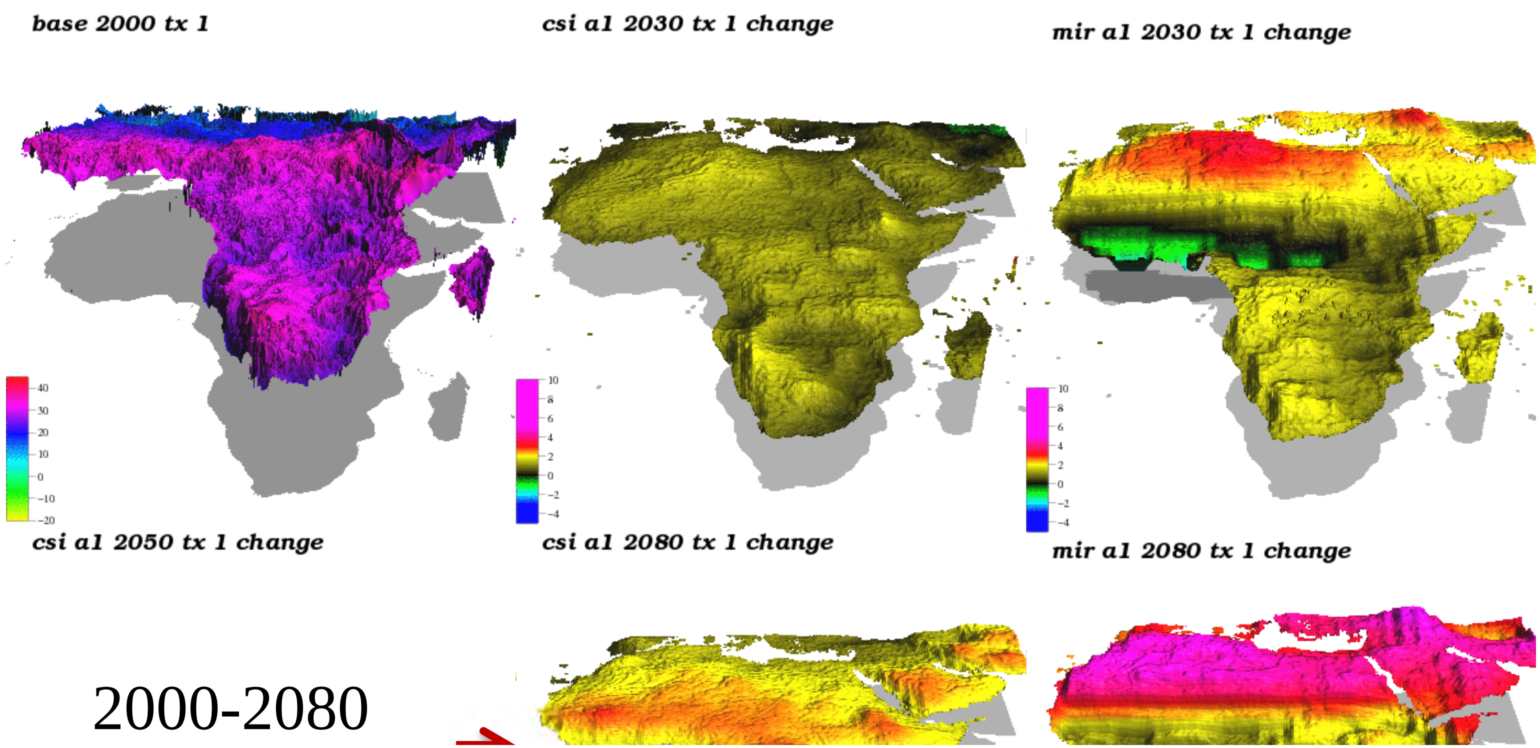
Change in average annual precipitation, 2000-2050, MIROC GCM, A1B (mm)



GCM temperature results vary as well

monthly maximum temp change scenarios, MIROC and CSIRO GCMs

2000 | 2000-2030 change, CSIRO A1B | 2000-2030 change, MIROC A1B

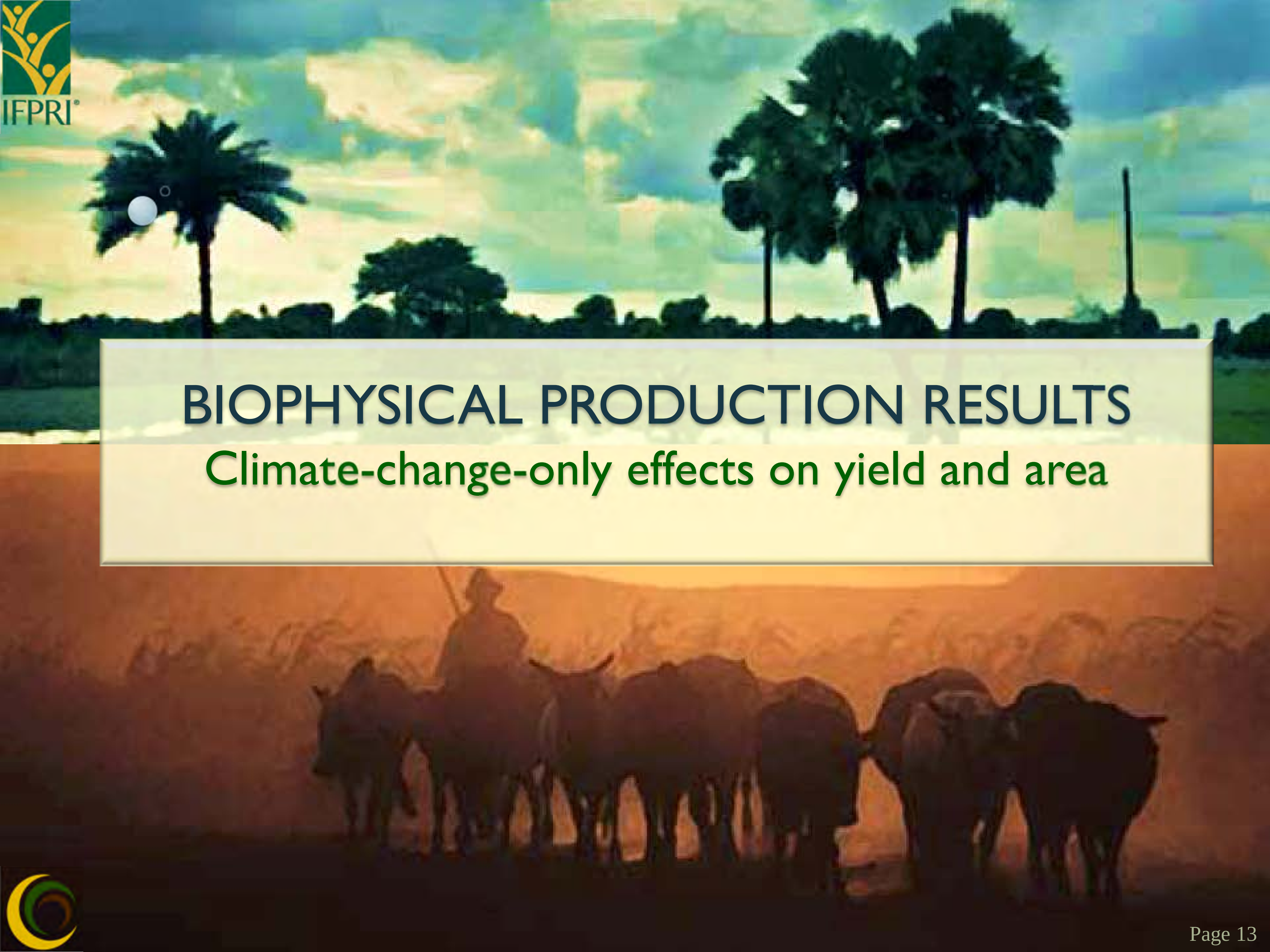


2000-2080

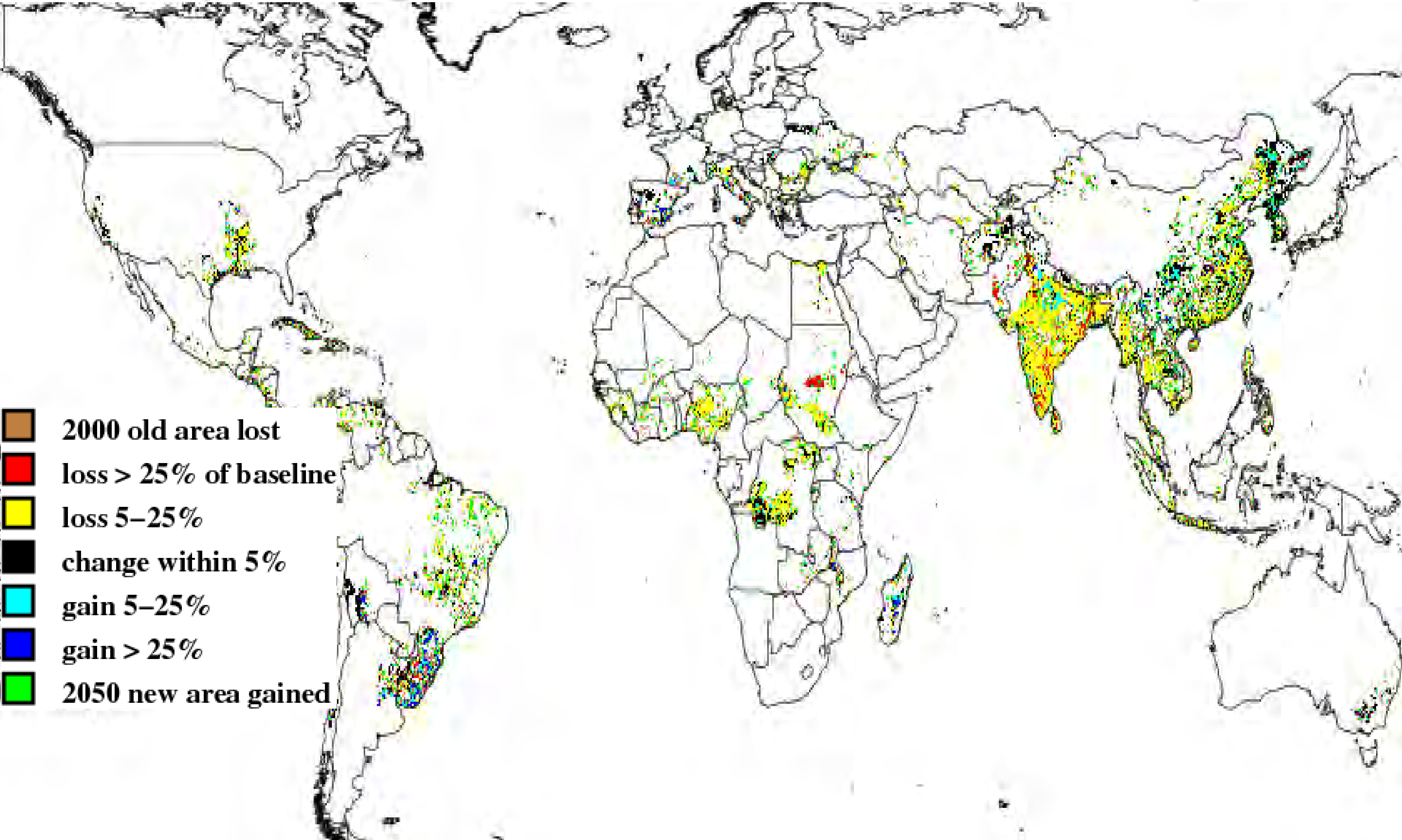
See http://www.ifpri.org/book-775/climate-change/mapindex for animations of different regions

BIOPHYSICAL PRODUCTION RESULTS

Climate-change-only effects on yield and area



Yield Effects, Irrigated Rice, *CSIRO* A1B
(% change 2000 climate to 2050 climate)



Yield Effects, Irrigated Rice, *MIROC* A1B
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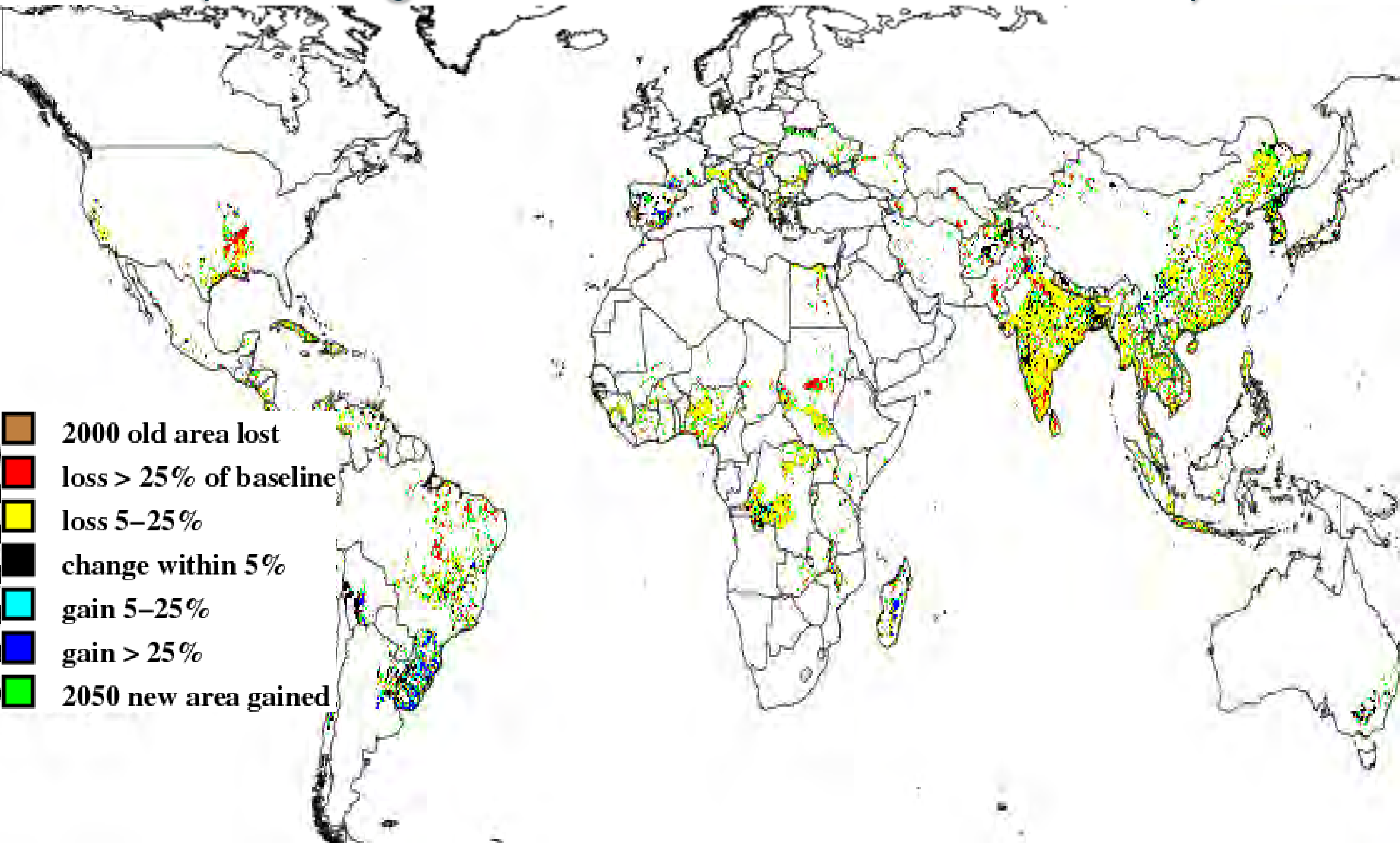
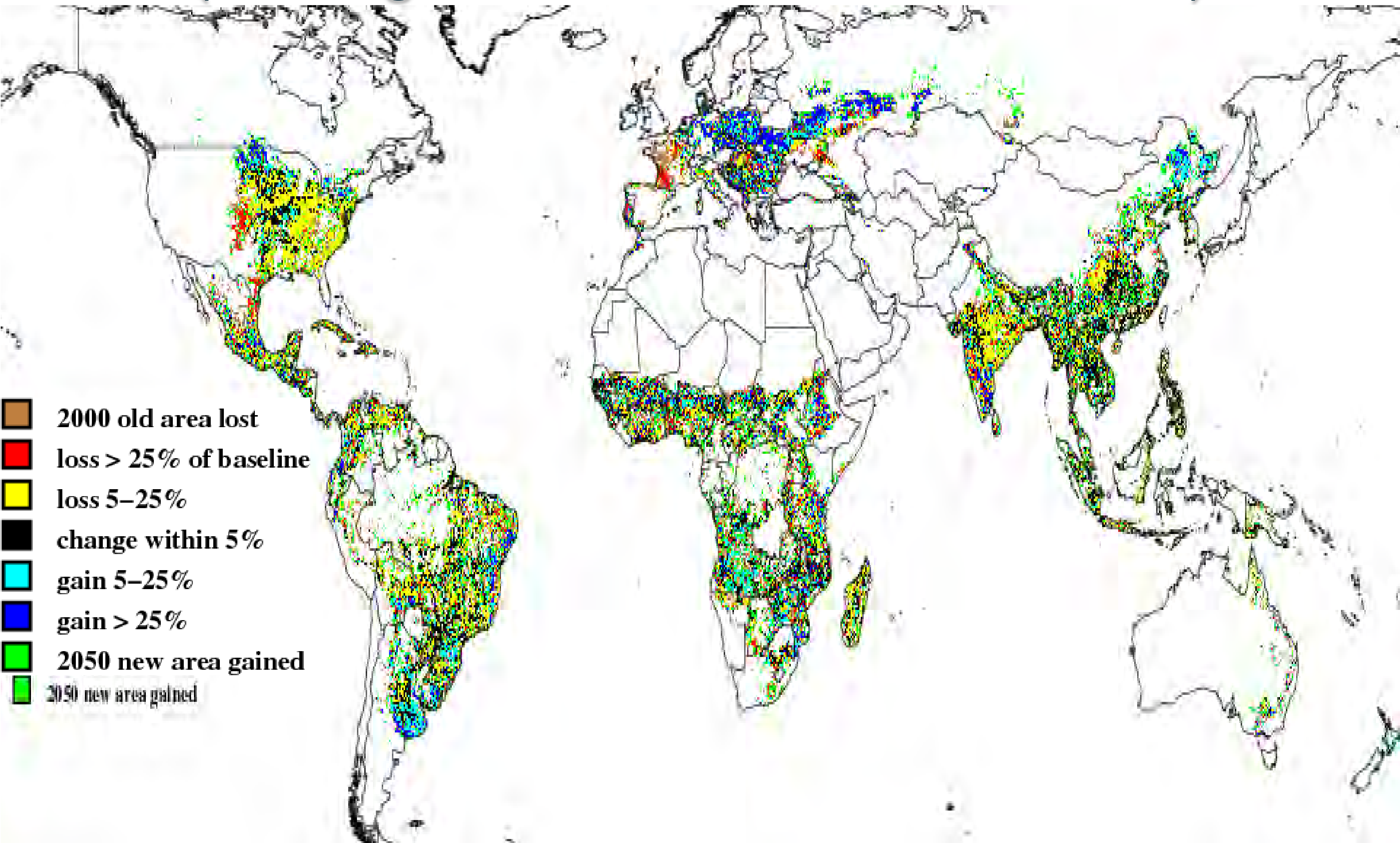


Yield Effects, Rainfed Maize, *CSIRO* A1B
(% change 2000 climate to 2050 climate)



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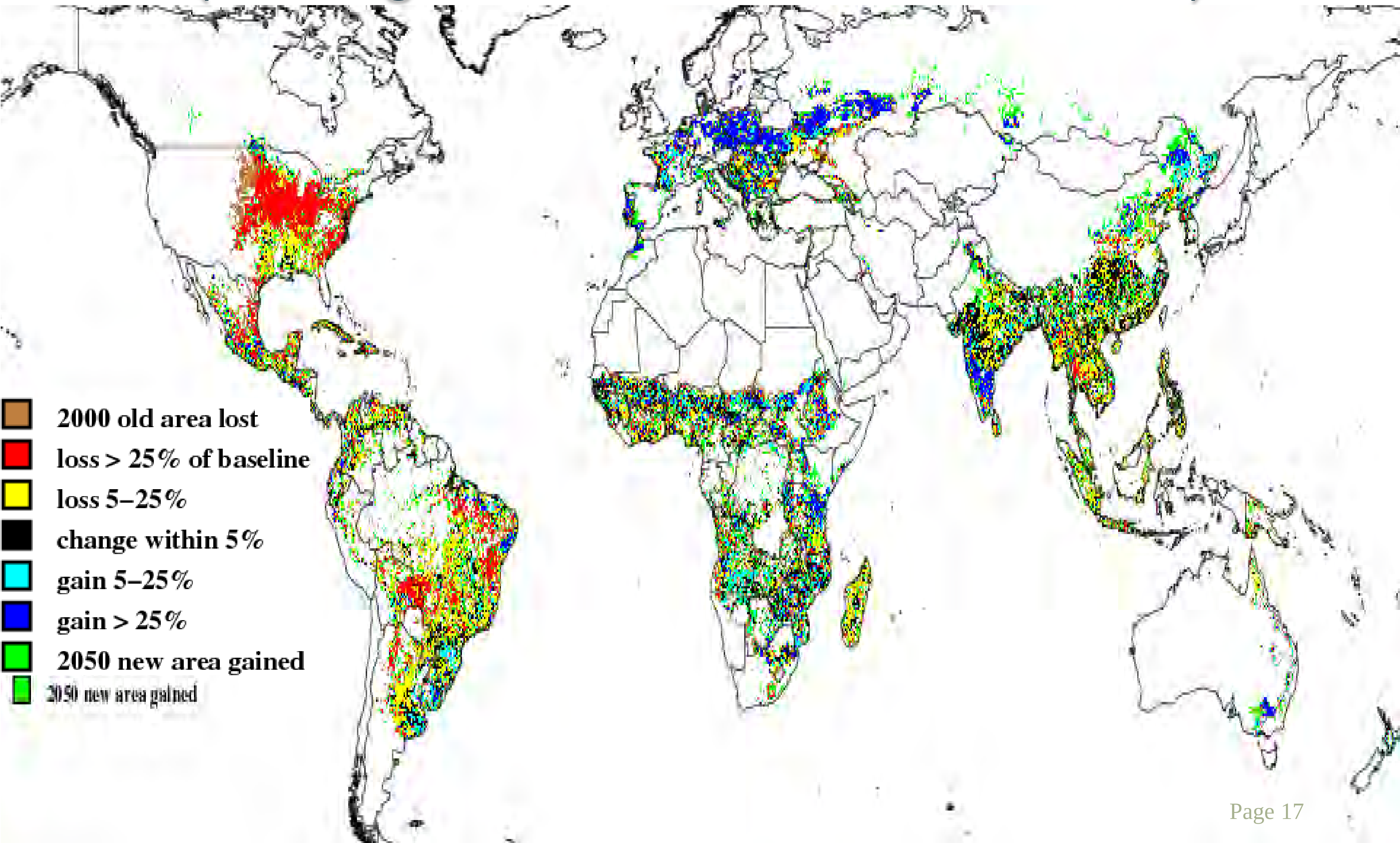
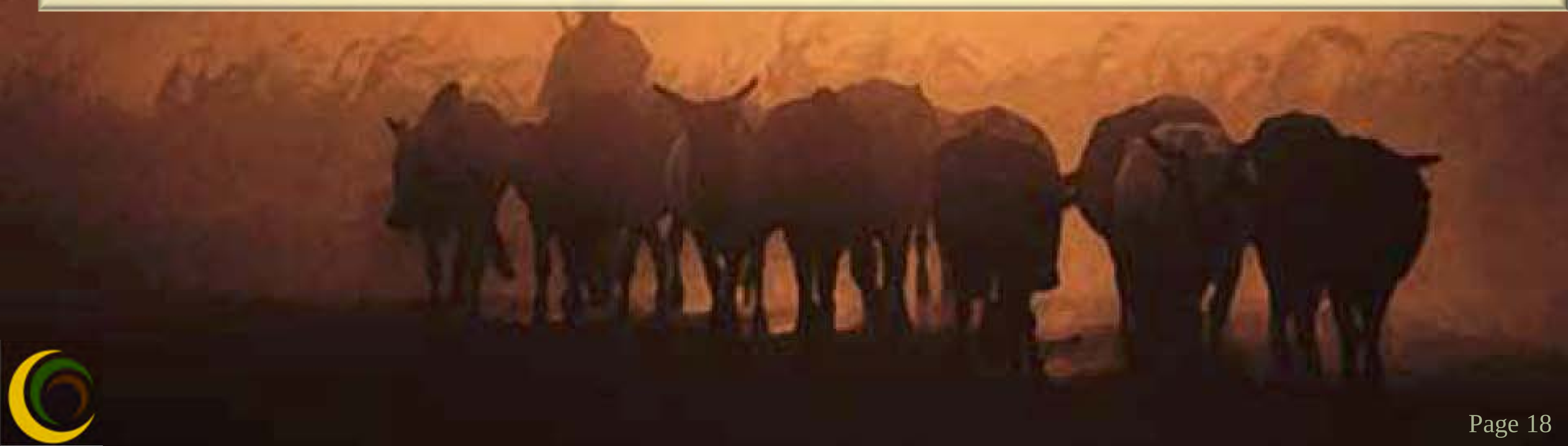


CHARACTERIZING PLAUSIBLE FUTURES

Overall (economic and demographic) scenarios under varying climate futures



Overall scenarios

Plausible futures for population and GDP growth

- Optimistic
  - High GDP and low population growth
- Baseline
  - Medium GDP and medium population growth
- Pessimistic
  - Low GDP and high population growth

Three global and regional GDP per-capita growth scenarios

Global growth rate assumptions, annual average 2010-2050 (%)

	Pessimistic	Baseline	Optimistic
Population	1.04	0.70	0.35
GDP	1.91	3.21	3.58
GDP per capita	0.86	2.49	3.22

African GDP per capita growth rate assumptions, annual average 2010-2050 (%)

	Pessimistic	Baseline	Optimistic
Central Africa	2.42	3.92	4.85
Western Africa	2.04	3.63	4.03
Eastern Africa	2.72	4.18	4.97
Northern Africa	1.78	2.60	3.49
Southern Africa	0.55	2.98	3.44

Five climate scenarios

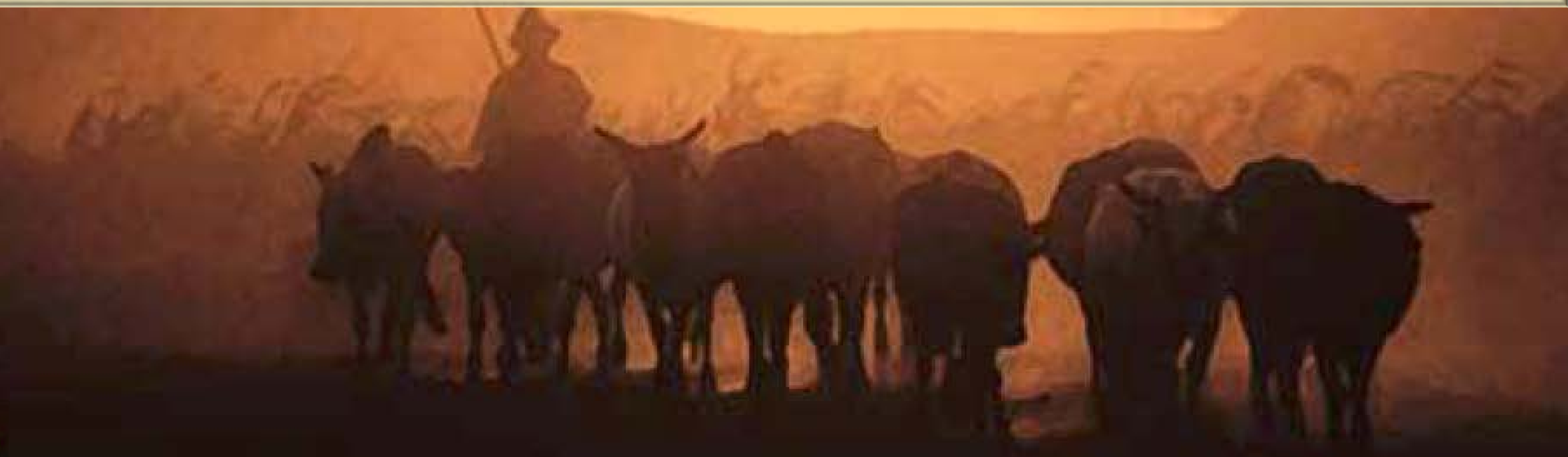
- Climate scientists "All scenarios have equal probability."
- Our modeling approach, for each overall scenario, use climate scenarios from…
  - Two GCMs – MIROC (Japanese) and CSIRO (Australian)
  - Two SRES scenarios – A1B and B1
  - Perfect mitigation

Scenario outcomes

- 3 overall scenarios each with 5 climate scenarios
- 15 plausible futures

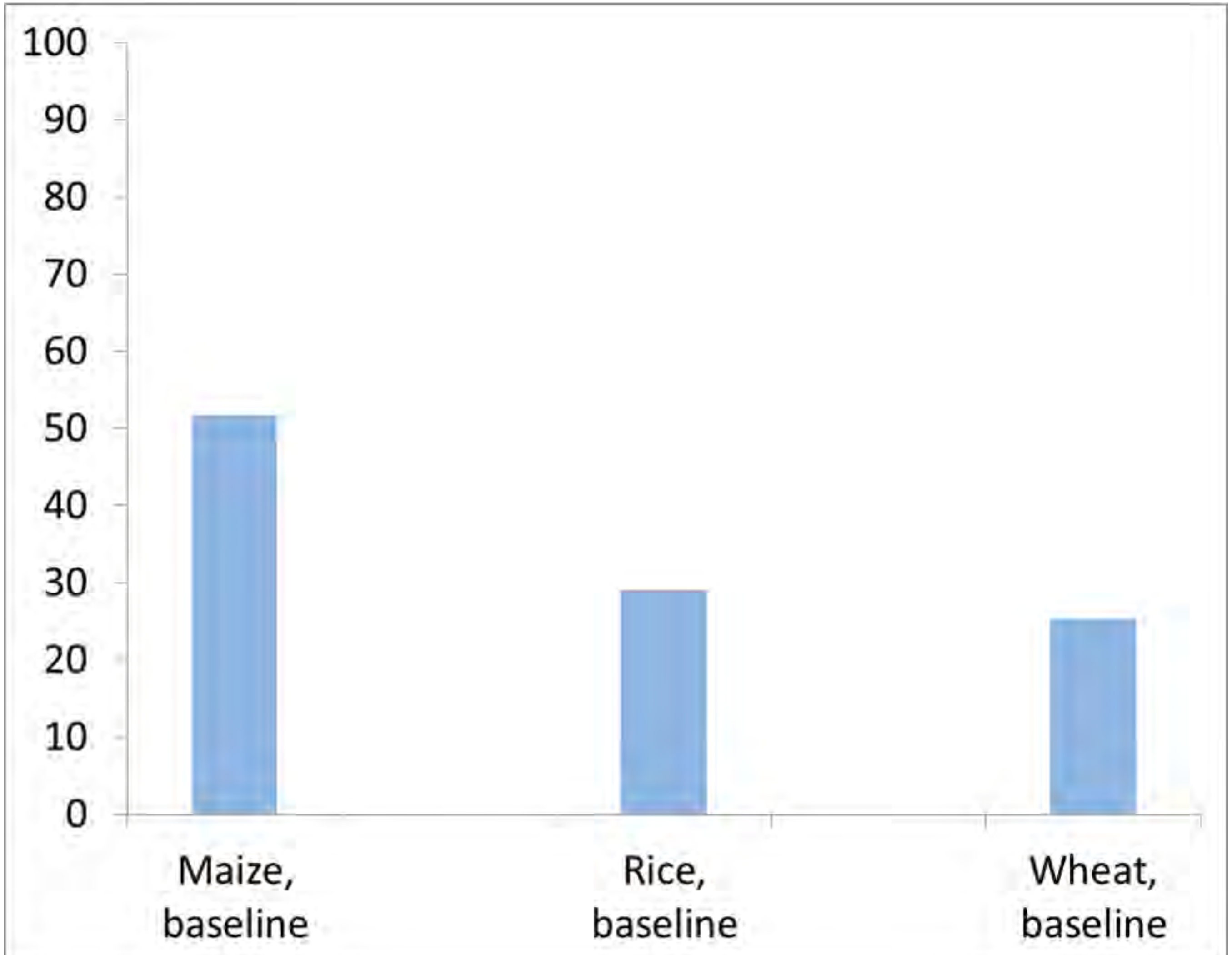
FOOD SUPPLY AND DEMAND RESULTS

Combining biophysical and socio-economic drivers



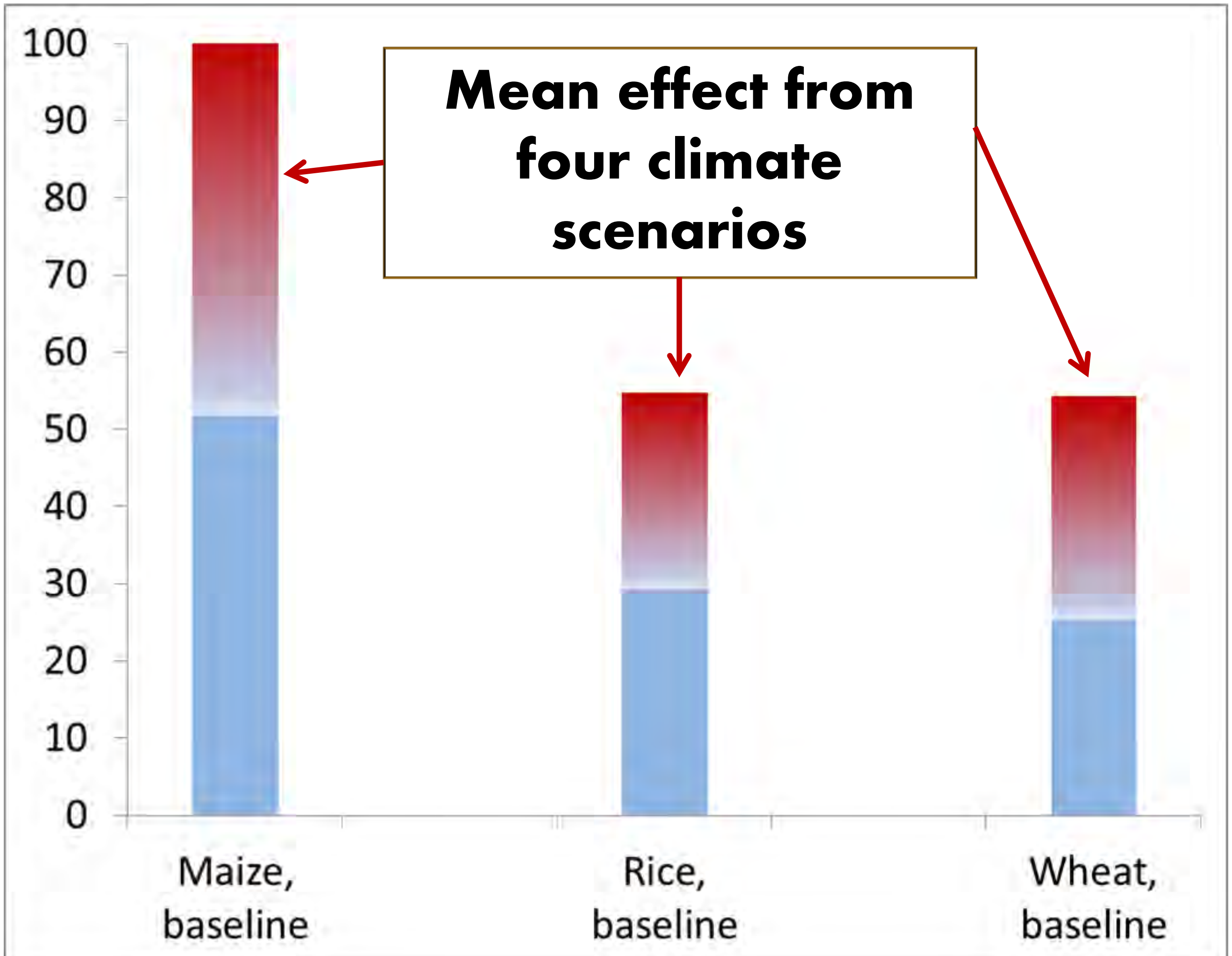
Income and population growth drive prices higher

(price increase (%), 2010 – 2050, Baseline economy and demography)



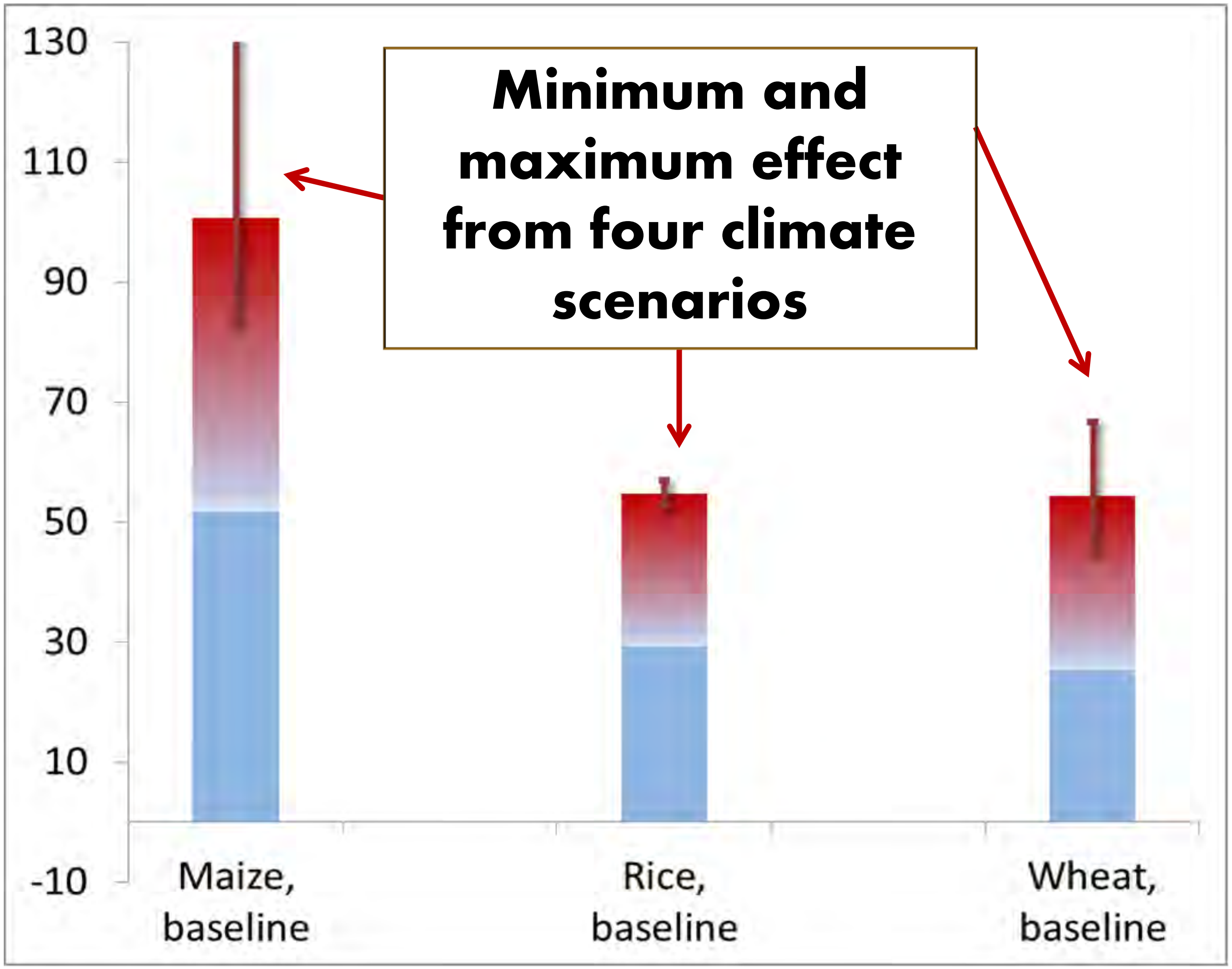
Climate change adds to price increases

(price increase (%), 2010 – 2050, Baseline economy and demography)



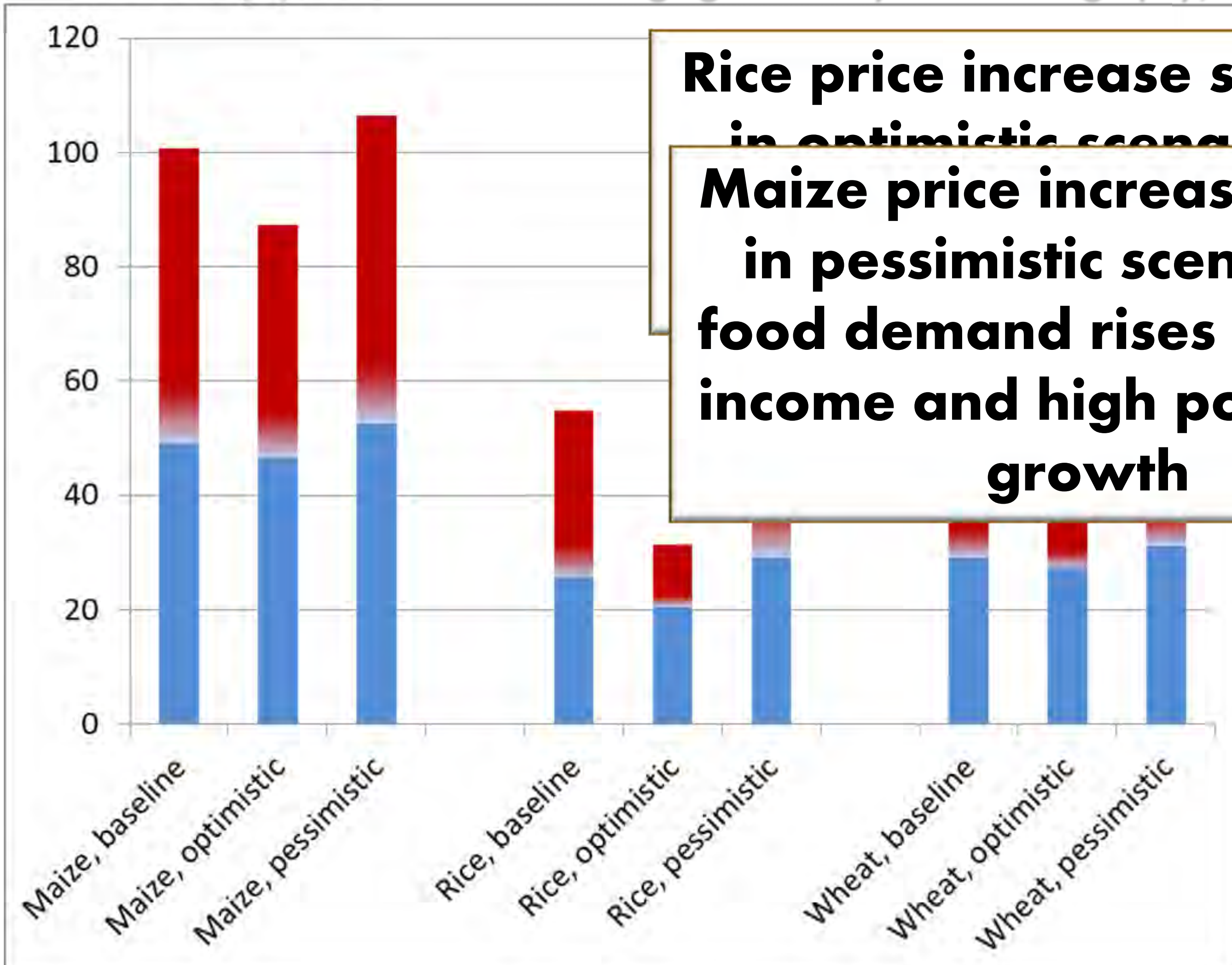
Climate change scenario effects differ

(price increase (%), 2010 – 2050, Baseline economy and demography)



Economy and population scenarios alter price outcomes

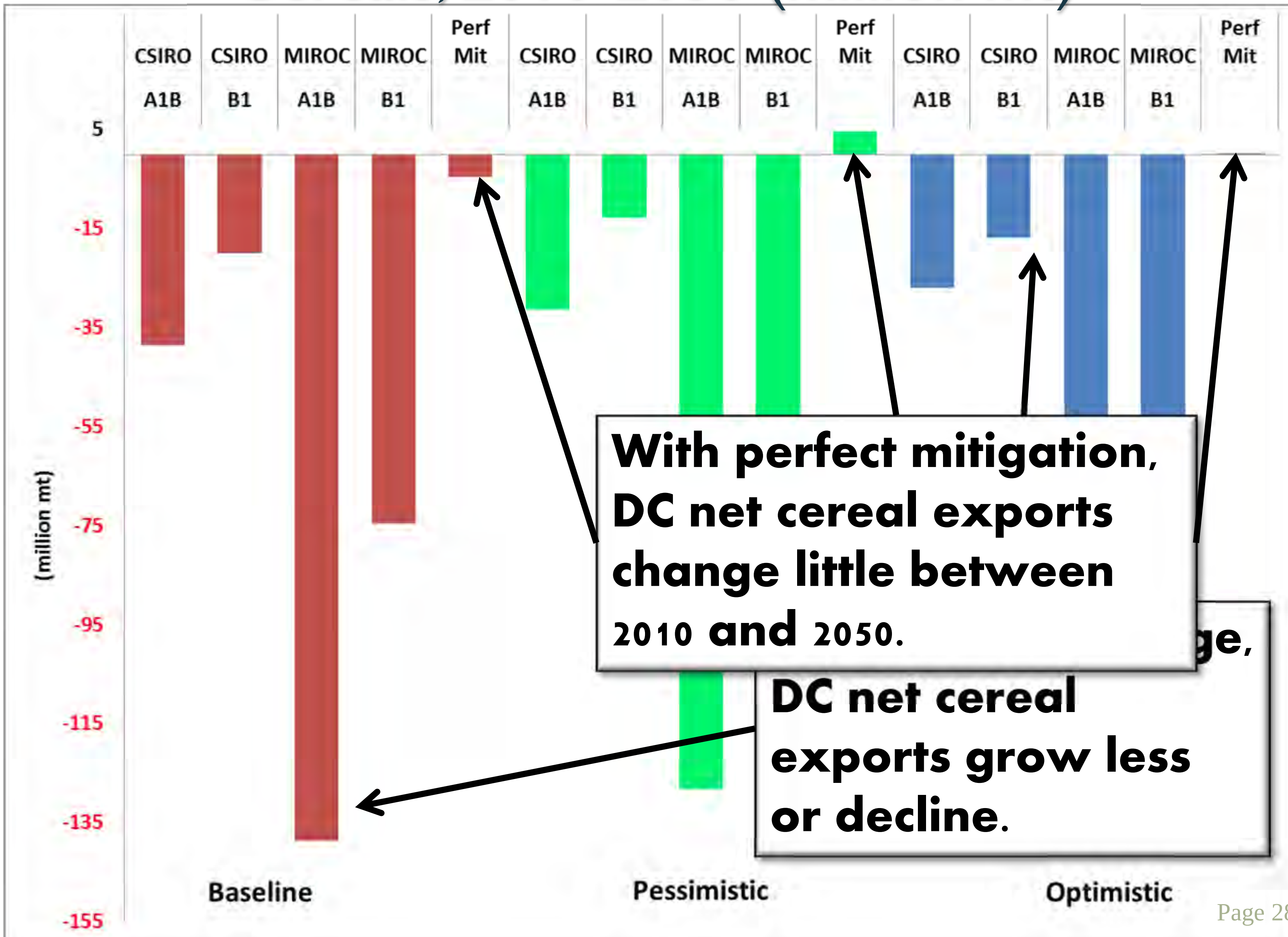
(price increase (%), 2010 – 2050, Changing economy and demography)



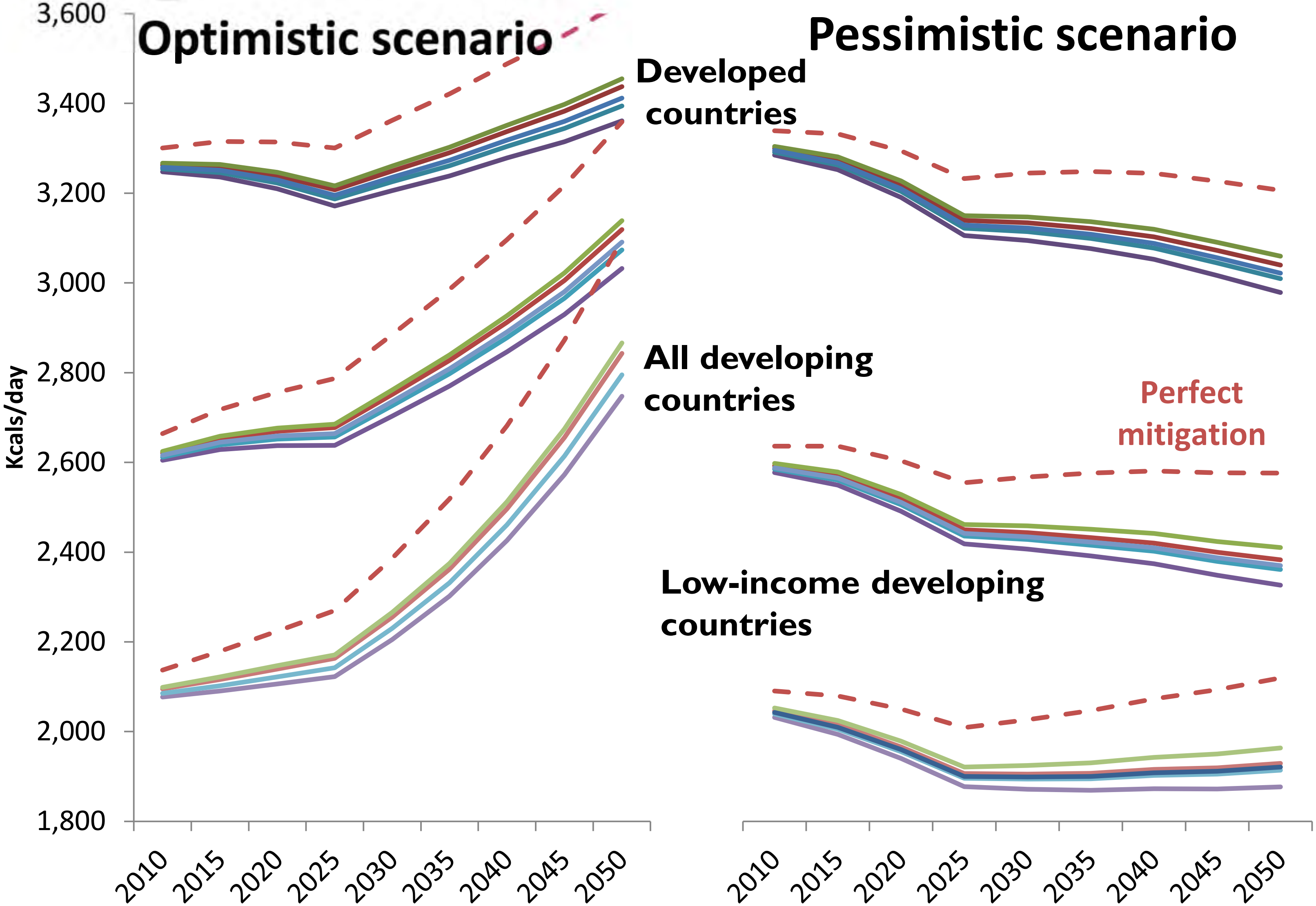
Rice price increase smallest

Maize price increase largest in pessimistic scenario as food demand rises with low income and high population growth

Developed Country, Change in Net Exports of Cereals, 2010-2050 (million mt)



Assessing food security and climate change outcomes



Exploring productivity enhancements

- Across-the-board improvement of 40 percent in developing countries
- Commercial (hybrid) maize improvement to 2 percent in selected countries
- Wheat improvement to 2 percent in selected countries
- Cassava improvement to 2 percent in selected countries
- Irrigation efficiency

Productivity improvements reduce poverty

(change in number of malnourished children in 2050, million)

Scenario	2050 simulation minus 2050 baseline (million)	
	Low-income Developing	Middle-income Developing
Overall	-6.6	-12.5
Commercial maize	-2.1	-1.7
Developing country wheat	-0.7	-1.9
Developing country cassava	-1.0	-0.4
Irrigation	-0.1	-0.3

Is impact optimistic or pessimistic?

- Omitted effects
  - Extreme events/increased availability
  - Sea level rise
  - Melting glaciers
- Critical assumptions include
  - Land supply elasticity
  - Yield potential

Conclusions from research monograph

- Sustainable economic growth is a powerful form of climate change adaptation
- Agricultural productivity research output in hands of farmers can reduce poverty and improve climate change resilience
- Open international trade is essential for dealing with uncertainties
- Mitigation is critical
  - Adaptation to 2050 is manageable, but less certain beyond

www.ifpri.org/climate-change

Thank you