



# Global Warming and Agriculture

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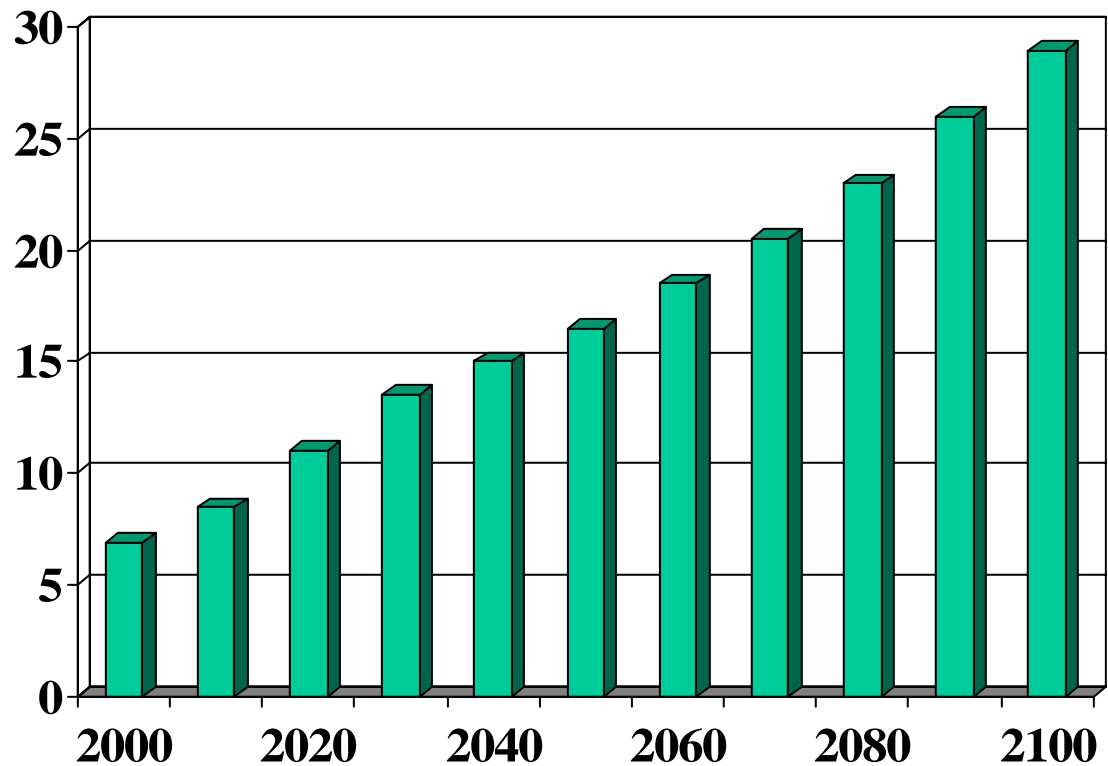
Center for Global Development and

Peterson Institute for International Economics

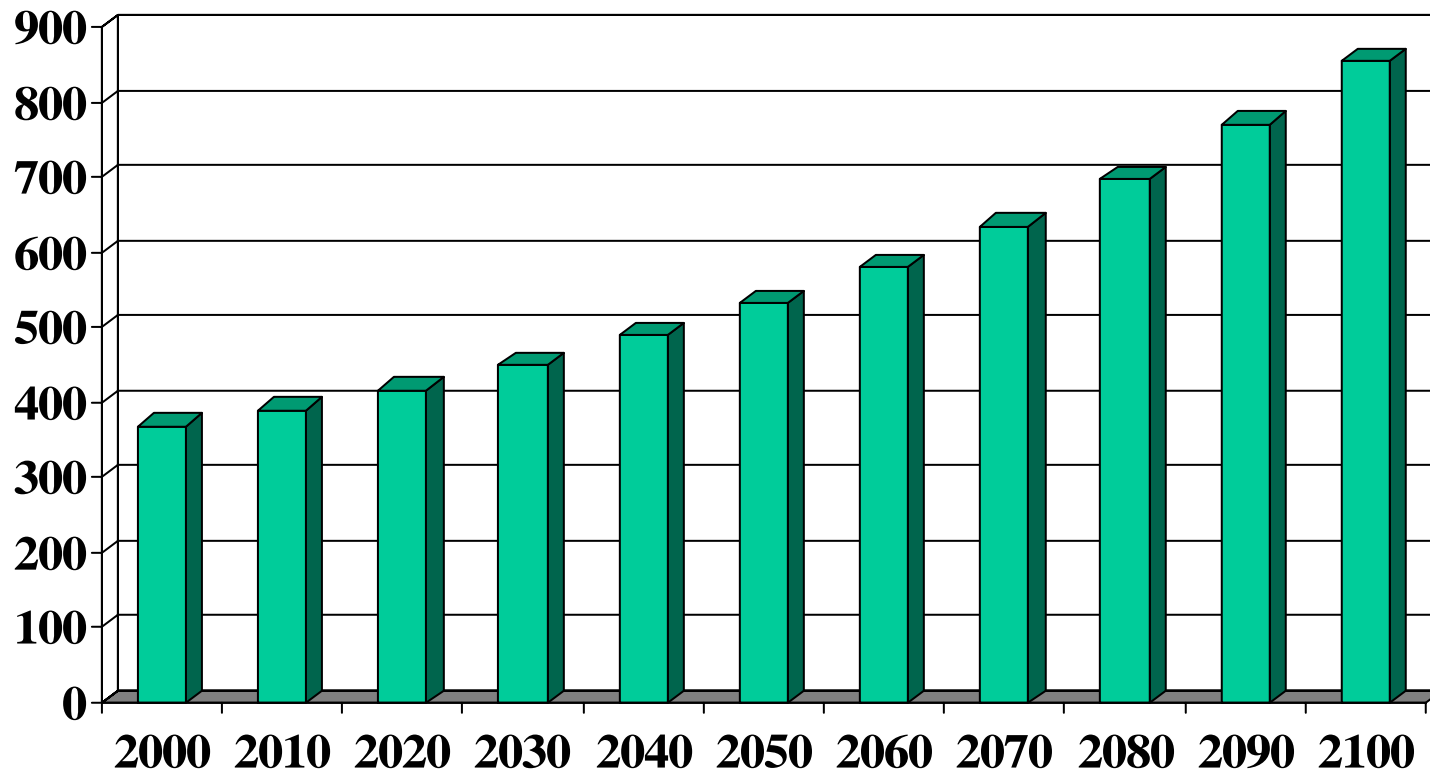
Model	Resolution	Warming for 2xCO <sub>2</sub> (°C)
German Climate Research Centre	2.8° x 2.8°	2.6
UK Hadley Centre	2.5° x 3.75°	3.0
Australian Commonwealth Scientif. & Indust. Res. Org	3.2° x 5.6°	3.7
Canadian Centre for Climate Modeling	3.7° x 3.7°	3.6
US Geophysical Fluid Dynamics Laboratory	2.25° x 3.75°	3.4
Japanese Centre for Climate Research Studies (f)	5.6° x 5.6°	3.5

# Baseline CO2 Emissions (A2)

(billion tons carbon equivalent)



# Baseline CO2 atmospheric concentration (parts per million)



# Converting Grid Sizes

(resolution and number of land-based cells)

	Resolution	# of cells
IPCC Actuals, 1961-90	1° x 1°	22,156
Typical climate model	3° x 4°	1,836
Standardized grid (this study)	2° x 3°	3,672

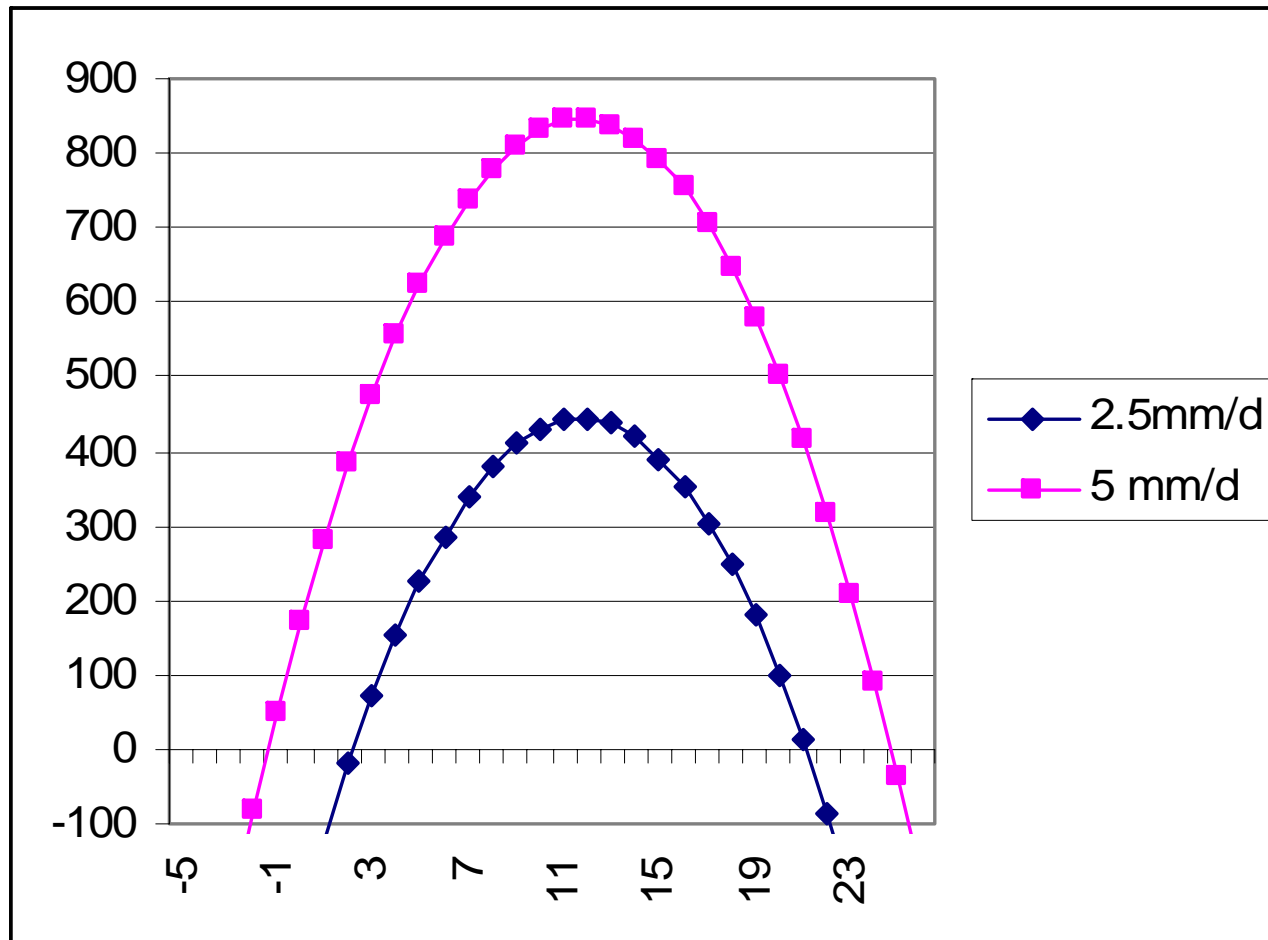
# Global Climate Change by 2080s

	Land area weights	Farm area weights
Temperature (°C) (base)	13.15	16.2
Precipitation (mm/d) “	2.20	2.44
Change by 2080s:		
Temperature (°C)	4.95	4.43
Precipitation (mm/d)	0.13	0.07
Precipitation (percent)	5.9%	2.9%

# Agricultural Impact Models Used

- Crop Models (18 countries): Rosenzweig-Iglesias
- Ricardian Models:
  - Mendelsohn-Schlesinger based on US
  - World Bank for Africa, Latin America
  - Mendelsohn-Dinar-Sanghi for India

# Output per hectare at alternative average temperatures (\$ and °C)

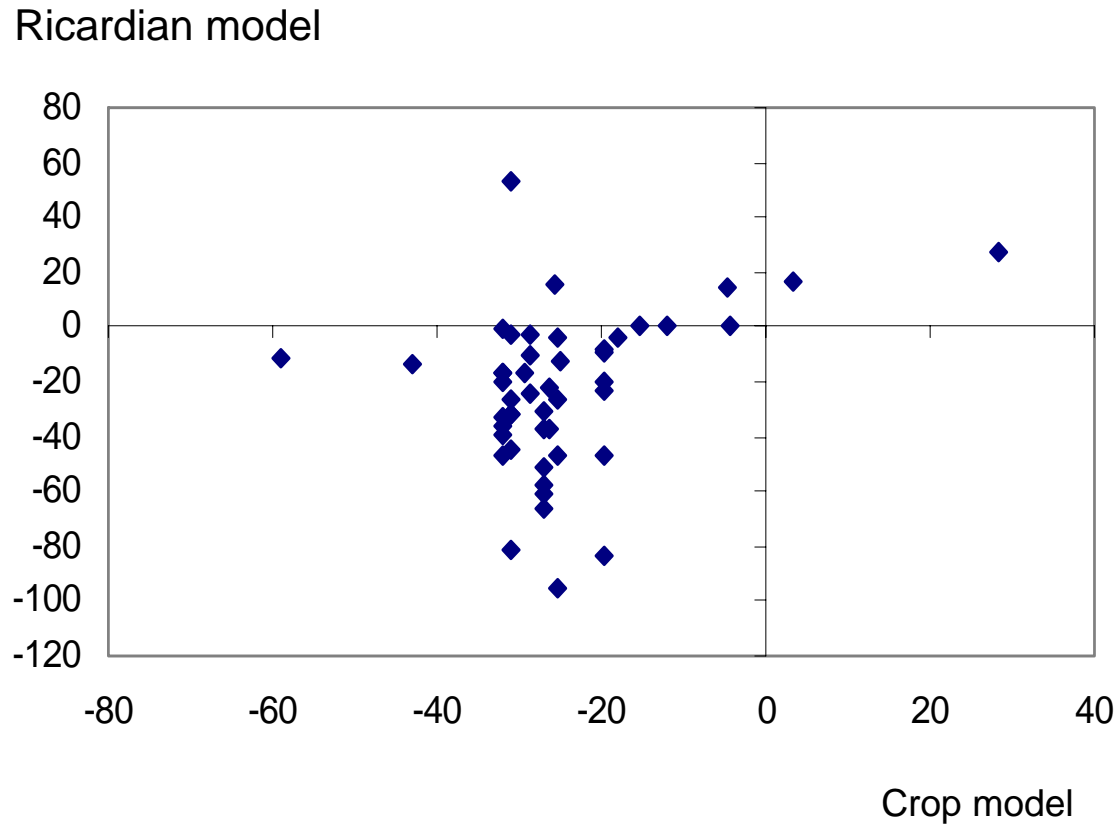




# How Much Carbon Fertilization?

- Carbon dioxide is an input into photosynthesis
- Wheat, rice, soybeans, cotton (C3): more response; corn, sugarcane (C4): less
- Early laboratory experiments overstated effect. Open field (FACE) results now show lower impact.
- Estimate: 15% yield boost for 735 ppm

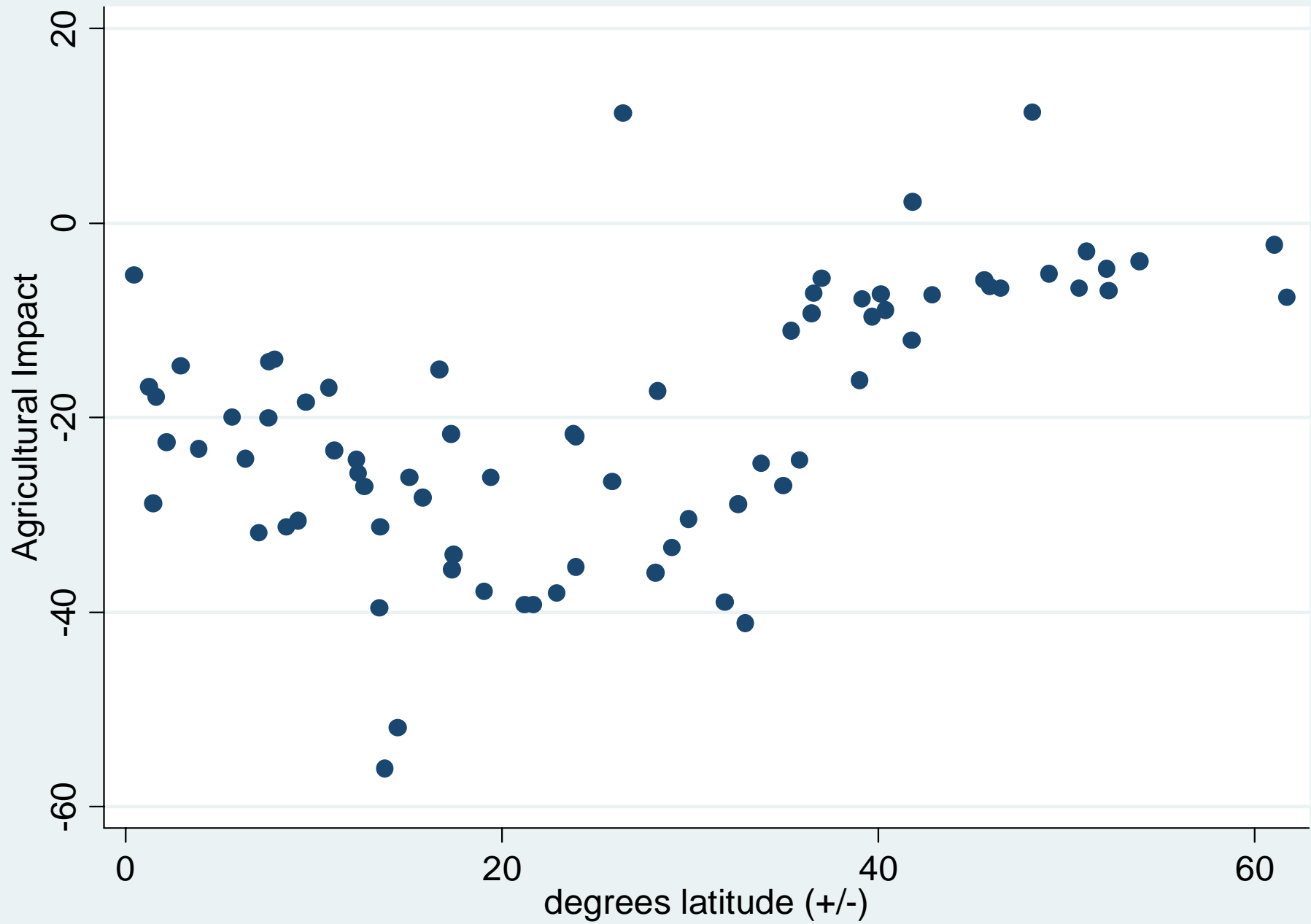
**Figure 5.4 Percentage change in agricultural capacity by the 2080s in 47 countries and regions (without carbon fertilization)**



# Results, selected countries

(percent change in agricultural productivity)

	Ricardian	Crop Model	Weighted Avg	
			w/oCF	w/CF
Argentina	-4	-18.1	-11.1	2.2
Brazil	-5.1	-28.7	-16.9	-4.4
US	4.7	-16.5	-5.9	8.0
SW plains	-11.1	-59.0	-35.1	-25.0
India	-49.2	-27.0	-38.1	-28.8
China	3.8	-12.6	-7.2	6.8
S. central	-18.8	-12.6	-14.6	-1.8

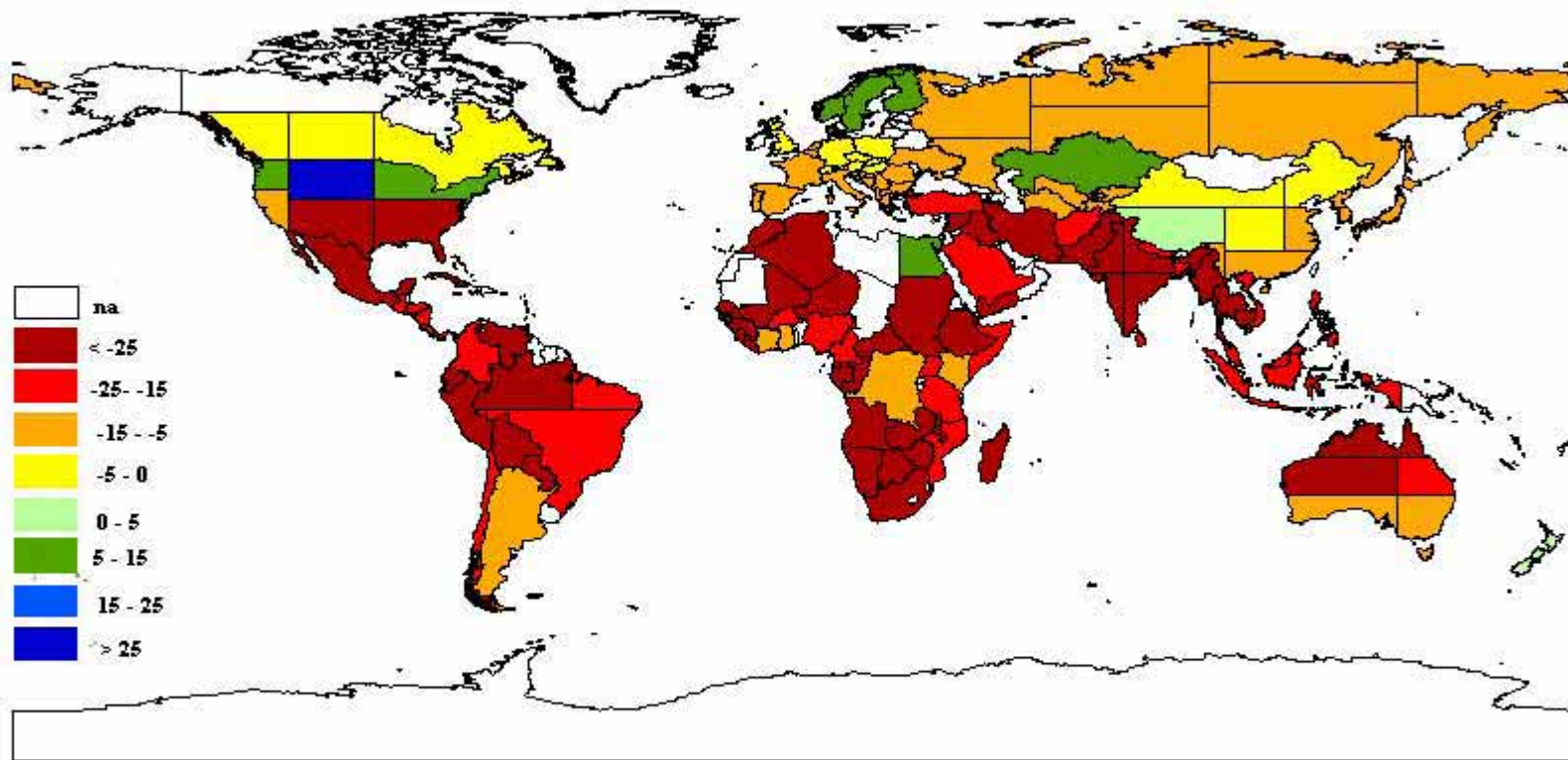


# Results, selected countries

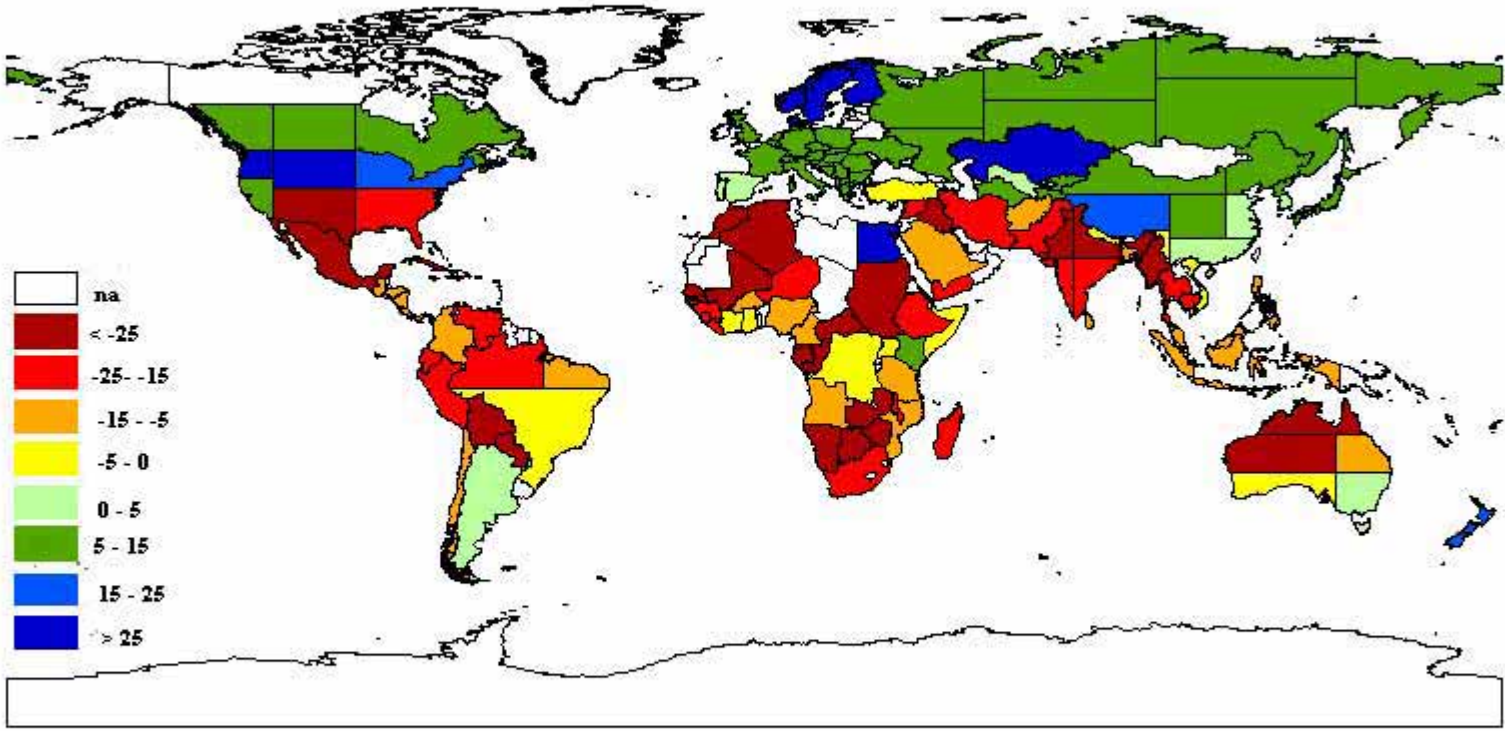
(percent change in agricultural productivity)

	Ricardian	Crop Model	Wtd Average	
			w/oCF	w/CF
Mexico	-35.9	-35.1	-35.4	-25.7
Nigeria	-12.1	-24.9	-18.5	-6.3
South Africa	-47.0	-19.8	-33.4	-23.4
Ethiopia	-31.4	-31.1	-31.3	-20.9
Canada	0	-4.3	-2.2	12.5
Spain	-4.5	-11.1	-8.9	4.8
Germany	13.8	-11.1	-2.9	11.7

## Impact on Agricultural Productivity without Carbon Fertilization (percent)



# Impact on Agricultural Productivity with Carbon Fertilization (percent)



# Results by Region

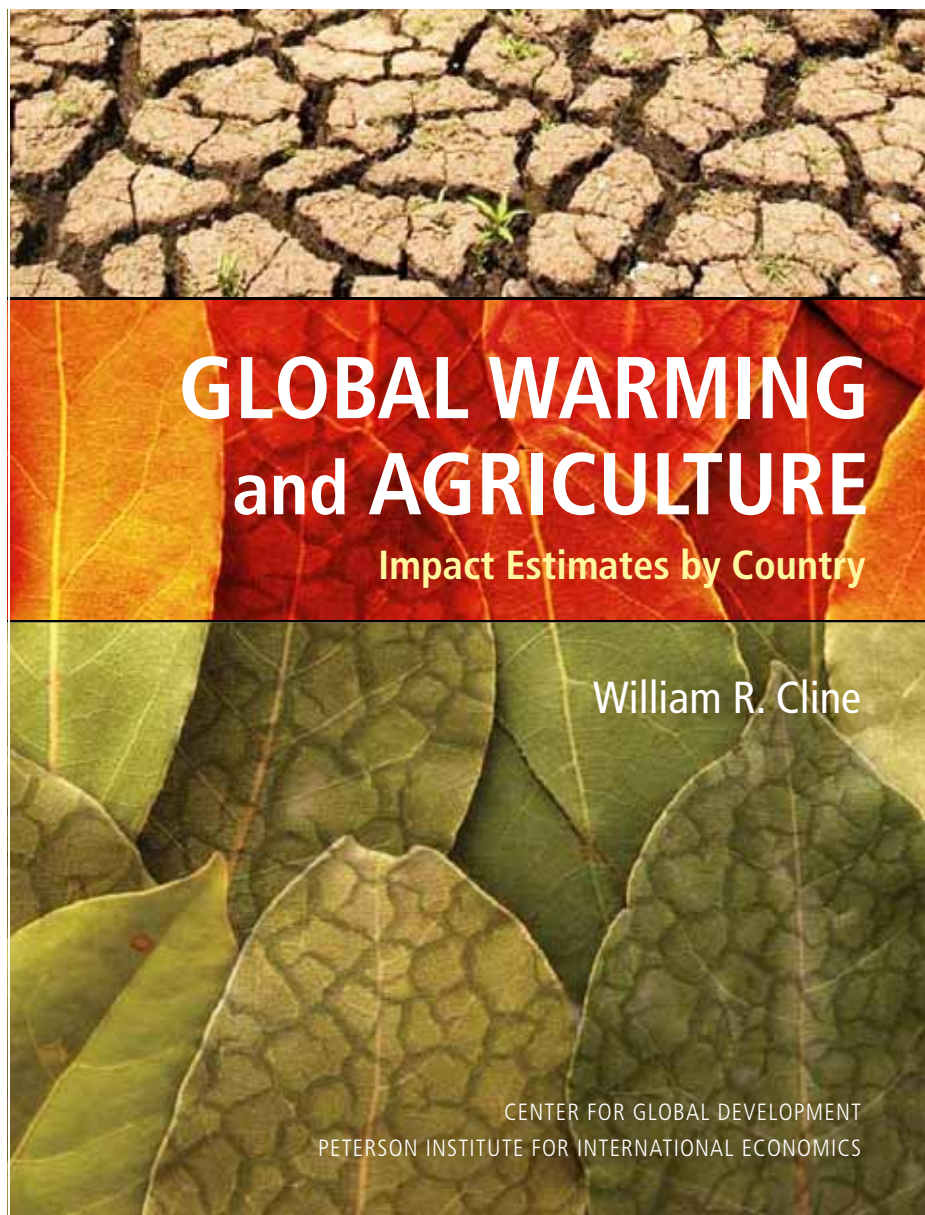
(% change in agricultural productivity)

	w/o CF	w/ CF
World	-15.9	-3.2
Industrial countries	-6.3	7.7
Developing countries exc. Eur.	-21.0	-9.1
Median	-25.8	-14.7
Africa	-27.5	-16.6
Middle East –North Africa	-21.2	-9.4
Asia	-19.3	-7.2
Latin America	-24.3	-12.9



# Technological Change is No Panacea

	2004	2085
Population (billion)            medium	6.5	10.5
high	6.5	14.7
Per capita ppp income (\$)	6,330	14,000
Per capita food consumption (index)	100	163
Food demand (index)	100	260-370
Food supply: technology (index)	100	350
Diversion to energy crops (%)	1	30
Food supply: combined (index)	100	245



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