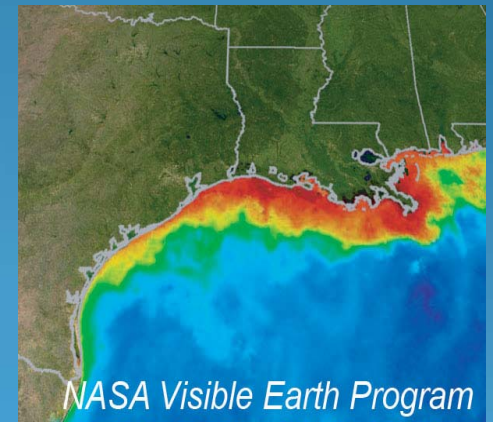
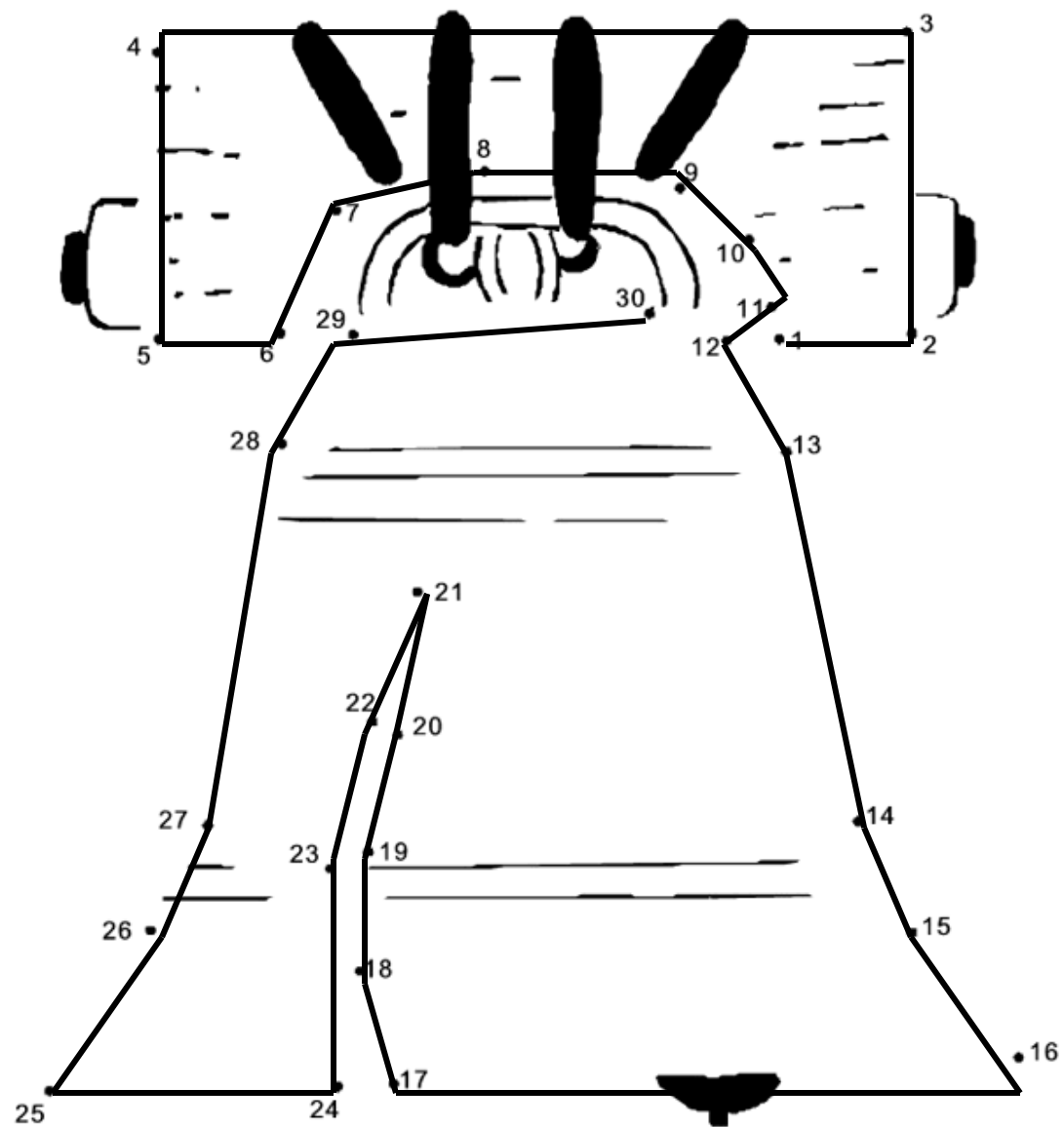


Is soil and water degradation inevitable? Don't bet your life on it!

Soil and Water Conservation Society
Annual Meeting 2014
Lombard, Illinois

Rick Cruse
Iowa State University







Global grain stocks tighten, deluge in Australia

By Bruce Hextall

SYDNEY | Wed Jan 12, 2011 10:17pm IST

SYDNEY (Reuters) - Australia's worst floods in decades shut down a key grains port, while the United States signaled further tightening of domestic and global supplies, heightening fears over surging food inflation.

Corn and soybean futures in Chicago jumped to 30-month highs after the U.S. government reduced its estimate of corn and soybean production in the United States and Argentina, where hot, dry weather has begun to take a toll on crops.

Estimates of Australia's wheat crop and exports were also cut, at a time when there are concerns with the U.S. crop due to dry weather. Last year, Russia banned exports after the worst drought in a century decimated production.

The challenge to produce enough food will be greater over the next 50 years than in all human history

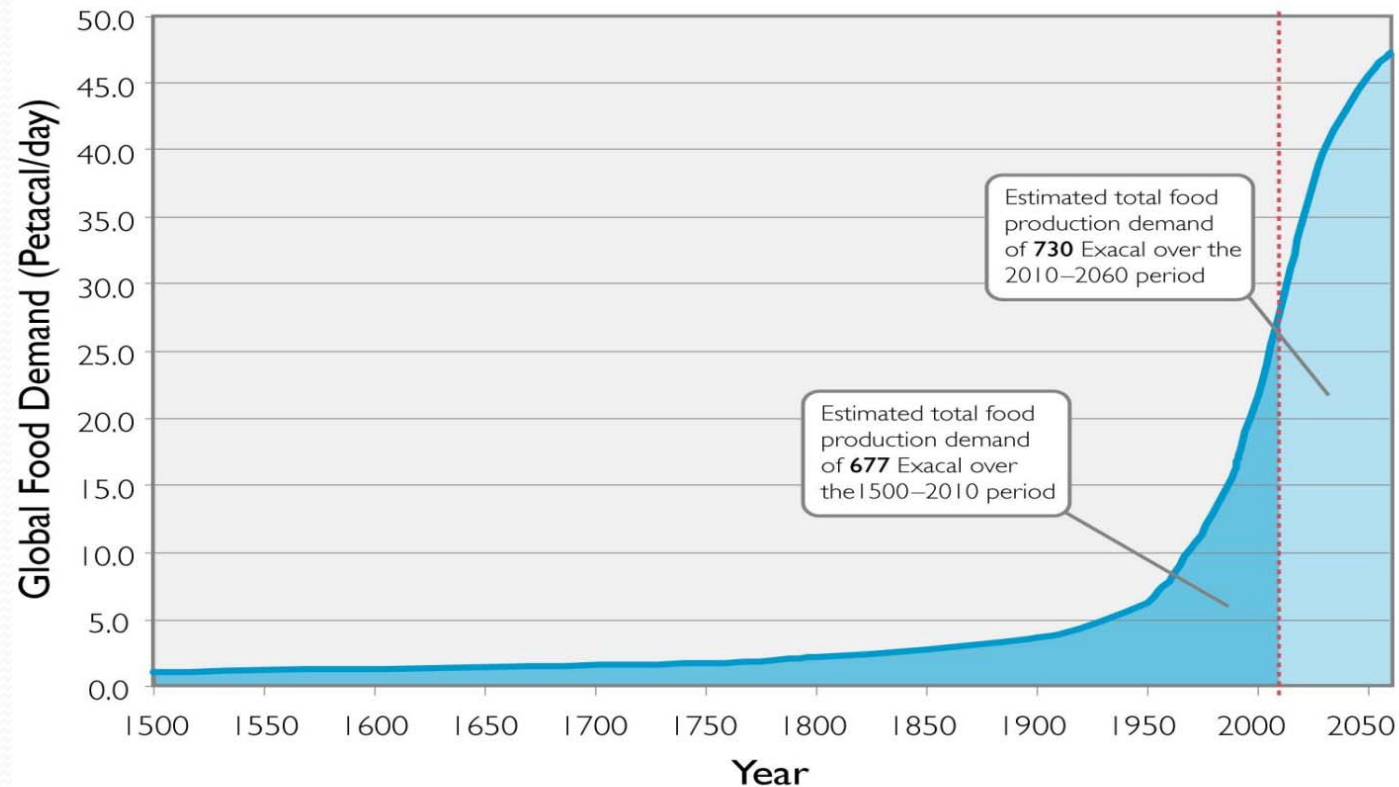


Figure 1. Explanatory notes:

- Based on data from FAOSTAT and UN Population Division, with simple scenario modelling from CSIRO 2009 (BA Keating, unpublished)
- Assumes growth trends in per capita food consumption growth in developing countries (currently 2668 kcal per capita per day) are maintained such that current developed country food consumption levels (3331 kcal per capita per day) are reached by 2050
- Assumes that diversion of food products (or production resources) to biofuels grows from current levels to 15% by 2050
- Assumes no food wastage prior to 1920 ramping up to current estimates of food wastage of 30% and these are not reduced going forward.
- A Petacal is 10^{15} calories, an Exacal is 10^{18} calories.

Demand for Higher Quality Food

- 3 billion people → middle class (next 20 years)¹
- More meat – 73% ↑ by 2050¹



6 – 8 lb



1 lb

¹United Nations Secretary-General's High-level Panel on Global Sustainability (2012). Resilient People, Resilient Planet: A future worth choosing. New York: United Nations.

Meat Consumption, Soils & Water?

- 5 oz meat/day/capita – US¹
- Assume 3 billion eat 4 oz/day
- 750,000,000 lb meat/day
- ??? 1,300 lb beef animals



- **1,000,000 animals/day**

¹USDA/Economic Research Service, www.ers.usda.gov

WHY?

Supply/Productivity Limitations

- Land conversion



- 41 Million US Acres 1982-2007
- 7% Ag land conversion by 2030¹

¹FAO. 2002. World Agriculture: Towards 2015/2030. FAO, Rome.

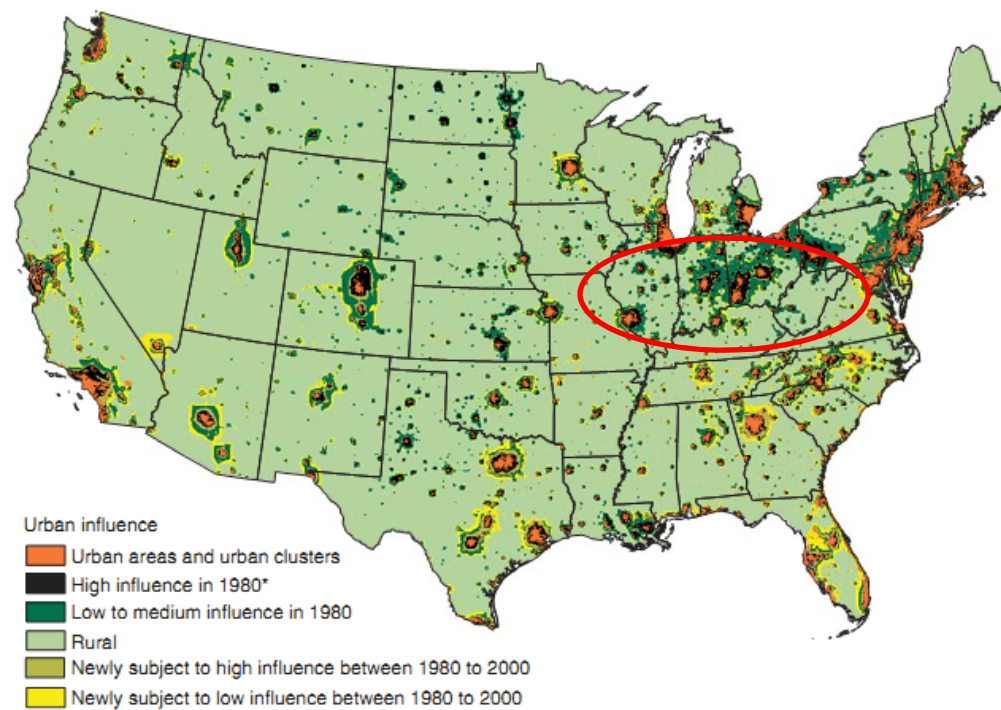
Table 4

Share of land use that remained the same, 1982-2007

	5-year periods					25-year period
	1982-87	1987-92	1992-97	1997-02	2002-07	1982-2007
	<i>Percent</i>					
Cropland	93	92	95	93	96	78
Pasture/rangeland	95	96	95	96	98	86
Forestland	98	98	98	98	99	92

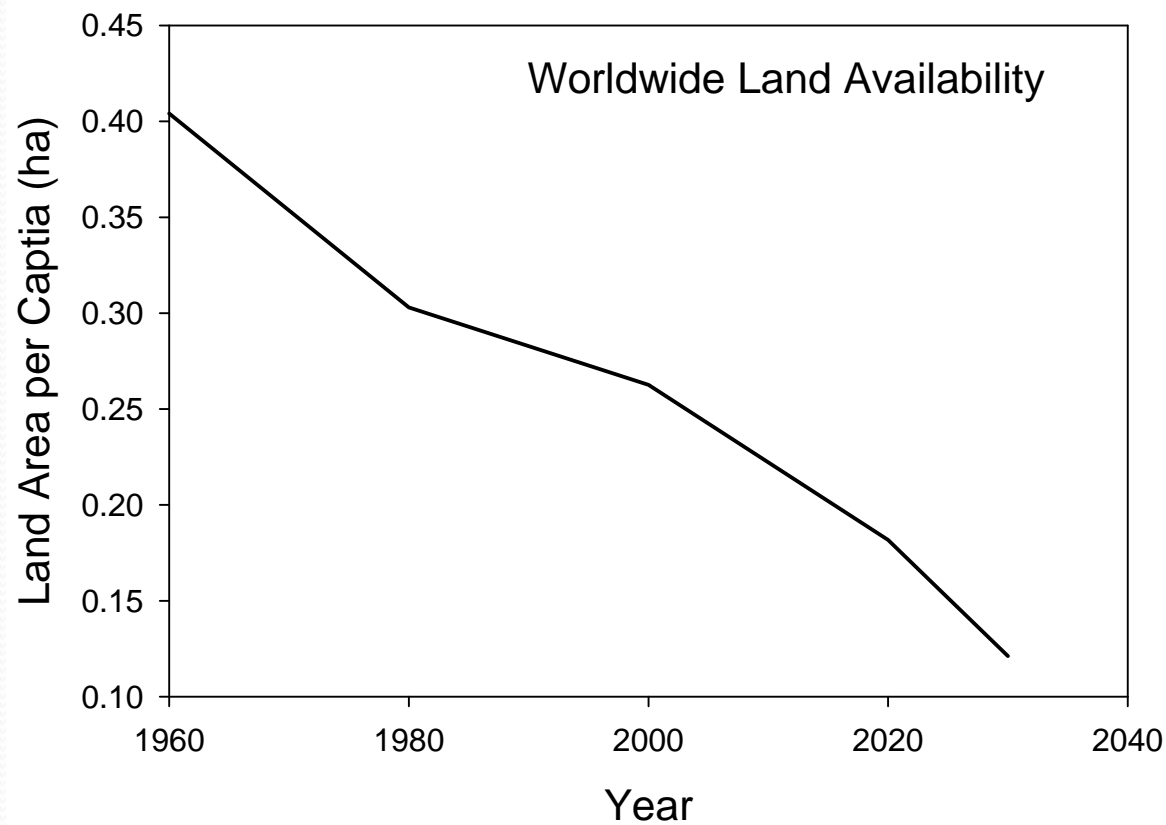
Source: USDA, Economic Research Service calculations based on USDA's Natural Resources Conservation Service, National Resources Inventory data (2009).

Figure 12
Degree of urban influence, 1980-2000



Nickerson, C., R. Ebel, A. Borchers, and F. Carriazo, 2011, Major Uses of Land in the United States, 2007. USDA ERS: Economic Information Bulletin No. 89. Washington, D.C.: USDA

Worldwide Land Area



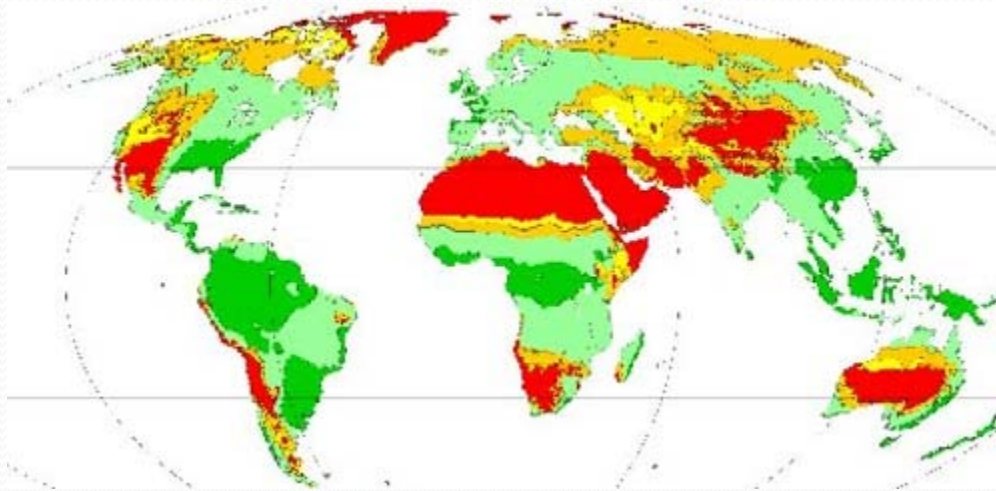
Brazil – Immense Untapped Capacity

- ~ 400,000,000 Ha yet to be developed
- ~ 15% lost to infrastructure for development
- ~ 340,000,000 Ha expansion potential



The Rest of the Story

- 7% world ag land converted by 2030¹ ~ 342,000,000 Ha
- Brazil expansion ~ 340,000,000 Ha



¹FAO. 2002. World Agriculture: Towards 2015/2030. FAO, Rome.

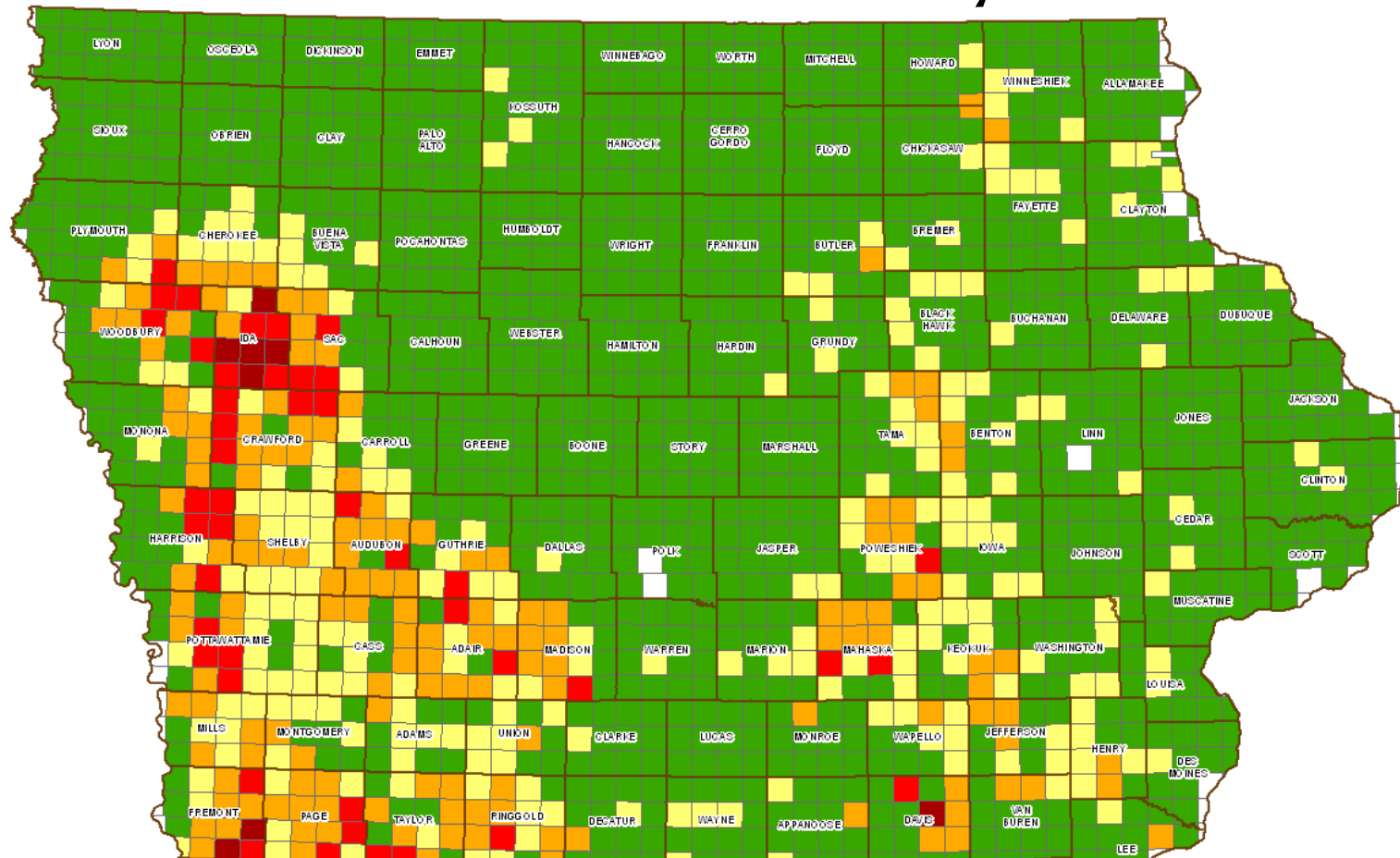
Supply/Productivity Limitations

- 25% Agricultural land seriously degraded



FAO. 2011. State of the world's land and water resources for food and agriculture. Summary Report. FAO. Rome

25% of Iowa's row crop acres eroded at 20 – 100 times the soil renewal rate in 2007.

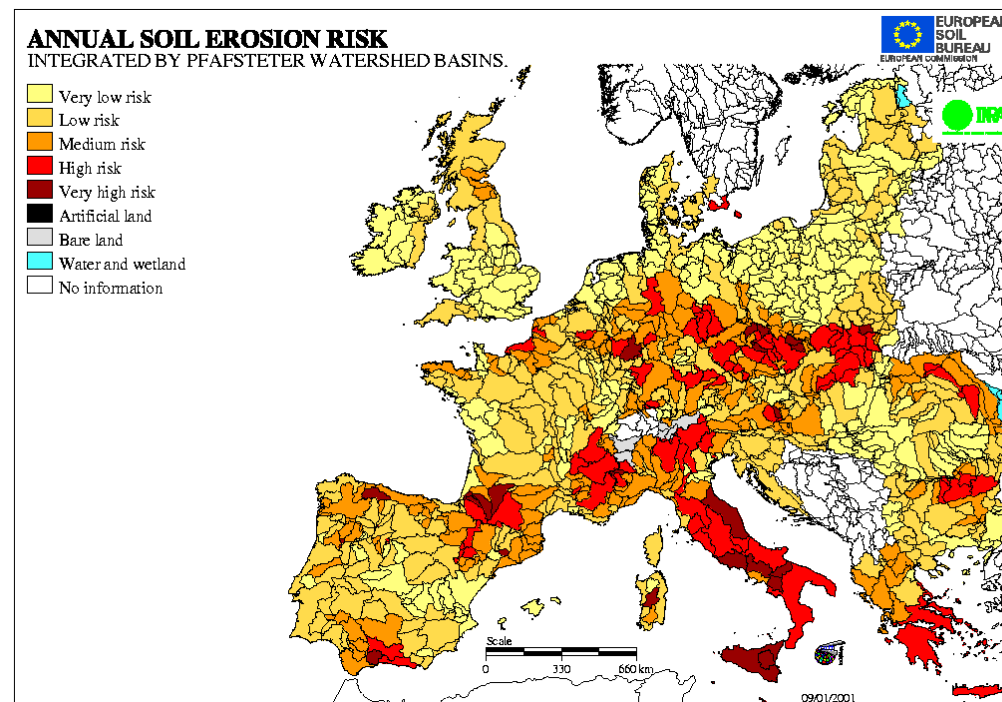


Average Soil Erosion (tons/acre)

○ No Data ● 0 - 5.0 ● 5.1 - 10.0 ● 10.1 - 20.0 ● 20.1 - 50.0 ● 50.1 - 100.0 ● Greater than 100

Cox, Craig, Andrew Hug, and Nils Bruzelius. 2011. Losing Ground. Environmental Working Group. Available at: http://static.ewg.org/reports/2010/losingground/pdf/losingground_report.pdf

Actual soil erosion rates for tilled, arable land in Europe are, on average, 3 to 40 times greater than the upper limit of tolerable soil erosion.¹



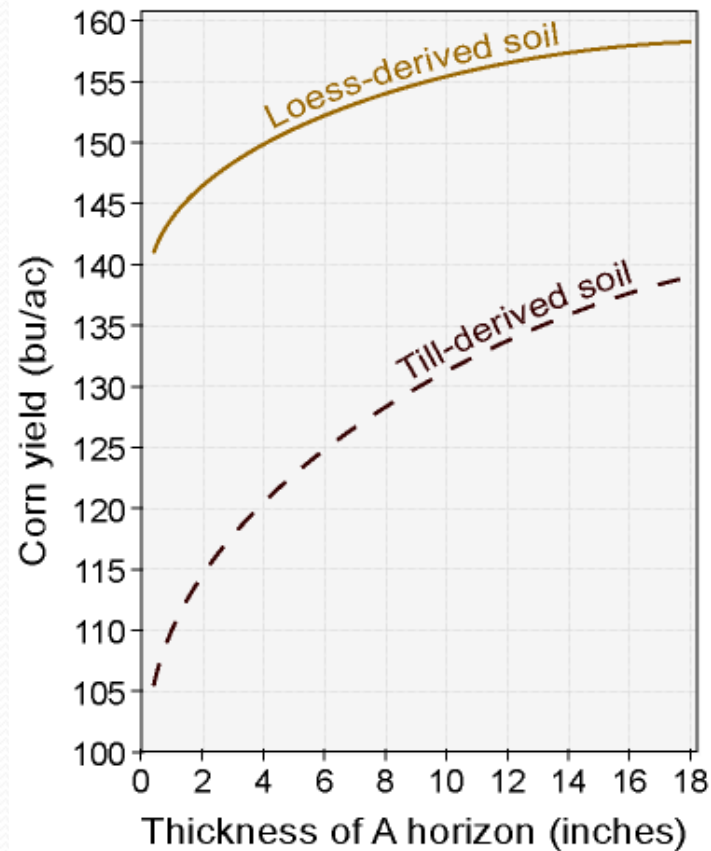
¹F.G.A Verheijen, R.J.A. Jones, R.J. Rickson, and C.J Smith. 2009. Tolerable versus actual soil erosion rates in Europe. *Earth Science Reviews*. 94:23-38.



REST of the STORY

Erosion you see is NOT included!

Does soil erosion affect soil productivity?



Kazemi, Masoud, L.C. Dumenil, and T.E. Fenton. 1990. Effects of accelerated erosion on corn yields of loess-derived and till-derived soils in Iowa. Final report for Soil Conservation Service, Agreement No. 68-6114-o-8, Des Moines, IA.

Irrigation

- ~ 40% of world food comes from 18% of world's cropland¹
 - India 3/5 of grain harvest
 - China 4/5 of grain harvest



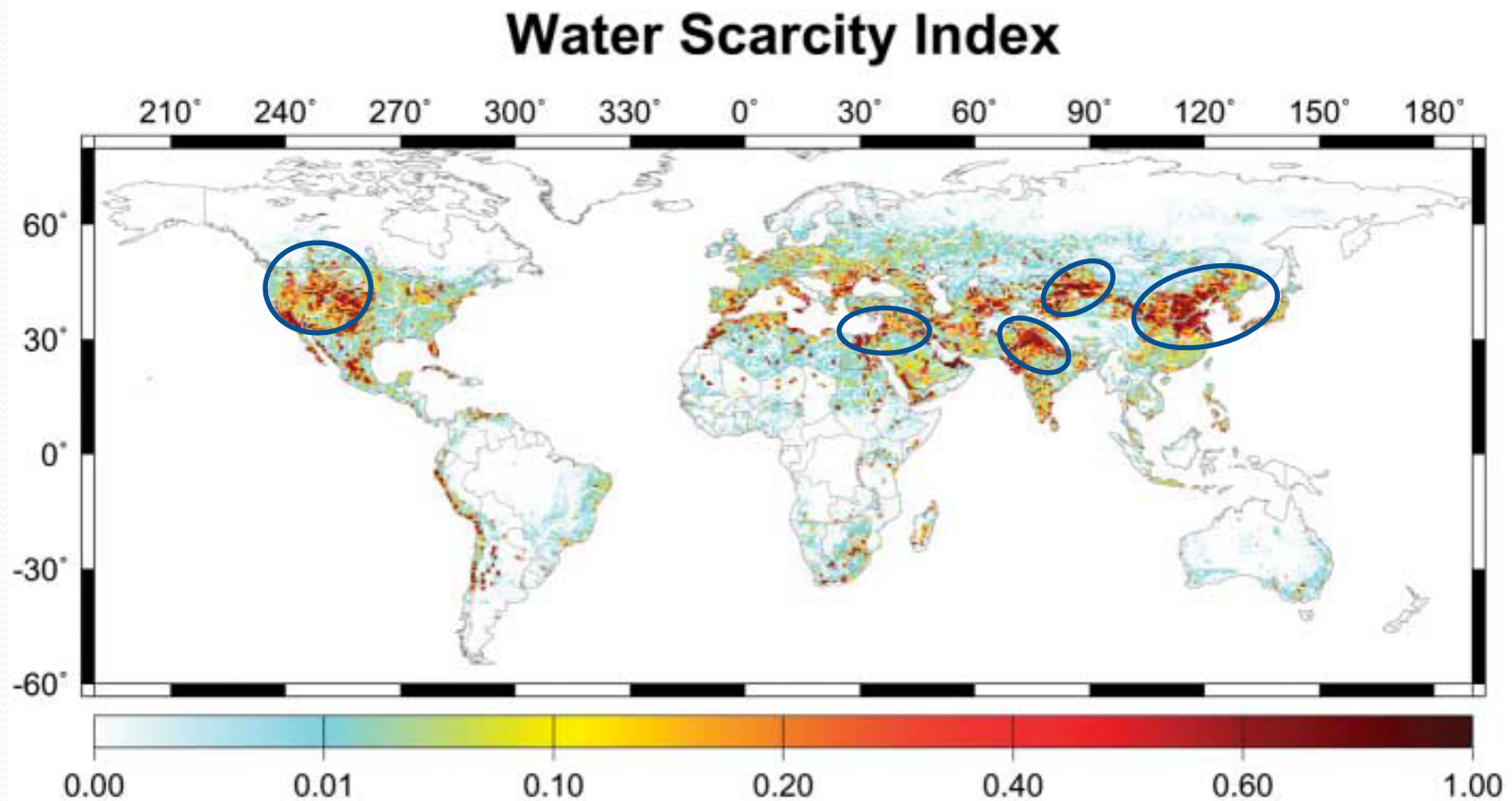
¹W Danielle Nierenberg, Linda Starke and Erik Assadourian. 2007
State of the World – 2006. World Watch Institute.

Water Scarcity Index =

Human Fresh Water Consumption
Renewable Fresh Water



Oki, Taikan and Shinjiro Kanae. 2006. Global hydrological cycles and world water resources. *Science*. 313:1068-1072



Oki, Taikan and Shinjiro Kanae. 2006. Global hydrological cycles and world water resources. *Science*. 313:1068-1072

Severe groundwater level declines (0.5-3 m/year) have occurred throughout northern China in the last three to four decades, particularly in deep aquifers.¹

- Irrigation
- Reservoir construction



¹Currell, Matthew J., Dongmei Han, Zongyu Chen and Ian Cartwright. 2012. Sustainability of groundwater usage in northern China: dependence on palaeowaters and effects on water quality, quantity and ecosystem health. *Hydrological Processes*. 26:4050-4066. DOI:10.1002/hyp9208

High Plains Aquifer Depletion

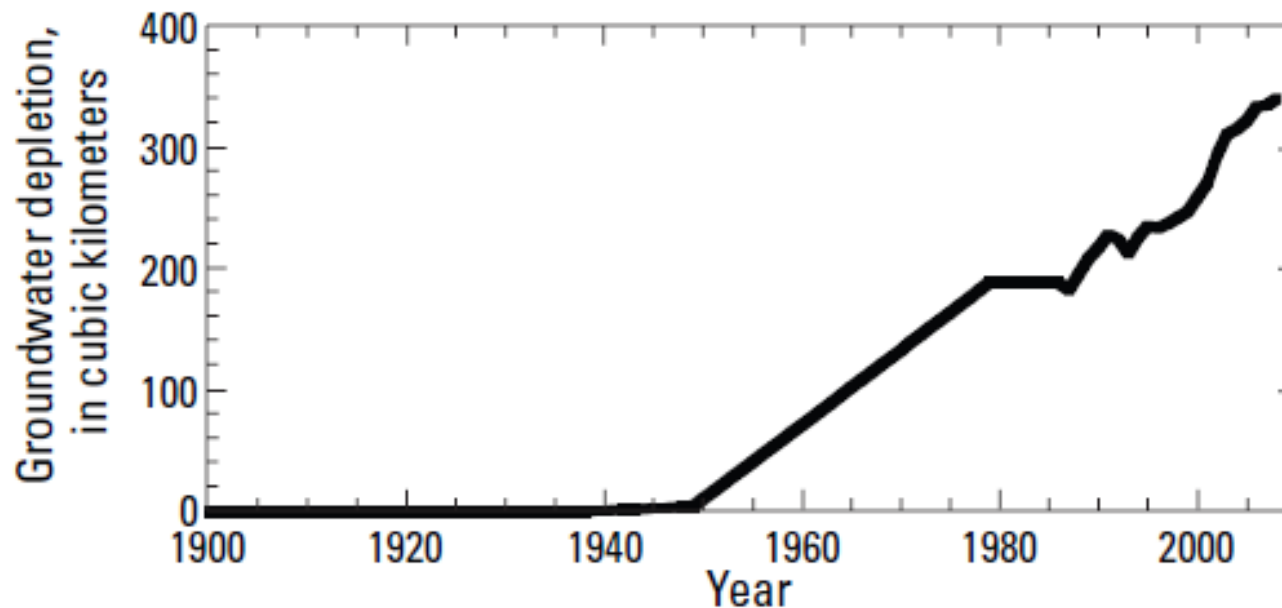
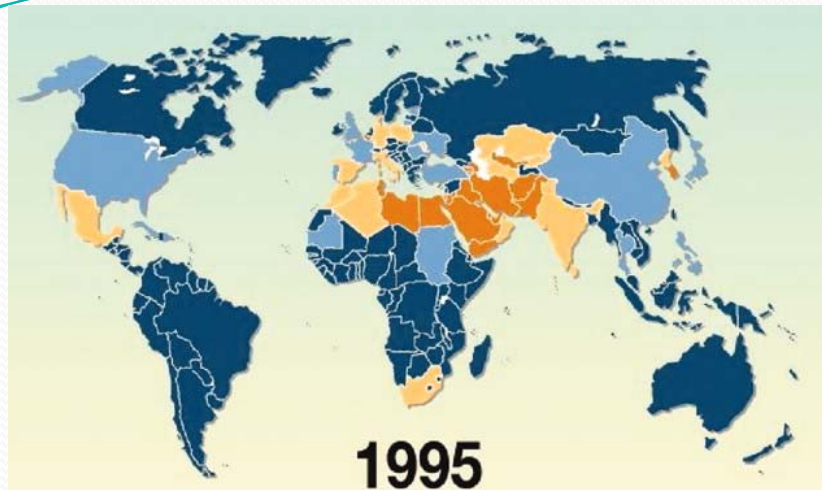


Figure 19. Cumulative groundwater depletion in the High Plains aquifer, 1900 through 2008.

Konikow, L.F., 2013, Groundwater depletion in the United States (1900–2008): U.S. Geological Survey Scientific Investigations Report 2013–5079, 63 p., <http://pubs.usgs.gov/sir/2013/5079>.



Water withdrawal as a percentage of total available water



United Nations Environment Programme (UNEP)/GRID-Arendal Maps and Graphics Library, 2009].



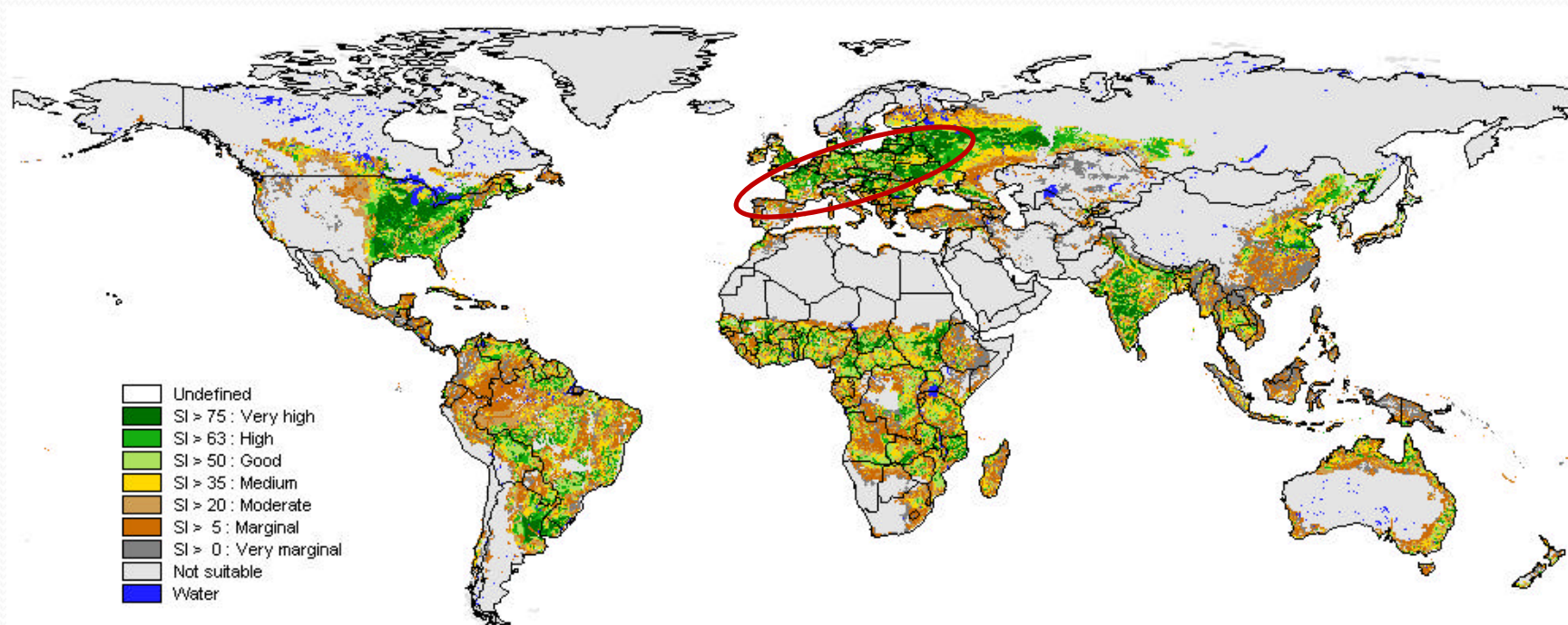
Climate change & food security?

- Climate Change From 1980 - 2008¹
 - Wheat production reduced 5.5%
 - Maize production reduced 3.8 %

¹David B. Lobell, Wolfram Schlenker, and Justin Costa-Roberts. 2011. **Climate Trends and Global Crop Production Since 1980**. *Published online 5 May 2011*
[DOI:10.1126/science.1204531.]

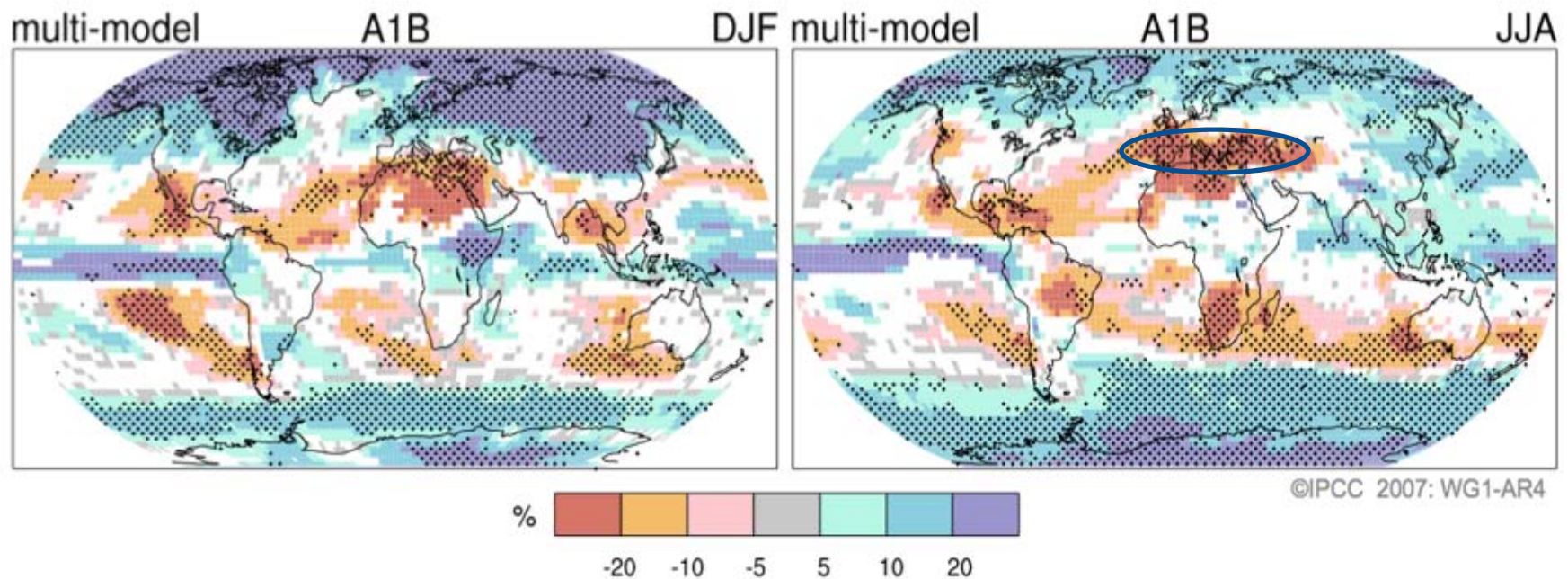
Terrain Suitability Index

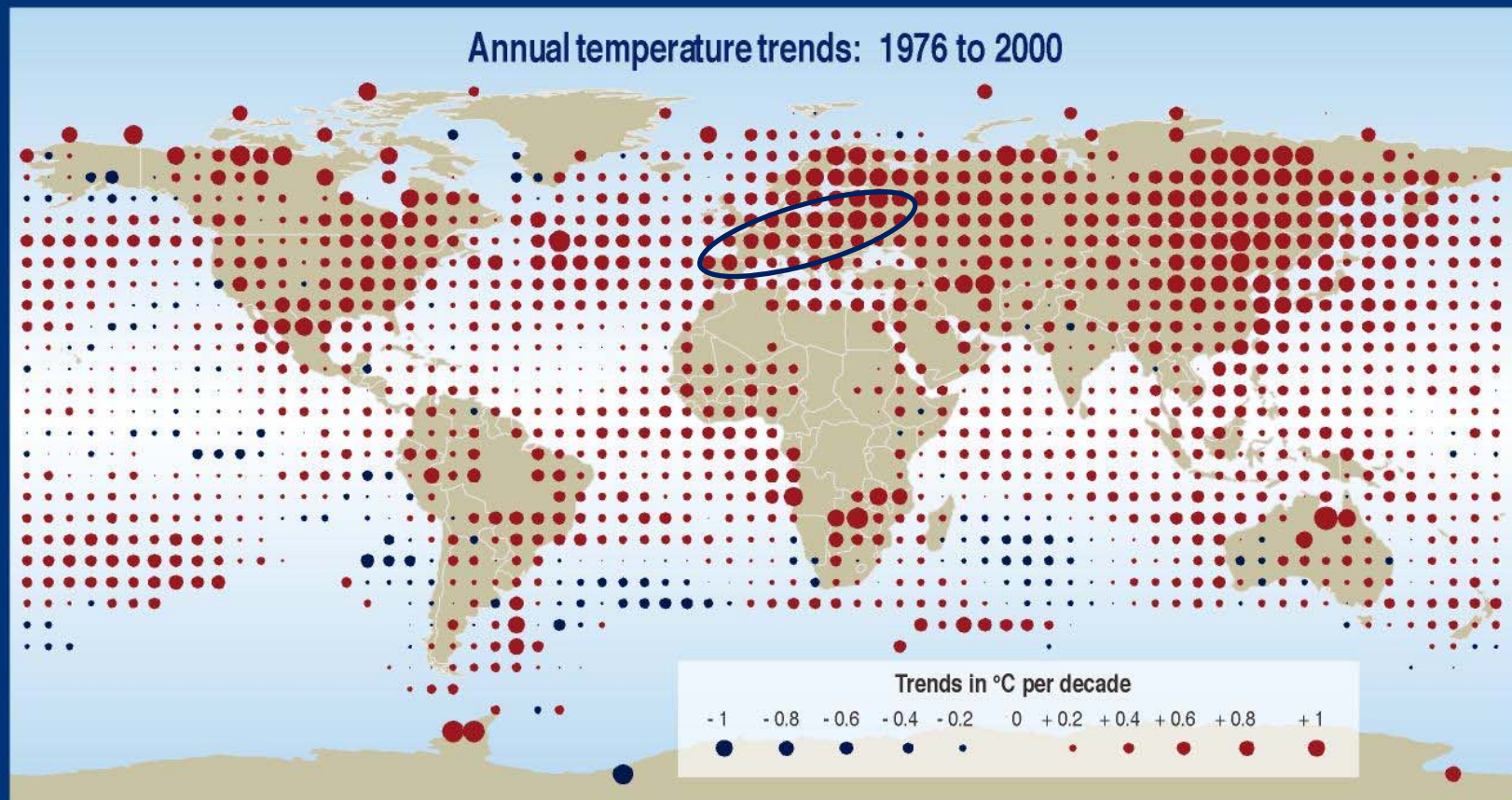
Soil and Terrain Suitability Index (SI) for a Range of Rain-Fed Crops and Pasture Types for the Current Climate



Fischer, et al., 2002: Global agro-ecological assessment for agriculture in the 21st century: methodology and results. Research Report RR-02-02. ISBN 3-7045-0141-7., International Institute for Applied Systems Analysis, Laxenburg, Austria, 119 pp. [Online at <http://www.iiasa.ac.at/Research/LUC/Papers/gaea.pdf>] Cited in the IPCC Fourth Assessment Report, Working Group II, Ch. 5, p. 280.

Projected Patterns of Precipitation Changes

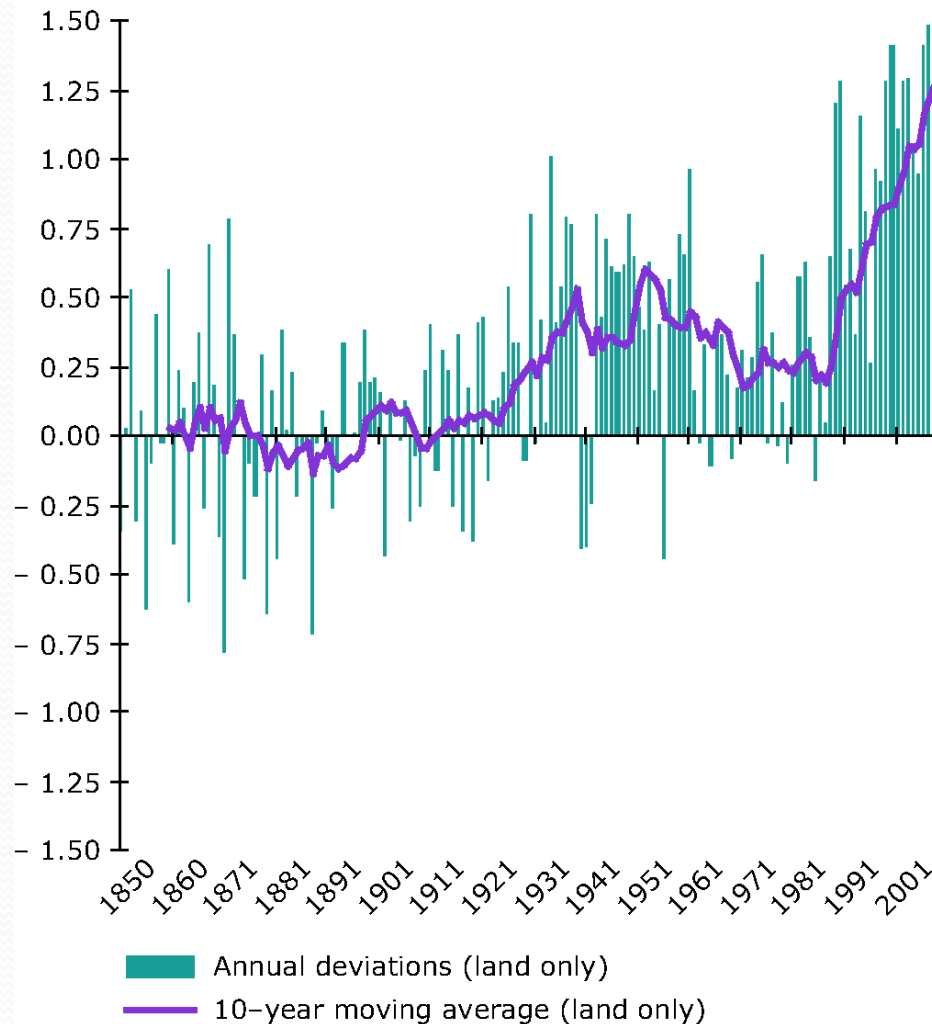




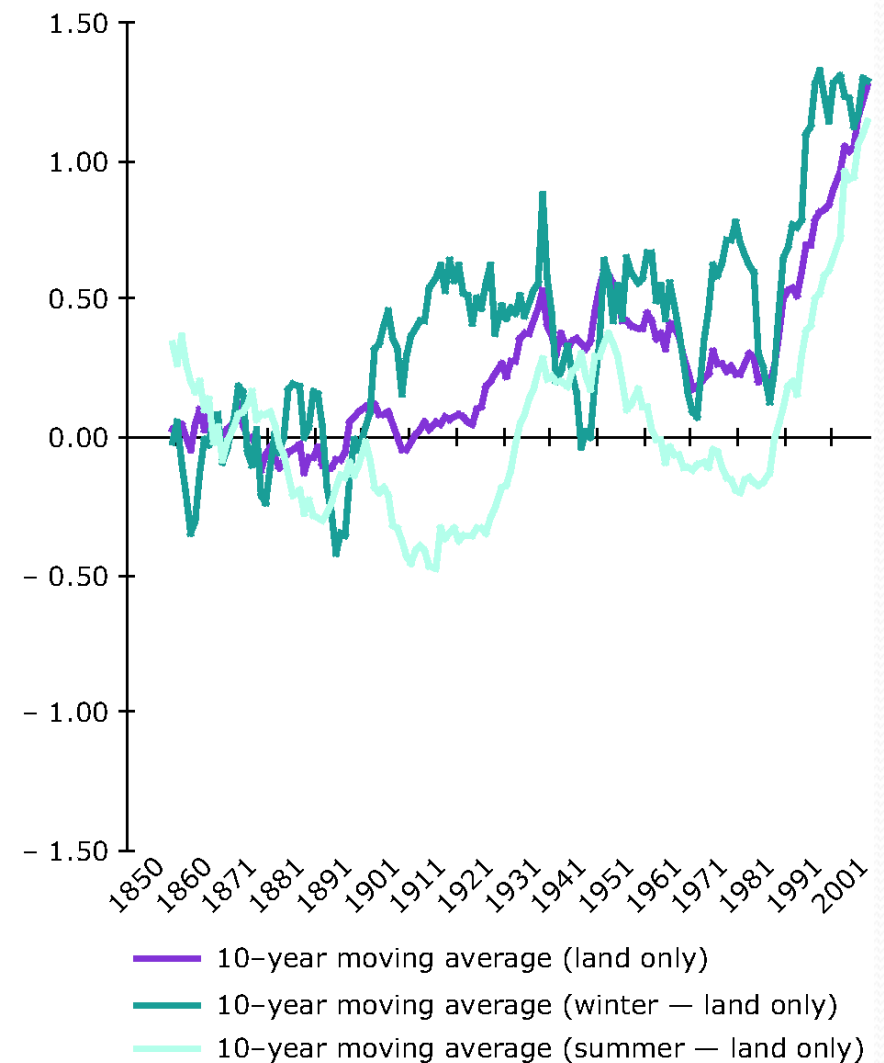
SYR - FIGURE 2-6b

Mean surface temperature in Europe 1850-2009, annual and by season¹.

Temperature deviation, compared to 1850–1899 average (°C)

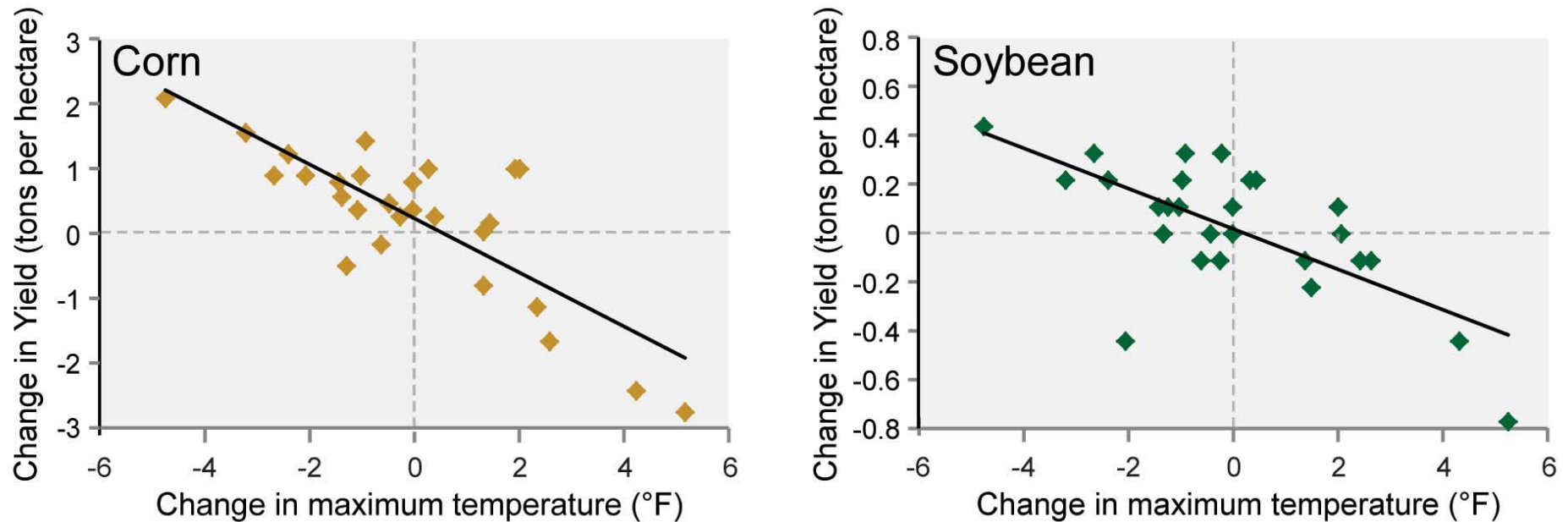


Temperature deviation, compared to 1850–1899 average (°C)



¹European Environment Agency. 2011. Mean surface temperatures in Europe 1850-2009, annual and by season.
<http://www.eea.europa.eu/data-and-maps/figures/mean-surface-temperature-in-europe>

Summer temperature (J, J, A) effects on corn and soybean yields

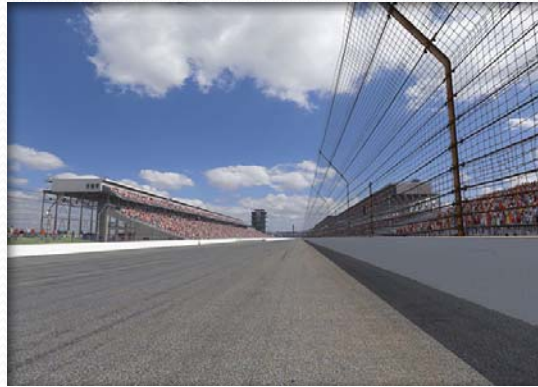


Harvests in Illinois and Indiana, two major producers, were lower in years with average maximum summer (June, July, and August) temperatures that were higher than the 1980-2007 average.

2014 National Climate Assessment. U.S. Global Change Research Program. Available at: <http://nca2014.globalchange.gov/highlights/report-findings/agriculture>



+



= Performance

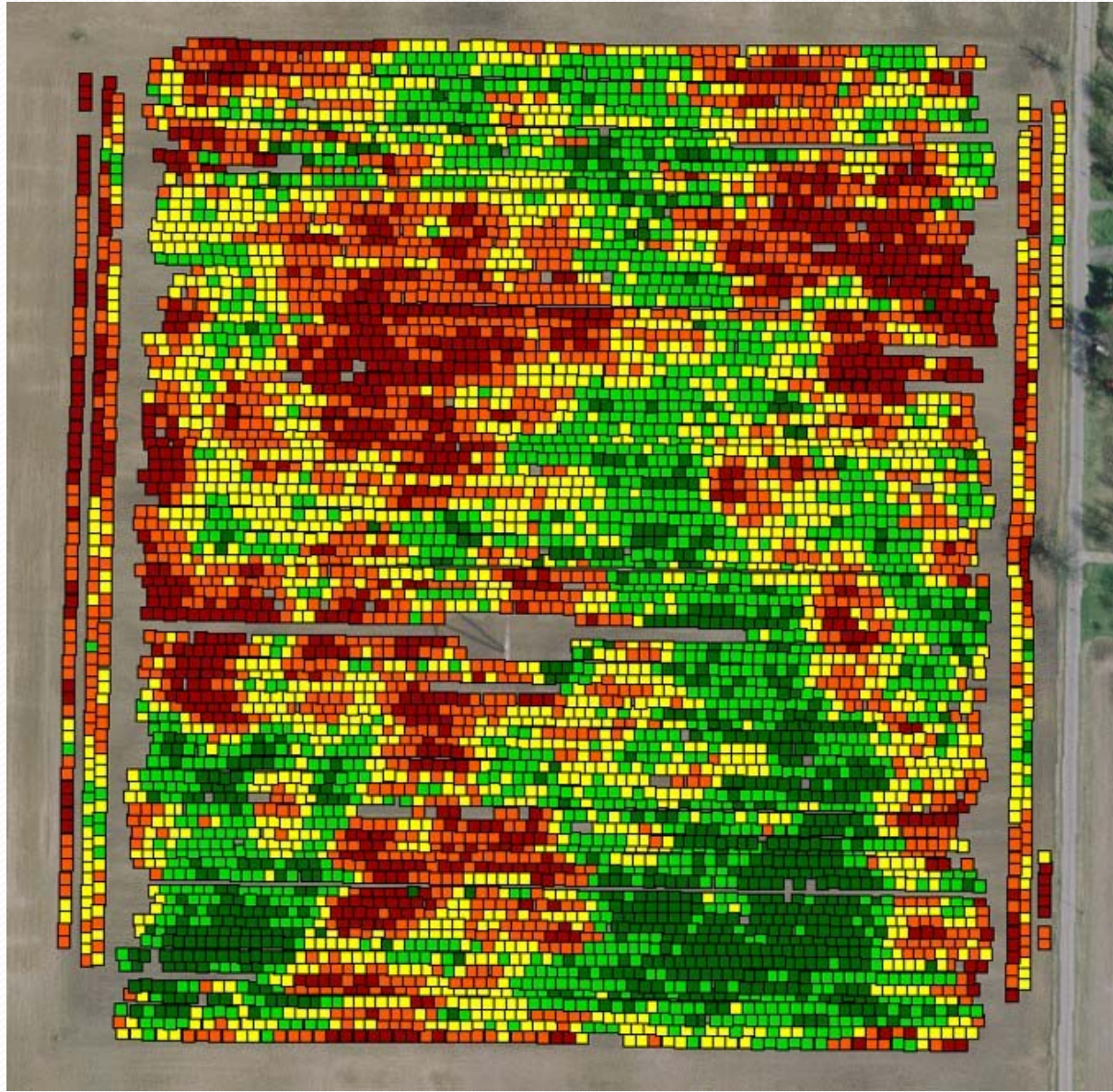


+



= ????





Working Lands



Our agricultural lands must work.



NASA file



Take Away Message

- **Remaining** soil and water resources
 - Are critical for global food security
 - Are economically imperative for rural areas everywhere
 - Will increase in importance
 - Are not replaceable and have no substitute
- Maintaining existing resources will require proactive approach



Challenges we face

- What evidence exists that we are on a functionally sustainable path?
- If not on a sustainable path do we have a vision of what that path is?
- Do we have the political will to address the causes rather than the symptoms of our current problems?



Ag Realities

- Agriculture is morphing to Agribusiness
 - Fewer farmers control more
 - Enterprise size is increasing
 - Culture is multidimensional, business is less so
- Farming is very competitive
- Successful farmers make money



Ag Realities

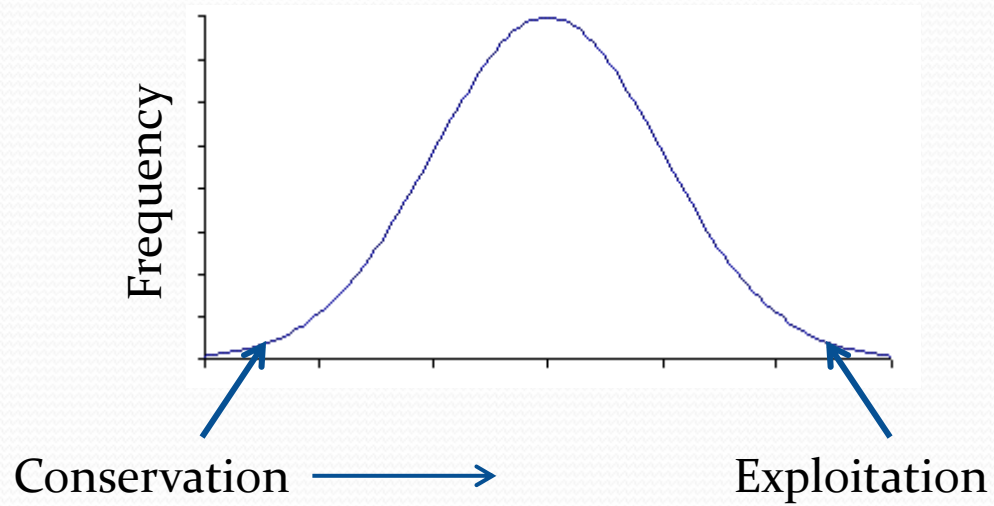
- Voluntary conservation approaches work best when incentives and benefits are aligned
- Majority of harvested land is rented
 - Conservation incentives and benefits are not well aligned
- Markets are farmed, not the land



Ag Realities

- Very strong ag and industry lobby
 - Rationally not aligned with conservation goals
 - Aligned with \$\$\$ for individual industry
- Major policy elements not well aligned with soil conservation and water quality
- Soil erosion science is weak

Ag Realities





What's New

- Increased watershed focus
- Industry recognition of sustainability issues
- Food industry talking the talk – will they walk the walk?
- Farmers vocalizing the 'R' word
- Increased emphasis on cover crops



What's not new

- Specialization
- Loss of cultural based management skills and increasing reliance on technology
- Growth in size of operations and equipment



What's not new

- Government policy in conflict with conservation
- Degradation of soil and water resources



Elements of a fix

- Goal and a Plan
 - Commitment to those goals
 - Agriculture and agribusiness are different and must be treated as such
- Policies
 - That do not put conservation committed farmers at a competitive disadvantage
- Address the problem, not the symptom
 - Exploitation at expense of conservation

