World Agriculture: Forces for Change

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16 July 2007

Forces for Change

- Globalization and policy changes
- Demand growth
  - Food, forest products and biofuels
- Increasing resource scarcity and global climate change
- Golden age of biological and information sciences
- Necessity to generate parity of returns to investment and to management

Globalization

- Increasing integration of economies (from the most local level) around the world
  - Trade -- Technology/knowledge
  - Financial capital -- People/labor
- Result of:
  - Technological advances that reduce cost and increase speed of international transactions
  - Trade liberalization –- both multi- and bi-lateral
- Creates unprecedented opportunities for specialization and exchange of goods and services (global sourcing & supply chains)
- Exposes previously isolated markets to competition

Globalization of Agriculture

- Fraction of world ag production that moves through trade is growing rapidly.
- Fraction that flows in value-added form is increasing faster than bulk commodities
- Global supply chains mean that more trade is occurring within firms
- Globalization creates competitive challenges and opportunities for farmers.
  - Distinction between commodities and differentiated products important

World Agriculture in Disarray*

- Most high income countries subsidize their agriculture, distorting relative returns to various outputs and inducing larger total investment in agriculture relative to other sectors.
- Many LDCs' food policies turn the terms of trade against agriculture to keep urban food prices low, reducing the incentive to invest; agriculture underperforms relative to its potential.
- Protectionist import policies and export subsidies further distort what is produced where.

*Title of a famous book by D. Gale Johnson

Current WTO Ag Trade Negotiations

- Much has already been agreed:
  - Eliminate all ag export subsidies
  - Reduce trade-distorting domestic subsidies
  - Reduce import tariffs
  - Give the least developed countries open access to high income country markets for most goods.
- The issue in this round is NOT to get rid of ag subsidies, but to replace those linked to production of specific commodities.
- Thorny issues concerning depth of cuts & number of exceptions are delaying a deal.

Prospects

- The Uruguay Round Agreement on Agriculture will continue to set the rules of the road for international agricultural trade until some future round of negotiations changes them.
- Replacement of trade-distorting forms of support with non-trade-distorting likely to continue.
- If this round fails or is delayed, expect:
  - proliferation of bilateral trade agreements
  - more cases to be filed with WTO against OECD agricultural supports

Megatrends in Demand

- The consumer is driving the entire food system, creating niche opportunities, but never forget that niches fill fast.
- Increasing consolidation in processors and retailers
- High-income country markets of the past are shrinking
- The future is in developing countries, where there are many more people to be fed and incomes are growing.

Projected Population Growth
(U.N. medium projections)

Region	2005	2050	
World	6,465	9,076	+ 40%
High Income	1,211	1,236	+ 2%
Low Income	5,253	7,840	+ 49%
Africa	906	1,937	+114%
Asia	3,905	5,217	+ 33%
Latin America	561	783	+ 40%
North America	331	438	+ 32%
Europe	728	653	-10%

Dynamics of Global Food Demand

- 1.25 billion people live on less that $1/day; 840 million of them suffer under-nutrition or hunger.
- 3 billion people live on less than $2/day; by $2 per day, most hunger (calorie) problems solved.
- Between $2 and $10 per day people eat more meat, dairy products, fruits, vegetables & edible oils, causing rapid growth in raw ag commodity demand.
- After $10 per day, people buy more processing, services, packaging, variety, and luxury forms, but not more raw ag commodities.

Huge Growth in Food Consumption Expected from Economic Growth

Country	Population	% < $1/day	% < $2/day
China	1298.8	16.6	46.7
India	1065.1	34.7	79.9
Indonesia	238.5	7.5	52.4
Brazil	184.1	8.2	22.4
Pakistan	159.2	13.4	65.6
Russia	144.0	6.1	23.8
Bangladesh	141.3	36.0	82.8
Nigeria	125.8	70.2	90.8
Mexico	105.0	9.9	26.3

Source: World Bank. World Development Indicators database

Projected World Food Demand

- World food demand could double by 2050
  - 50% increase from world population growth – all in developing countries
  - 50% increase from broad-based economic growth in low income countries
- How many presently low income consumers are lifted out of poverty will be the *most important* determinant of the future global demand for food.
- The World Bank estimates that the number of people in developing countries living in households with incomes above $16,000/year will rise from 352 million in 2000 to 2.1 billion by 2030.

Growing Demands on Forests, Too

- The same forces of population and income growth that increase demand for food also increase demand for things made out of wood, e.g. paper, furniture, building materials; poles.
- In rich countries, growing demand for environmental amenities and preservation of (especially old-growth) forested areas.
- Now biofuels production is claiming more and more land to grow feedstocks.

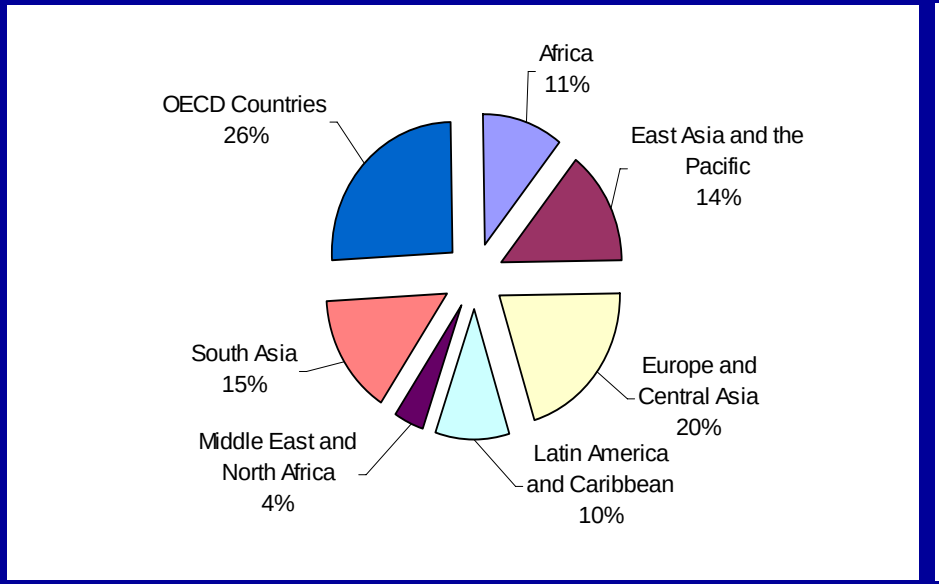
Biofuels Now Driving Ag Outlook

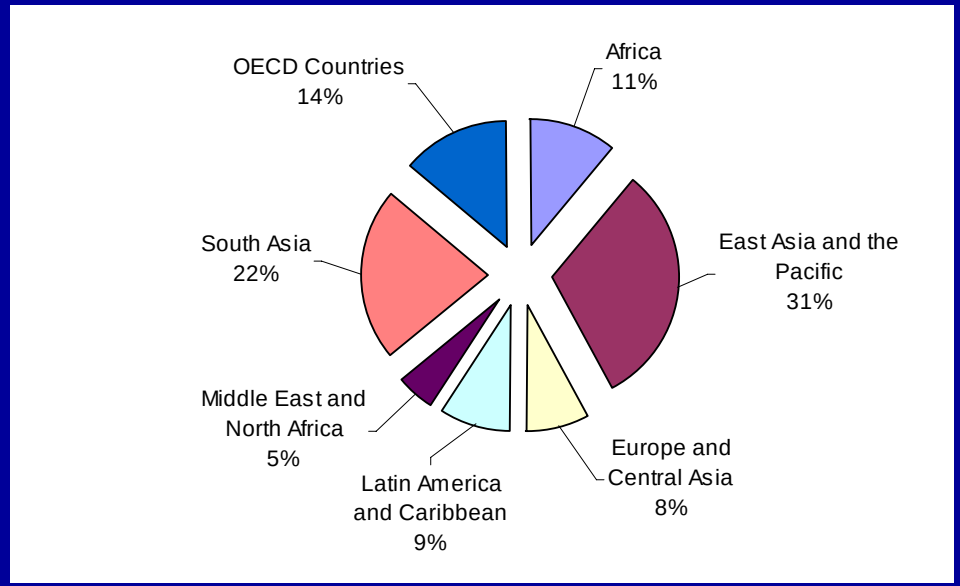
- Production of ethanol in the U.S. and biodiesel in Europe comprise the biggest shock to world agriculture since 1970s.
- Creating large demand for maize and edible oils, which is pulling land out of other crops in U.S. and destroying of rainforests in S.E. Asia.
- Drop in U.S. agricultural exports is creating opportunities for other countries to grow maize, soybeans & wheat that the U.S. won't export.
- How long before we have technology for producing ethanol from cellulosic feedstocks?

Larger Fraction of World Ag Production to Move Through Trade

- The world's arable land and fresh water are not distributed around in the world in the same proportions as is population.
  - No way for Asia or Middle East to be self-sufficient in food
- With population growth, urbanization and broad-based economic development, many LDCs' food consumption to outstrip their production capacity and they will become larger net importers.
- Efficient producers of animal products, grains and oilseeds, wherever they are, will benefit.

The World's Arable Land (left) Is Distributed Very Differently than Its Population (right)





The Land Constraint

- There is at most 12% more arable land available that isn't presently forested or subject to erosion or desertification – and degradation of many soils continues.
- The area of land in farm production could be doubled…
- But only by massive destruction of forests and loss of wildlife habitat, biodiversity and carbon sequestration capacity
- The only environmentally sustainable alternative is to at least double productivity on the fertile, non-erodible soils already in crop production.

Constraints on World Ag Production

40% too dry

21% too wet

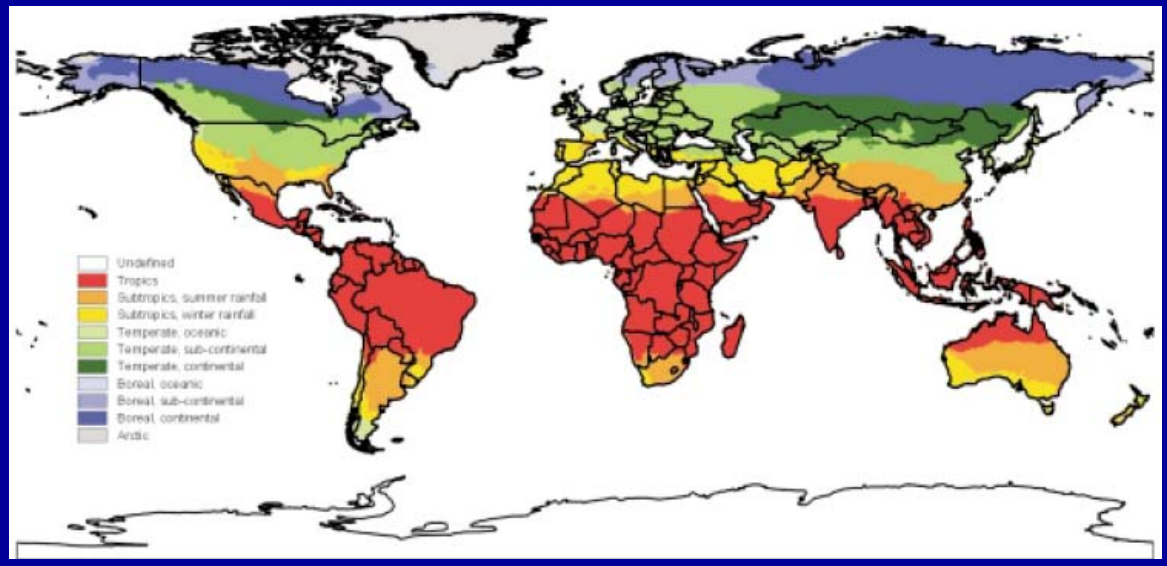
21% too cold

6% too rough terrain

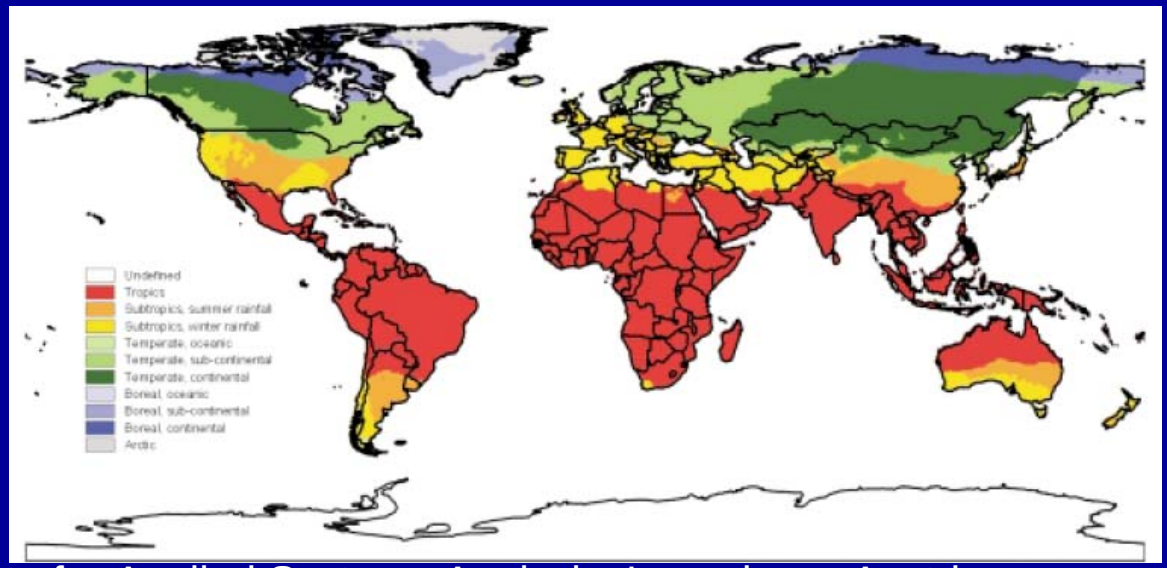
2% unsuitable soils

Global Climate Change

Before

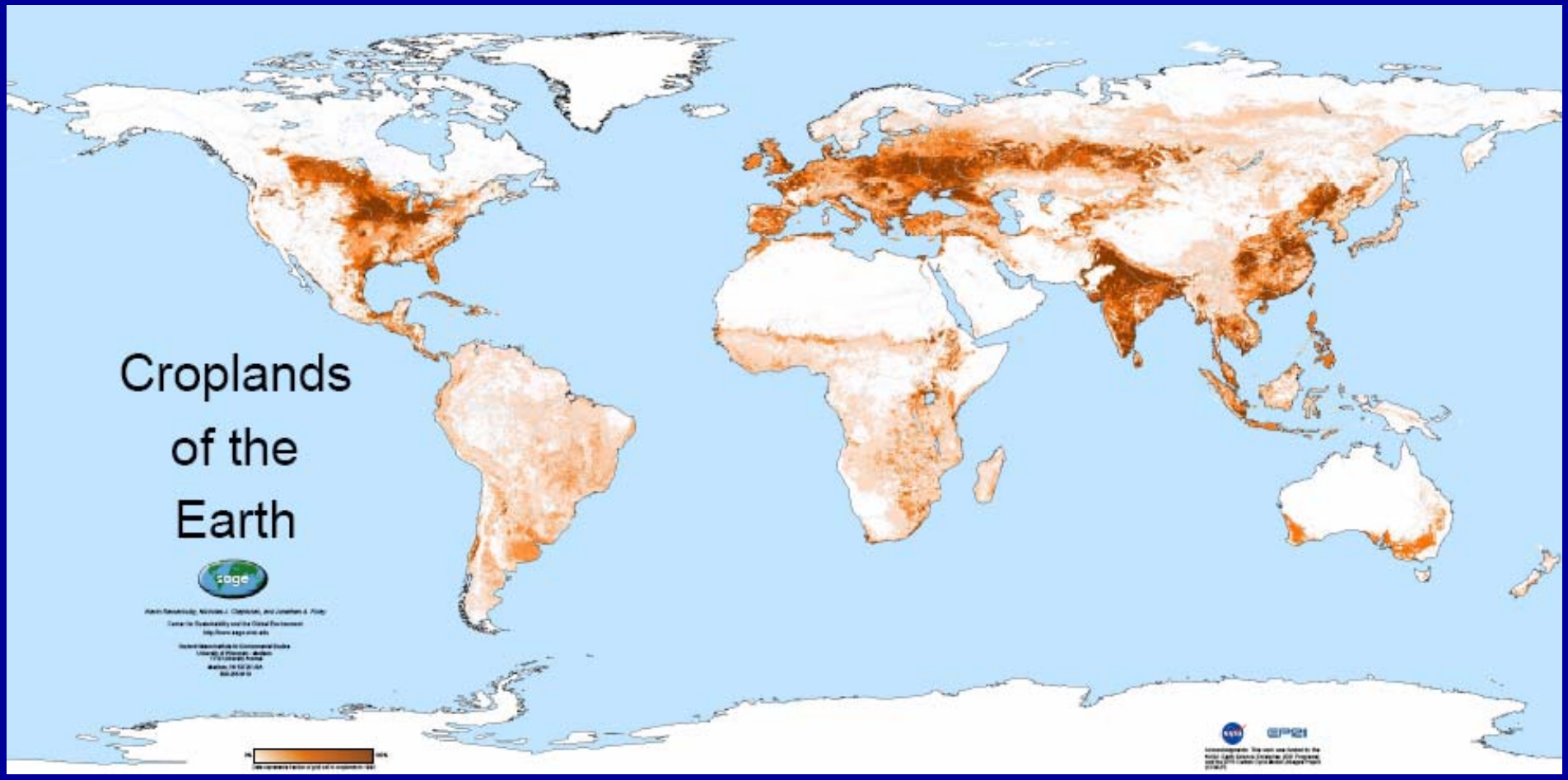


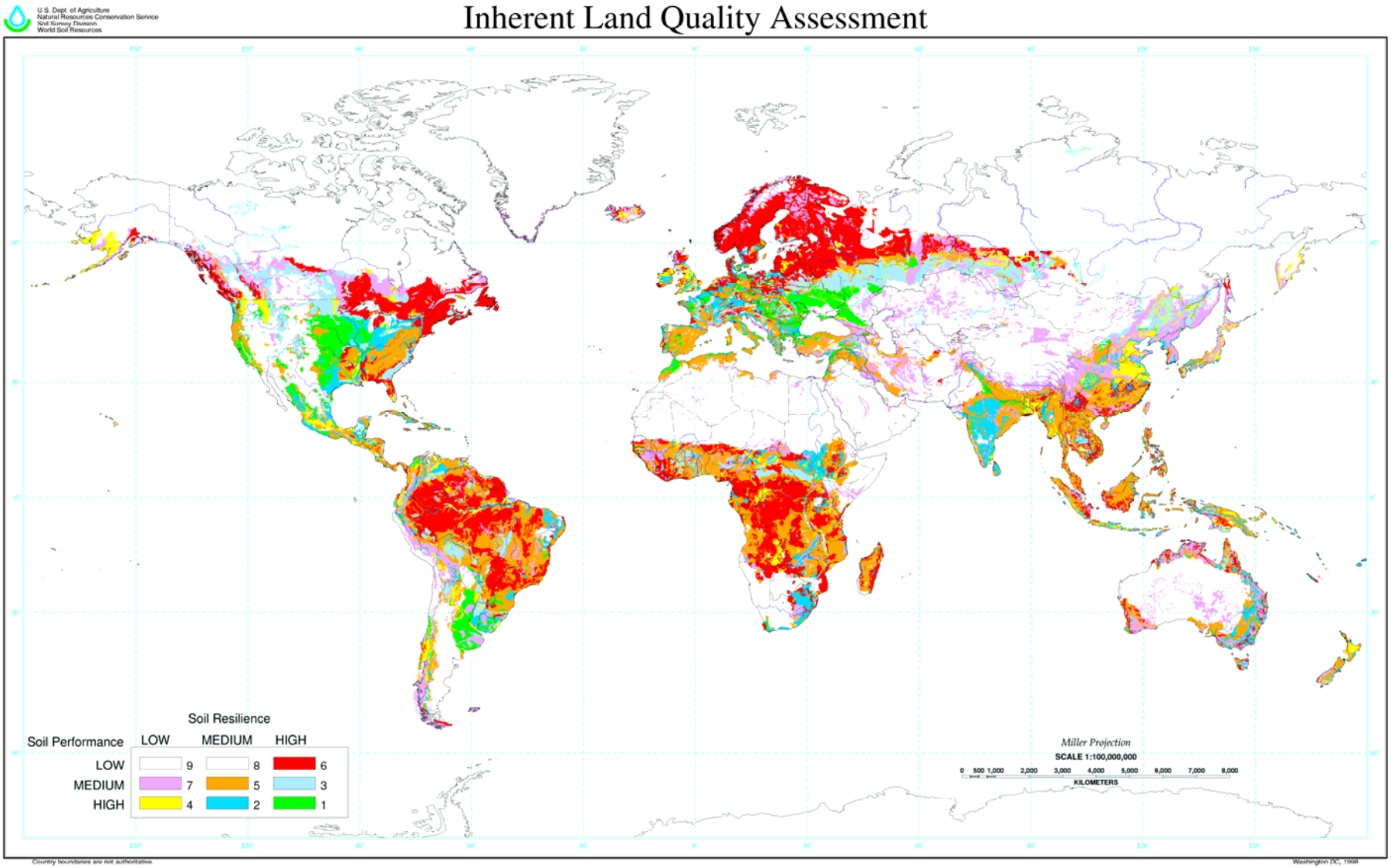
After



Source: International Institute for Applied Systems Analysis, Laxenburg, Austria

Can Technology Enable Expansion of Arable Land Area?




U.S. Dept. of Agriculture
Natural Resources Conservation Service
Soil Survey Division
World Soil Resources
Inherent Land Quality Assessment
Soil Resilience
Soil Performance
LOW
MEDIUM
HIGH
LOW 9 8 6
MEDIUM 7 5 3
HIGH 4 2 1
Miller Projection
SCALE 1:100,000,000
0 500 1,000 2,000 3,000 4,000 5,000 6,000 7,000 8,000
KILOMETERS
Country boundaries are not authoritative.
Washington DC, 1998

Water A Growing Constraint

- Farmers use 70% of the fresh water used in the world. They are both the largest users and the largest wasters of water.
- Water is priced at zero to most farmers, signaling that it is much more abundant than in reality. Anything priced at zero will be wasted.
- With rapid urbanization, cities are likely to outbid agriculture for available water.
- The world's farmers need to double food production using less water than today. Biofuels will add further to this challenge.

Research Investment Essential

- Since Malthus, prophets of doom have argued population growth will increase food demand faster than agricultural production can grow.
- Public and private sector investments in agricultural research have increased productivity faster than demand growth, with resulting 150 year downward trend in real price of grains.
- Need to triple world ag production by 2050 using less water and little more land than today.
- Future world market price trend will depend on whether research increases land and water productivity faster than world demand grows.

To Triple Ag Production Will Require More than Conventional Breeding

- Biotechnology creates opportunities to:
  - Improve nutritional content of grains, etc.
  - Increase tolerance to drought, wetness, temperature, salt, aluminum toxicity, …. (to increase yields and/or planted area under adverse or variable conditions)
  - Internalize resistance to diseases; viruses
  - Reduce pesticide use, esp. insecticides
  - Herbicide-resistant varieties
  - Slow down product deterioration

Environmental Benefits of GMOs

- Large reduction in insecticide use
- More effective weed control with less energy & less soil compaction
- Natural resistance to diseases
- Increase water use efficiency
- Preserve hundreds of millions of hectares of forests
- Reduce pressure on fragile lands

Stylized Characterization of High Income Country Agriculture

- Highly capital intensive, with much of highly specialized physical capital with low alternative value in other uses
- High productivity, technologically sophisticated agriculture requires farm operator to have large stock of specialized human capital
- Farm sector has small role in GDP & employment.
- Nonfarm public spends small percent of income on raw ag commodities & more on post-farm gate value-added.
- Farm family income and wealth exceed those in non-farm economy, although small full-time family farms lag.

Stylized Characterization of Low Income Country Agriculture

- Extensive rural poverty; farm family incomes lag non-farm family incomes
- Agriculture is labor intensive, with physical capital relatively unspecialized
- Low investment in rural education impedes technology adoption and out-migration from agriculture
- Farm sector bulks large in GDP generation and employment
- Nonfarm public spends significant percent of income on raw ag commodities
- Underinvestment in rural public goods, particularly infrastructure and agricultural research.

"Change will occur whether or not we plan for it. The question is whether we will have the foresight to embrace change and shape it to our benefit, or whether we will allow ourselves to become its victims."

Agriculture Task Force
Chicago Council on Global Affairs
September 2006