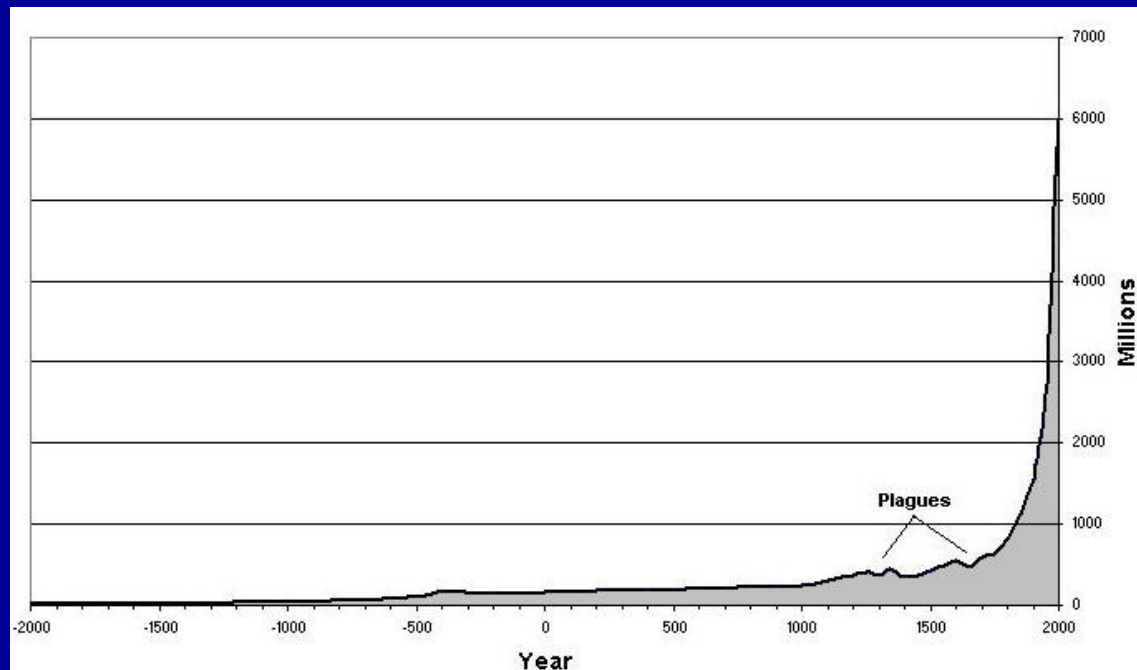


THE BIG ISSUE

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Evolution of World Population

- It took from the beginning of time to 1804 to get to the first billion people on earth.
- BUT, the population passed:
 - 2 billion in 1927 (123 years later)
 - 3 billion in 1960 (33 years later)
 - 4 billion in 1974 (14 years later)
 - 5 billion in 1987 (13 years later)
 - 6 billion in 2000 (13 years later)
 - 6.5 billion in 2006 (6 years later)



Projected Population Growth

(U.N. medium projections, in millions)

• <u>Region</u>	<u>2007</u>	<u>2050</u>	
• World	6,671	9,191*	+ 38%
• High Income	1,223	1,245	+ 2%
• Low Income	5,448	7,946	+ 46%
• Africa	965	1,998	+107%
• Asia	4,030	5,266	+ 31%
• Latin America	572	769	+ 34%
• North America	339	445	+ 31%
• Europe	731	664	- 9%

*The UN Population Office's low and high projections of the world population in 2050 are 7.8 billion and 11.9 billion, respectively.

10 Largest Countries (millions)

2007

2050

1. China	1,318	1. India	1,747
2. India	1,132	2. China	1,437
3. United States	302	3. United States	420
4. Indonesia	232	4. Indonesia	297
5. Brazil	189	5. Pakistan	295
6. Pakistan	169	6. Nigeria	282
7. Bangladesh	149	7. Brazil	260
8. Nigeria	144	8. Bangladesh	231

Source: Population Reference Bureau.



Huge Growth in Food Consumption Expected from Economic Growth

Country	Population	% < \$1/day	% < \$2/day
China	1318	9.9	34.9
India	1132	34.3	80.4
Indonesia	232	7.5	52.4
Brazil	189	7.5	21.2
Pakistan	169	17.0	73.6
Bangladesh	149	41.3	84.0
Nigeria	144	70.8	92.4
Philippines	85	14.8	43.0
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
- The World Bank estimates that the number of people in developing countries living in households with incomes above \$16,000 per year will rise from 352 million in 2000 to 2.1 billion by 2030.
- How many presently low income consumers are lifted out of poverty will be the *most important* determinant of the future global demand for food.



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 rainforests in S.E. Asia.
- Higher feed grains prices reducing profitability of livestock and poultry industries.
- When will we have technology for producing ethanol economically from cellulosic feedstocks? Can they be produced on inferior soils?

Growth of U.S. Ethanol Industry

- 2000: 1.7 billion gallons of ethanol produced; used 6% of U.S. maize harvest.
- 2007: 5.8 billion gallons produced; used 20% of maize harvest (now larger than exports).
- Now 134 ethanol plants are operating with total capacity of 7.2 billion gallons; 77 more are under construction or expanding.
- This will bring capacity to 13.4 billion gal. by 2008-09
 - Energy Bill of 2007 mandated 36 billion gal. of biofuels by 2022, of which 15 billion from maize.

Source: Renewable Fuels Association

Constraints on World Ag Production



40% too dry

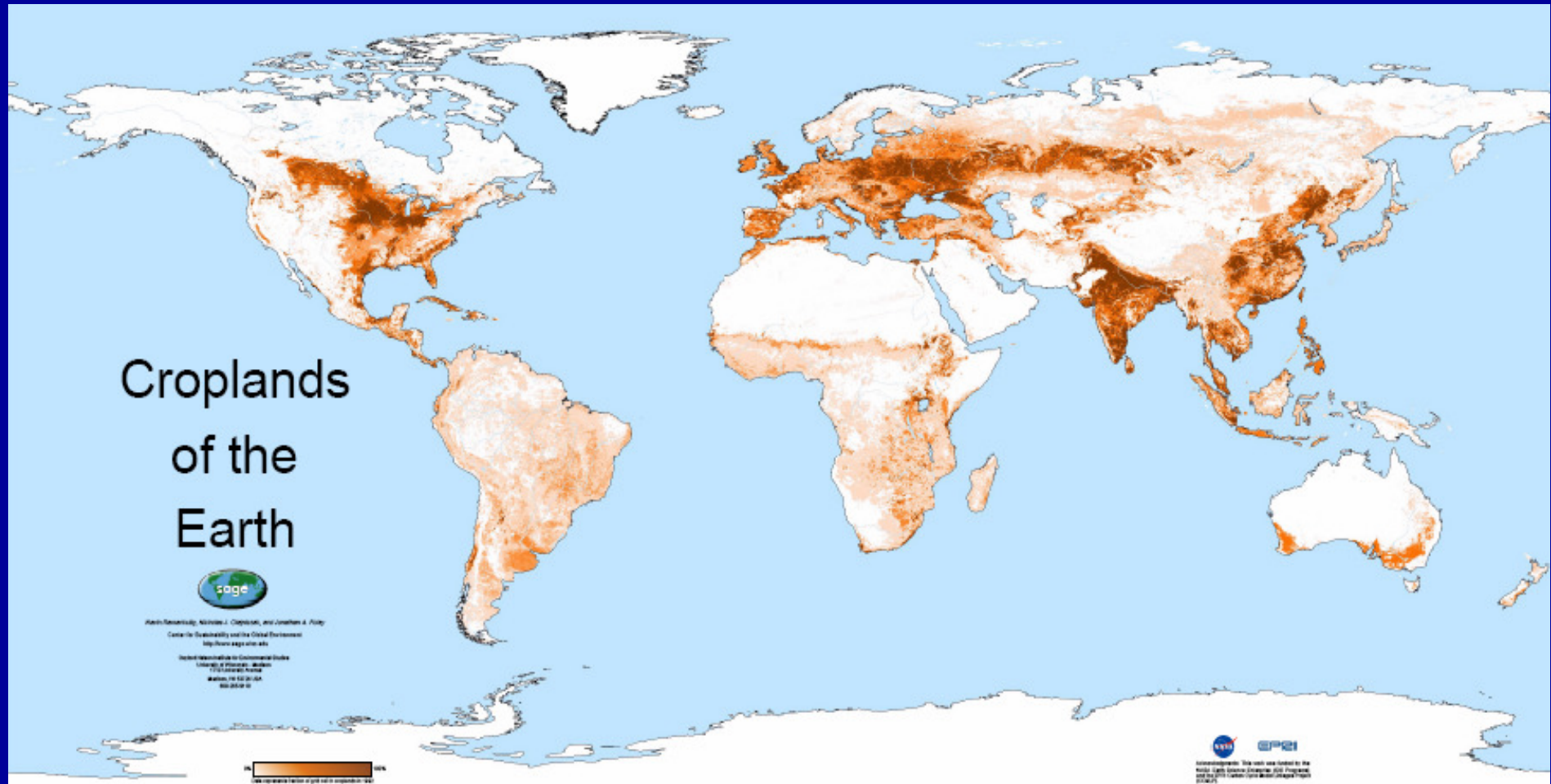
21% too cold

21% too wet

6% too rough terrain

2% unsuitable soils

Can Technology Enable Expansion of Arable Land Area?



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.

The Challenge

Can the world's farmers double food production?

Can they do it in an environmentally sustainable manner?

And what about the additional demands on them to help supply the world's energy demand?

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

“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

