

# **Running Out of Water: What's the Problem, What's the Solution**

Stratton Lecture on Critical Issues

Moderator, Peter Rogers

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# Introduce Panelists

- Franklin Fisher, Carlton Professor of Microeconomics, Emeritus at MIT
- Susan Murcott, Senior Lecturer in Civil and Environmental Engineering at MIT
- John Briscoe, Professor of the Practice of Environmental Health at the School of Public Health and Gordon McKay Professor of the Practice of Environmental Health at the School of Engineering and Applied Sciences, at Harvard.

# Two Road Blocks on the Path to Sustainability



**Thomas Robert Malthus, (1766-1834)**

**Malthus** postulated a geometric rate of growth of population and an arithmetic growth of land being brought under cultivation and, hence, an arithmetic rate of growth of food production. Malthus predicted widespread famine or violent conflicts to bring food and population into alignment with each other by “misery, war, pestilence, and vice.”

**Ricardo** articulated “declining returns” on investments in resources (coal and iron ore in his time, water, oil, and gas in our time) whereby the best (least-cost) resources are used first, followed by the next best, and so on. Increasing demand for the resource leads to price increases that will continue to rise until the resource becomes too expensive to use.



**David Ricardo. (1772-1823)**

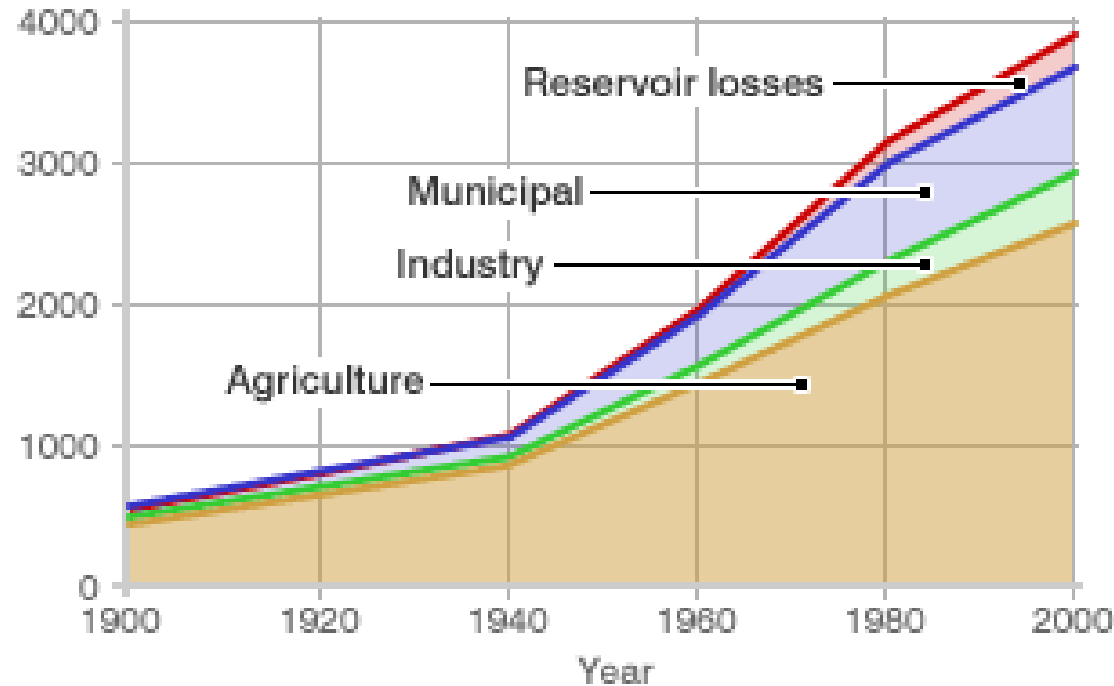
**These two nineteenth century concepts are at the root of our concern for Sustainable Development.**

# Conventional View of Increasing Demand Meeting Fixed Supply

- Since 1900 global population has tripled
- Water use has increased more than six-fold

Estimated annual world water use

km<sup>3</sup> per year



SOURCE: FAO Aqastat

# Water Supply and Sanitation: The Biggest Challenge?

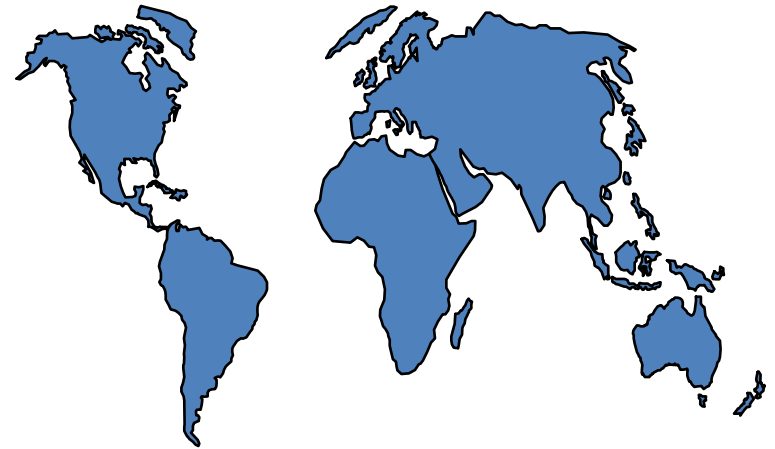
## Huge needs

- over 1 billion people without safe water, 2 w/o sanitation, 4 w/o sewage treatment
- existing systems are run-down
- Sanitation for 1.2 millions and water for 600,000 additional persons each week over 15 years to meet MDG

## No money

- fiscal constraints
- official aid stagnant (< \$3bn/yr, WB \$1bn)
- public utilities unable to self-finance or to carry debt
- private investment: a relative trickle so far

## *An old story*



## *what can we do?*

# Other Water Issues

**Flooding** due to increased or changed rainfall patterns, coastal flooding due to sea level rise, storm damages due to intensification of cyclones and hurricanes,

**Droughts** due to reduced precipitation, melting of glaciers, reduced snow pack, diversion of streams,

**Reduction in quality** due to pollution from households, cities, industries and agriculture,

**Severe damage** to aquatic ecosystems due to these quantity and quality changes, and finally

**Economic and social conflict** among countries, cities, industries, and agriculture over shrinking water supplies.

While these issues are often presented as future problems, they are also part of the current global situation of widespread asymmetries in amounts of available water resources across countries and regions within them, but also the widespread disparities in the ability of groups and individuals to access water even when it is available in adequate quantities. **We don't need to wait for "climate change."**

# And Finally, as if we needed more Casus belli, Water Wars

At the World Economic Forum, in Davos (24 January 2008) Mr. Ban Ki-moon, the UN Secretary-General, implicated drought as a cause of the conflict in Darfur and cautioned that a shortage of water resources could spell increased conflicts in the future. He pledged UN action on water resources. He also noted;

“Our experiences tell us that environmental stress, due to lack of water, may lead to conflict, and would be greater in poor nations,”

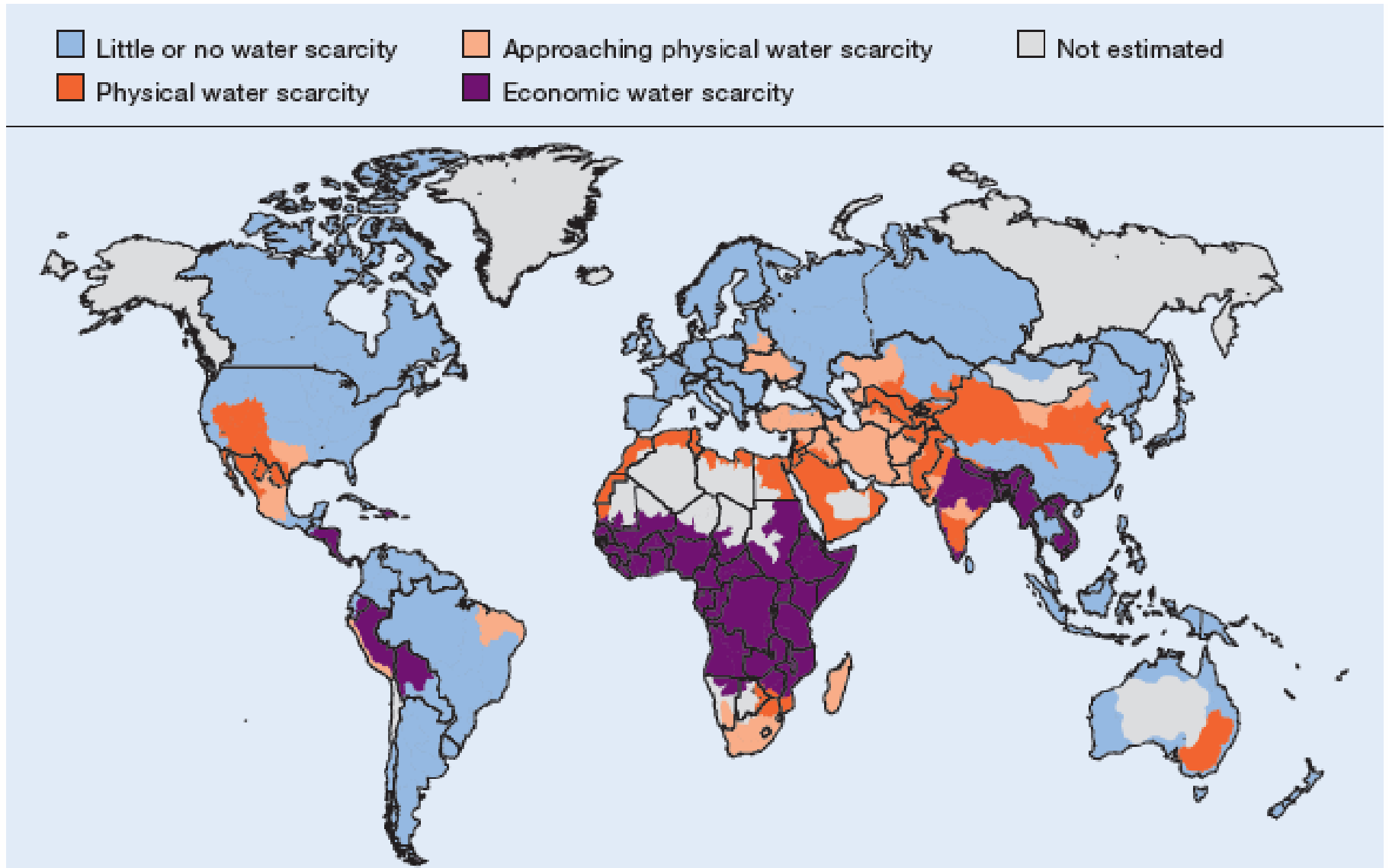
“Population growth will make the problem worse. So will climate change. As the global economy grows, so will its thirst. Many more conflicts lie just over the horizon,”

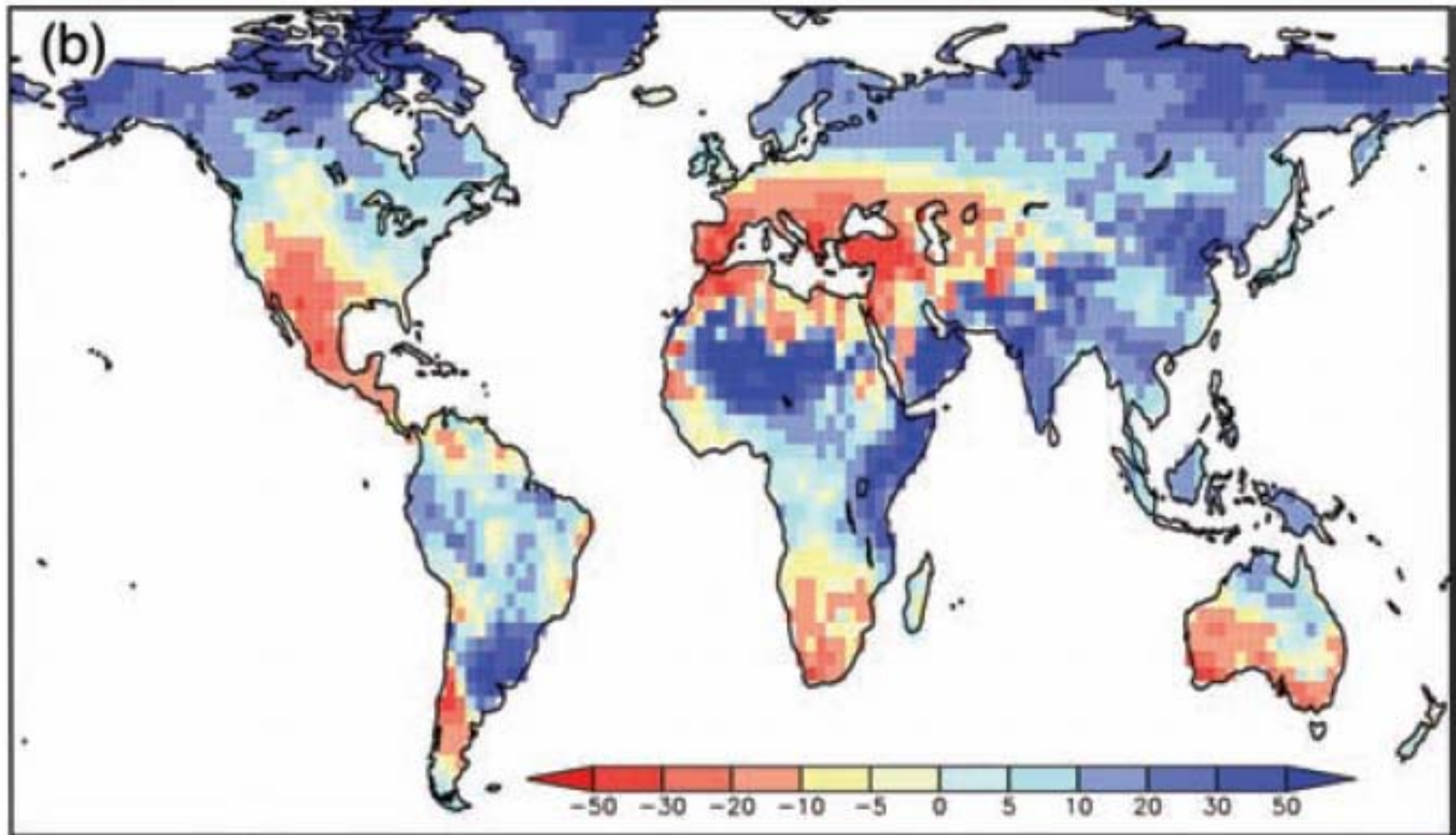
“This is not an issue of rich or poor, north or south,” he said, pointing to examples of water problems in China, the United States, Spain, India, Pakistan, Bangladesh and the Republic of Korea. All regions are experiencing the problem.”

# **Getting Hydrologists and Economists to agree on the Concept of Scarcity**

Results in a Hybrid, defining it two ways:  
Water Scarcity Based upon Physical  
Resource Availability and upon  
Economical Resource Availability

# The Present Physical and Economic Scarcity





IPCC SCENARIO FOR WATER AVAILABILITY: 2000-2100

Ensemble mean ,% change in mean runoff, 2000-2100. FAR WGII, p. 280.

# Water, Climate, Food: The Issues

- Food production is, by far, the largest water user on the planet.
- There is no substitute for water in crop production.
- There are currently large quantities of fresh water available on the earth, but they are poorly distributed with regard to space, and seasonal timing (more than 40,000 Km<sup>3</sup> ).
- Demand for fresh water for cities and industries has doubled over the past 20 years, and is predicted to increase by a factor of 2.2 from 900 Km<sup>3</sup> in the year 2000 to 1,963 Km<sup>3</sup> by 2050.
- The global climate is changing which will cause changes in magnitude, location, and timing of the primary sources of freshwater: rainfall and snow melt.
- Unfortunately, the state of the science is currently unable to predict these changes in magnitude, location, timing, and even whether the magnitudes will increase or decrease in particular locations.
- Used as a substitute for fossil fuels, biofuel demand from 2000-2007 is estimated to have accounted for a 30% increase in average cereal prices over the period. However, the subsequent high prices for food and feedstock are already causing shifts back into food crops in the US. (World Bank, 2008).

# Needs for Global Agriculture

- Global agricultural production growth rate will decline from the historical rate of 2.2% per year to 0.8% per year by 2050 (these rates still imply an 80% increase in production compared to 2000).
- By 2050 need another 185 million ha. (+19%) of rain-fed crop land, and another 60 million ha. (+30%) of irrigated land.
- To meet these goals for improved irrigation, the total capital investment needs from 2000 to 2050 were estimated to be \$304 billion to rehabilitate 222 million ha. and construct additional storage of 766 Km<sup>3</sup> of water.

Source: Comprehensive Assessment, 2007

## Exhibit 1: The Infrastructure Challenge

Percentages of total projected cumulative infrastructure investment needed during the next 25 years to modernize obsolescent systems and meet expanding demand, broken down by region (rows) and sector (columns).

### Middle East

\$0.9T

Total projected cumulative infrastructure spending 2005–2030: **\$41 trillion**

Africa \$1.1T

U.S./Canada

\$6.5T

South America/  
Latin America

\$7.4T

Europe

\$9.1T

Asia/Oceania

\$15.8T



**Source:** Booz Allen Hamilton, Global Infrastructure Partners, World Energy Outlook, Organisation for Economic Co-operation and Development (OECD), Boeing, Drewry Shipping Consultants, U.S. Department of Transportation