Resetting U.S. Climate Policy

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Panel 3A: FOSSIL FUELS & WORLD PEACE

The Relationship Between CO_2, Climate and Social Conflict

12th International Conference on Climate Change

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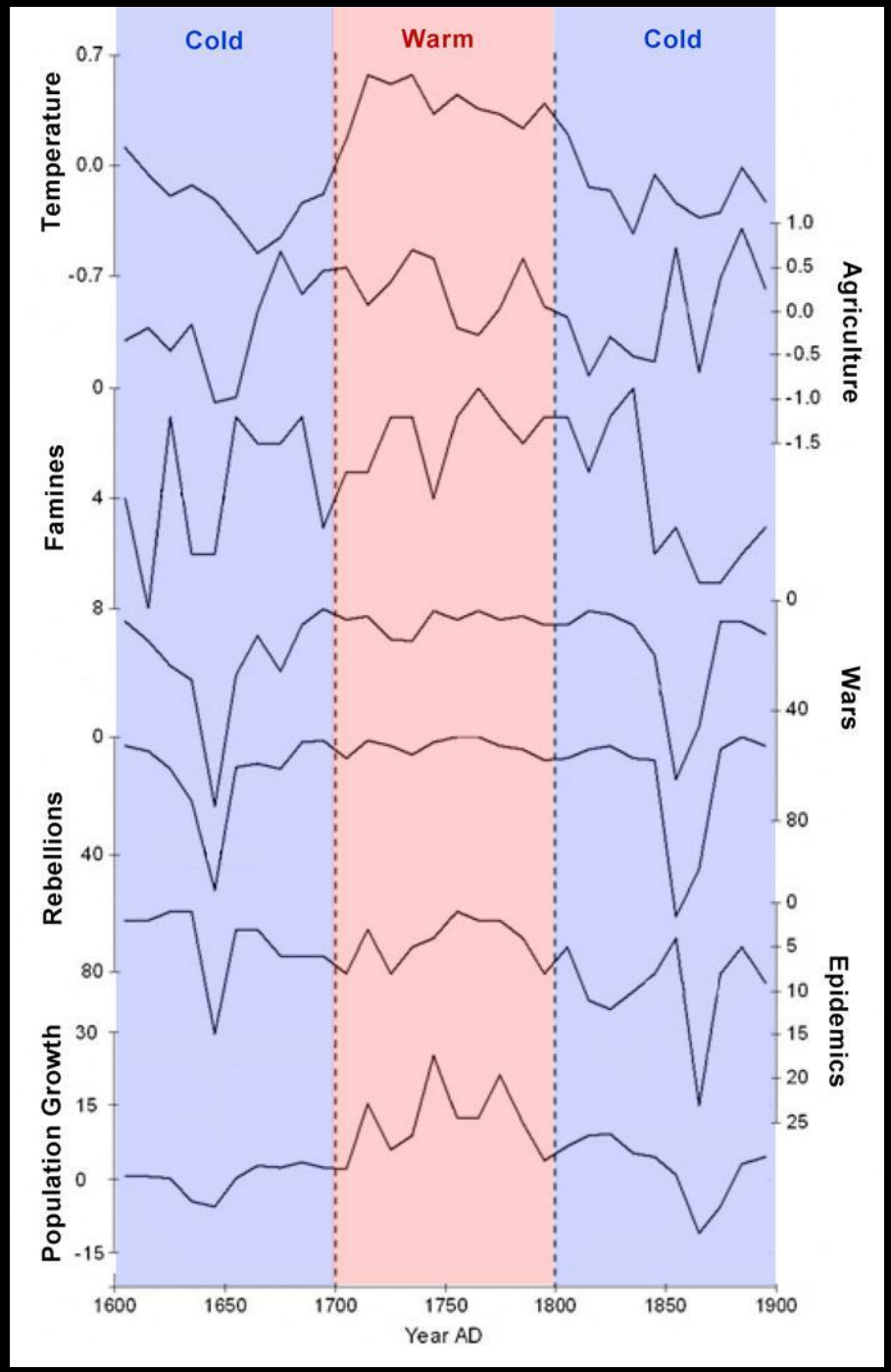
China:

- Long history
- Socially stable
- Well-populated
- Agrarian

Lee and Zhang (2013) found that “both natural calamities and human catastrophes [were] clustered in periods of cold climate”



Source:
Lee, H.F. and Zhang, D.D. 2013. A tale of two population crises in recent Chinese history. *Climatic Change* **116**: 285-308.

Zhang *et al.* (2005) Study

- Compared proxy climate records with historical data on Chinese wars, social unrest, and dynastic transitions from the mid-ninth through early twentieth century
- War frequencies, peak war clusters, nationwide periods of social unrest, and dynastic transitions were all significantly associated with cold climate.
  - All three distinctive peak war clusters (defined as more than 50 wars in a ten-year period) occurred during cold climate phases, as did all seven periods of nationwide social unrest and nearly 90 percent of all dynastic changes that decimated this largely agrarian society.

Source: Zhang, D., Jim, C., Lin, C., He, Y. and Lee, F. 2005. Climate change, social unrest and dynastic transition in ancient China. *Chinese Science Bulletin* **50**: 137-144.

Additional Regional Studies

- Tol and Wagner (2010) observed that “periods with lower temperatures in the pre-industrial era [were] accompanied by violent conflicts”
- Field and Lape (2010) report that fortification construction is significantly correlated with periods of cooling throughout the inhabited regions of the tropical pacific
- Benjaminsen *et al*. (2012) conclude that comparison of climate and conflict data from the African Sahel “gives little substance to claims that climate variability is an important driver of these conflicts”

Hemispheric to Global Scale Studies

- Analyzing data from “all countries of the world” over the 1980-2004 time period Koubi *et al*. (2012) report that “climate variability, measured as deviations in temperature and precipitation from their past, … does not affect violent intrastate conflict”
- In commenting on this finding they say it “is important because the causal pathway leading from climate variability via (deteriorating) economic growth to conflict is a key part of most theoretical models of the climate-conflict nexus”

Hemispheric to Global Scale Studies

- Zhang *et al*. (2011) examined the association between temperature change and population collapses in different regions and climatic zones of the Northern Hemisphere for the period 800-1900 AD.
- Of the 88 Northern Hemisphere population collapses identified, 80% were caused by cooling, 12% occurred during "mild conditions," and only 8% were caused by warming.
- "Temperature was positive and highly significant in the regressions in which a 10% increase in temperature produced on average a 3.1% increase in population growth rate"

Hemispheric to Global Scale Studies

- Slettebak (2012) examined “whether natural disasters can add explanatory power to an established model of civil conflict”
- Results indicated “they can, but that their effect on conflict is the opposite of popular perception.”
  - “To the extent that climate-related natural disasters affect the risk of conflict, they contribute to reducing it.” And this result holds “for a measure of climate-related natural disasters in general, as well as drought in particular,” which findings are “consistent with a large amount of research ... on the relation between disasters and the risk of anti-social behavior.”

Hemispheric to Global Scale Studies

- Gartzke (2012) further confirms that “global warming is associated with a reduction in interstate conflict”
  - “Incorporating measures of development, democracy, cross-border trade, and international institutions reveals that systemic trends toward peace are actually best accounted for by the increase in average international income,” which in turn is driven by “the processes that are widely seen by experts as responsible for global warming.”
  - “Stagnating economic development in middle-income states caused by efforts to combat climate change could actually realize fears of climate-induced warfare.”
  - “We must add to the advantages of economic development [as] it appears to make countries more peaceful,” and we must therefore ask ourselves if environmental objectives should be “modified by the prospect that combating climate change could prolong the process of transition from warlike to peaceful polities”

Additional studies posted on the CO2 Science website, in our Subject Index, under the topical heading of *War and Social Unrest*

“To Cultivate Peace, We Must First Cultivate Food”

- Former U.S. President Jimmy Carter

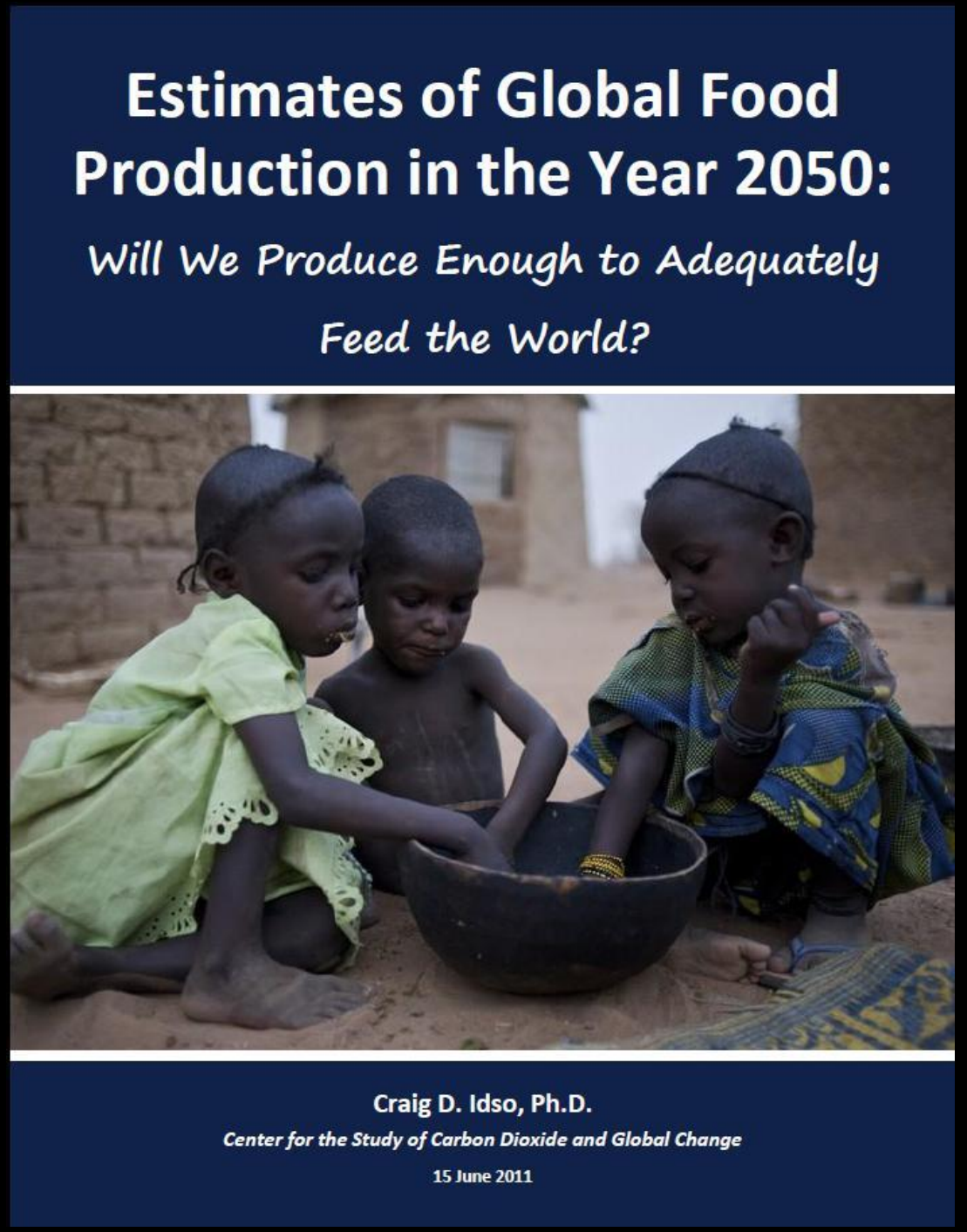
- “When the Cold War ended [in 1989], we expected an era of peace” but instead we got “a decade of war”
- Most of the past century’s wars were fueled by poverty in developing countries “whose economies depend on agriculture but which lack the means to make their farmland productive”
  - This fact, he continued, suggests an obvious, but often overlooked, path to peace, which is—“raise the standard of living of the millions of rural people who live in poverty by increasing agricultural productivity,” his argument being that thriving agriculture “is the engine that fuels broader economic growth and development, thus paving the way for prosperity and peace”

Higher CO_2 Concentrations Increase Agricultural Production!

- Atmospheric CO_2 is the basic food of plants
  - It is the primary raw material utilized by plants to construct their tissues
  - It plays an essential role in the photosynthetic process that sustains nearly all of Earth's vegetation, which in turn sustains nearly all the planet's animal life
- The insertion of more raw materials (in this case CO_2) into the production line results in more manufactured goods coming out of the other end, which in the case of the plant-growth production line is biosphere-sustaining food
- As President Carter stated, "leaders of developing nations must make food security a priority," for "there can be no peace until people have enough to eat"
  - Allowing the CO_2 content of the air to increase so as to boost agricultural production is one method by which that objective can be achieved

- Presented estimates of regional and global food supplies derived for the year 2050, both including and not including the direct growth-stimulating biological effects of the rise in the atmosphere's CO_2 concentration expected to occur over the next half century

- Analyzed those findings with respect to the food needs of the human population expected to be inhabiting the planet at that future date



Future Global Food Security in 2050

- There is indeed a global food security crisis looming on the horizon
- Continuing advancements in agricultural technology and expertise will most likely not be able to bridge the gap between global food supply and global food demand
- The positive impact of Earth's rising atmospheric CO_2 concentration on crop yields will considerably lessen (if not overcome) the severity of the coming food shortage
  - Such benefits will help to lift untold hundreds of millions out of a state of hunger and malnutrition, preventing starvation and premature death

“The rising level of atmospheric CO_2 could be the one global natural resource that is progressively increasing food production and total biological output, in a world of otherwise diminishing natural resources of land, water, energy, minerals, and fertilizer. It is a means of inadvertently increasing the productivity of farming systems and other photosynthetically active ecosystems. The effects know no boundaries and both developing and developed countries are, and will be, sharing equally.”

– Dr. Sylvan H. Wittwer (1982)

- Norman Borlaug, the father of the Green Revolution and 1970 Nobel Peace Prize recipient, has also written about the need to vastly increase the world's agricultural productivity
- He projected that in order to meet the needs of the growing population of the planet, "we will have to nearly double current production again" within a few short decades

Editor's Choice

Ending World Hunger. The Promise of Biotechnology and the Threat of Antiscience Zealotry

Norman E. Borlaug

Nobel Prize Laureate for Peace, 1970

During the 20th century, conventional breeding produced a vast number of varieties and hybrids that contributed immensely to higher grain yield, stability of harvests, and farm income. Despite the successes of the Green Revolution, the battle to ensure food security for hundreds of millions miserably poor people is far from won. Mushrooming populations, changing demographics, and inadequate poverty intervention programs have eroded many of the gains of the Green Revolution. This is not to say that the Green Revolution is over. Increases in crop management productivity can be made all along the line: in tillage, water use, fertilization, weed and pest control, and harvesting. However, for the genetic improvement of food crops to continue at a pace sufficient to meet the needs of the 8.3 billion people projected to be on this planet at the end of the quarter century, both conventional technology and biotechnology are needed.

WHAT CAN WE EXPECT FROM BIOTECHNOLOGY?

The majority of agricultural scientists, including myself, anticipate great benefits from biotechnology in the coming decades to help meet our future needs for food and fiber. The commercial adoption by farmers of transgenic crops has been one of the most rapid cases of technology diffusion in the history of agriculture. Between 1996 and 1999, the area planted commercially with transgenic crops has increased from 1.7 to 39.9 million ha (James, 1999). In the last 20 years, biotechnology has developed invaluable new scientific methodologies and products, which need active financial and organizational support to bring them to fruition. So far, biotechnology has had the greatest impact in medicine and public health. However, there are a number of fascinating developments that are approaching commercial applications in agriculture.

Transgenic varieties and hybrids of cotton, maize, and potatoes, containing genes from *Bacillus thuringiensis* that effectively control a number of serious insect pests, are now being successfully introduced commercially in the United States. The use of such varieties will greatly reduce the need for insecticides. Considerable progress also has been made in the development of transgenic plants of cotton, maize, oilseed rape, soybeans, sugar beet, and wheat, with tolerance to a number of herbicides. The development of these plants could lead to a reduction in overall herbicide use through more specific interventions and dosages. Not only will this development lower production costs; it also has important environmental advantages.

Good progress has been made in developing cereal varieties with greater tolerance for soil alkalinity, free aluminum, and iron toxicities. These varieties will help to ameliorate the soil degradation problems that have developed in many existing irrigation systems. These varieties will also allow agriculture to succeed in acidic soil areas, thus adding more arable land to the global production base. Greater tolerance of abiotic extremes, such as drought, heat, and cold, will benefit irrigated areas in several ways. We will be able to achieve more crop per drop by designing plants with reduced water requirements and adopting between-crop/water management systems. Recombinant DNA techniques can speed up the development process.

There are also hopeful signs that we will be able to improve fertilizer-use efficiency by genetically engineering wheat and other crops to have high levels of Glu dehydrogenase. Transgenic wheats with high Glu dehydrogenase, for example, yielded up to 29% more crop with the same amount of fertilizer than did the normal crop (Smil, 1999).

Transgenic plants that can control viral and fungal diseases are not nearly as developed. Nevertheless, there are some promising examples of specific virus coat genes in transgenic varieties of potatoes and rice that confer considerable protection. Other promising genes for disease resistance are being incorporated into other crop species through transgenic manipulations.

I would like to share one dream that I hope scientists will achieve in the not-too-distant future. Rice is the only cereal that has immunity to the *Puccinia* sp. of rust. Imagine the benefits if the genes for rust immunity in rice could be transferred into wheat, barley, oats, maize, millet, and sorghum. The world could finally be free of the scourge of the rusts, which have led to so many famines over human history.

The power of genetic engineering to improve the nutritional quality of our food crop species is also immense. Scientists have long had an interest in improving maize protein quality. More than 70 years ago, researchers determined the importance of certain amino acids for nutrition. More than 50 years ago, scientists began a search for a maize kernel that

- “Extremists in the environmental movement seem to be doing everything they can to stop scientific progress in its tracks”
- “The platform of the antibiotechnology extremists, if it were to be adopted, would have grievous consequences for both the environment and humanity”
- “Some scientists, many of whom should or do know better, have also jumped on the extremist environmental bandwagon in search of research funds”
    - Dr. Norman Borlaug (2001)

- Dr. Borlaug's well describe the situation faced with respect to the ongoing rise in the air's CO_2 content
  - He talked, for example, about the "unsubstantiated scare mongering done by opponents of genetic engineering"
  - "Nowhere is it more important for knowledge to confront fear born of ignorance than in the production of food"
  - "Agricultural scientists and leaders have a moral obligation to warn political, educational, and religious leaders about the magnitude and seriousness of the arable land, food, and population problems that lie ahead, even with breakthroughs in biotechnology"
  - "If we fail to do so, we will be negligent in our duty and inadvertently may be contributing to the pending chaos of incalculable millions of deaths by starvation"

Atmospheric Carbon Dioxide: *The Elixir of Life!*

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