

# CLIMATE ALERT

A PUBLICATION OF THE CLIMATE INSTITUTE | *Protecting the Balance Between Climate and Life on Earth*

Summer 2008 -- Vol. 18, No.3

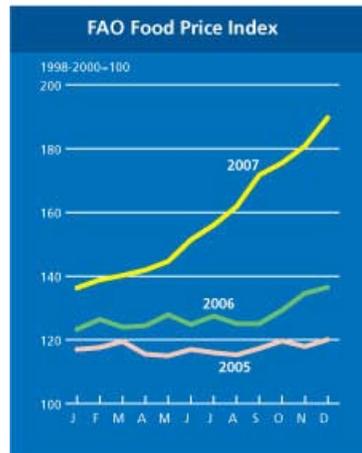
## Climate Change & Food Security

For the past two years, the world has been experiencing what has been termed a “food crisis” as a combination of factors have converged to create dramatic increases in food price and, for some, dire food scarcities. The results have been various:

- In the United States, worries over inflation have come to dominate the political debate in a presidential election year.
- More than 14 countries saw rioting and demonstrations over food prices. In Haiti, where some were reduced to eating mud cakes in a desperate effort to stave off hunger, civil unrest eventually forced the President’s resignation and threatened to plunge the country into anarchy.
- Throughout the world, confidence in our still immature globalized trade system was tested as several governments including India, Vietnam, Egypt, and Cambodia sought to ban or limit grain exports.
- As high prices undercut the buying power of fixed budgets, global aid and development organizations were forced to watch the reversal of hard-won progress toward reducing malnutrition and meeting Millennium Development Goals.

The causes for the crisis are multiple; many of them have almost nothing to do with climate change, including high oil prices, a weak

dollar, speculative investment, population growth, and changing diets. However, some factors are related to climate change, most notably a series of weather events (including a six



Since the start of 2006, the average world price for rice has risen by 217%, wheat by 136%, corn by 125% and soybeans by 107%.<sup>2</sup>

year drought in Australia, a typhoon in Burma and flooding in America’s Midwest) that diminished grain stocks and led to greater price uncertainty. While no single weather event can be attributed to climate change, each one of these occurrences is indicative of the types of meteorological adversity that should be expected to happen with increased frequency in a global warming scenario.

Climate change has also played another, less direct role in the food crisis by fueling apprehensions about the effects of greenhouse gas emissions. This, in turn, has helped to drive the push for the production of more bio-fuels. As energy crops compete with foodcrops they inevitably cut into food inventories and drive up prices. Corn ethanol, with its especially high input requirements, has done the most to diminish foodstocks: one gas tank’s worth of ethanol fuel requires an amount of corn that could feed one person for an entire year.<sup>3</sup> Many question the morality of using food for fuel

when other technologies are available to satisfy the demand for energy without contributing to global hunger.

These trends show no signs of abating, and it seems very likely that in the future, climate change will increasingly diminish food security and widen the gap between the rich and the poor. Preventing a deepening food crisis and lessening the potential for wider social and geopolitical unrest will require swift action to reduce greenhouse gas emissions, policies to protect the millions of people facing poverty and hunger, and changes to agricultural practices worldwide.

This task will be complicated by the fact that food production is not only a victim of climate change, but also a culprit in its emergence. While agriculture will be forced to adapt to challenges involving new soil conditions, weather patterns and water availability scenarios, there is pressure to find ways to mitigate its extensive contribution to greenhouse warming. Currently, agriculture contributes 12% of global greenhouse gas emissions.<sup>4</sup> However, this figure does not include greenhouse gases from deforestation or nitrogen fertilizer production, which are counted under ‘industry.’ Greenhouse gas emissions from all facets of agriculture may total closer to 25-30% of all emissions, and this percentage is likely to rise with an increasing demand for food.<sup>5</sup>

In order to guarantee food security, agriculture must adapt to yield reductions from floods, droughts and rising temperatures, while at the same time addressing its contributions to global climate change.

Current agricultural practices require large amounts of oil to produce the chemical fertilizers necessary to grow crops, run the factories to process grain into packaged foods, and fuel the trucks and airplanes to transport food across the world. Even before adding the fuel

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## A Message From the President

### FISHES, LOAVES AND FORESIGHT

Commentary by John C. Topping, Jr.

In November 2006 a paper by a team of scientists led by Boris Worm of Dalhousie University projected a collapse of global seafood stocks by 2050, largely from overharvesting. This analysis does not even factor in possible adverse effects on deep water fisheries of growing acidification of oceans or of disruptions of the marine food chain that may ensue from rapid climate warming in polar regions. Regrettably this decimation of fisheries that produce a significant amount of the protein for humanity is occurring as other stresses to food supply are mounting. This Special Issue of *Climate Alert on Climate Change and Food Security* seeks to explore what may be the most severe climate related challenge over the next generation. Climate change is not the only threat to world food supplies - likely growth in total human population of another two to three billion, overgrazing of pastoral lands, soil erosion, and nutrient depletion of existing farmlands all imperil food security. Climate change, particularly if, as seems likely, it is often accompanied by greater swings in the hydrological cycle (more intense rainfall that exacerbates soil erosion and water shortages in places such as the Andes and South Asia due to glacial melt) may be the metaphorical straw that broke the camel's back.

As this Special Issue suggests, agriculture is both affected by climate change and a contributor to it. Development of effective strategies will require not only a grasp of likely climate futures and how they may play out at the regional level, an understanding of how best to maintain genetic diversity in the face of

likely perceived need to use biotechnology to avert famine, and an understanding of how public policies in seemingly unrelated areas can affect food supplies. Over the past couple of years the push in the US and the EU for biofuels for vehicles to limit dependence on petroleum imports has contributed to a run up in prices of corn and related products.

In the face of sizable and perhaps growing uncertainty about year to year weather patterns in a particular region a key element in an agricultural and general climate response strategy will be to enhance resilience. Over the years humans have often been ingenious in coping with changing food supplies, migrating as game became scarce in a particular locale and as societies moved to an agricultural base finding various ways to irrigate crops, improve tilling practices and breed plants or livestock. Existing with little margin for error, indigenous societies have had to develop such coping skills to survive. **The Seventh Tribal College Forum** held August 12-14 at Haskell Indian Nations University in Lawrence, Kansas discussed at some length how Indigenous Ways of Knowing, i.e. environmental knowledge gathered by keen observation and experience and sometimes passed down over generations, often in oral form, can be combined with climate impacts tools and geographic information systems data to develop climate adaptation strategies for indigenous communities. From this Tribal College Forum a collaboration has arisen that involves Tribal Colleges and Universities such as Haskell with superior access to such indigenous knowledge and experience in environmental planning with partner institutions such as Dartmouth College, the Climate Institute and the National Center for Atmospheric Research with background in climate research and policy. Already Dartmouth's Arctic Studies Institute is partnering under an National Science Foundation grant with the Inuit Circumpolar Conference, Greenland to

ensure that scientific researchers doing climate work in Greenland gather data that can be useful to the Inuit Nation in developing a climate response strategy. About a decade ago the Inter-American Institute for Global Change Research began some remarkable collaboration involving Western Hemisphere meteorological agencies and agricultural agencies to enable farmers to use El Niño-Southern Oscillation (ENSO) forecasts to adjust crop planning. Similarly knowledge of how food producers and gatherers in both indigenous and modern societies respond to weather related stress is vital for effective adaptation planning.

Success in implementing climate response strategies in areas as pervasive and diffused as the food producing sector may entail both a holistic approach involving meteorology, water resource planning, social science and agricultural or fisheries know how and a breakthrough in capturing the public imagination. Such a transformation may be underway in Mexico where construction is beginning this summer on the **Sir Crispin Tickell Climate Centre**, soon to be the world's highest climate observatory. National pride and excitement over this has inspired the State of Puebla, where the Observatory will be located, to create an **Observatory Education and Outreach Centre** in Flor del Bosque Park in Puebla, and three museums, one in Cancun and two in Mexico City, to begin to create climate awareness centers, all with interactive displays. Several of these will enable museum visitors to assess potential links between climate, energy, food production, and the economy. These displays may move other institutions toward the holistic approaches needed to ensure Mexico's resilience in grappling with challenges to food security posed by climate change and set a marker for other vulnerable nations.



## CLIMATE INSTITUTE NEWS



### John Englander joins the Climate Institute Board of Advisors

A dynamic entrepreneur and expert in marine environmental organizations, John Englander has been a leader in ocean protection his entire adult life.

In 1974, he took over the struggling Underwater Explorers Society (“UNEXSO”) based in Freeport, Grand Bahamas and turned it into a pioneering institution that would become one of the world’s largest dive operations, operating a fleet of boats, a diversified instructional program, and one of the biggest retail dive stores in the world.

Englander also created the Dolphin Experience, an innovative close-encounter program that allowed for the first time divers and non-divers to interact with dolphins in the open ocean. He headed the diving industry’s non-profit environmental organization, Ocean Futures, and was shortly hired by Jacques-Yves Cousteau to become CEO of the Cousteau Society, where he served briefly until Cousteau’s death.

In addition to extensive experience throughout the Caribbean, he has led scuba expeditions to the High Arctic and Lake Baikal in Siberia. In 1992, he organized a voyage to dive many of Columbus’ alleged landfalls. He has had a key role setting up dive operations in the Caymans, Cozumel, the Yucatan, and the Turks and Caicos Islands.

Since 2004, he has been the CEO of the International Seakeepers Society, “an organization set up in 1998 by a small number of yacht owners to address deteriorating conditions of the seas. Their initial mission has been to develop a compact, automated and cost-effective ocean and atmospheric monitoring system to install aboard their yachts, providing data to scientists on the health of the world’s oceans. This Seakeeper 1000 is now deployed in more than 45 locations around the world, including yachts, cruise ships, ferry boats, buoys and piers.”

### Puebla and Climate Institute Climate Awareness and Education Efforts

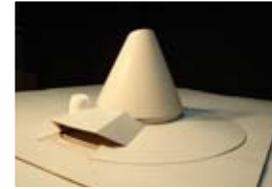


The Mexican state of Puebla has positioned itself at the forefront of climate change protection. Its Governor, Mario Marín Torres, has agreed to fund an Outreach Centre and a Climate Theater in Flor del Bosque, a State Nature Park in the city of Puebla, that will serve as the principal hub for environmental education and climate protection activities in Puebla.

The Outreach Centre will link to the Sir Crispin Tickell High Altitude Global Climate Observation Centre – the world’s highest Climate Observatory – to be built atop Sierra Negra, an inactive volcano. Besides its value as a national rallying point in the climate protection battle, the Tickell Observatory will fill a crucial gap in the global change observing system.

Its location at a high altitude should make it a suitable site for calibrating satellite measurements and developing more accurate regional profiles of greenhouse emissions.

Governor Marín has asked the Climate Institute to maintain and operate the related High Altitude Global Climate Observatory Education and Outreach Centre, designed to enhance climate awareness efforts and provide information on how the public can respond to climate change.



### Ernie Stevens’ Involvement for Climate Protection in Tribal Lands

The Seventh Tribal College Forum held in Haskell Indian Nations University, Lawrence, KS (August 12-14) was a key opportunity to welcome a great variety of speakers from different horizons and learn from their wisdom, experience and perspective on climate change. Among them was Ernie Stevens, Jr., Chairman of the National Indian Gaming Association (NIGA) the most significant single group in philanthropy in the Native American Community.



An alumnus of Haskell Indian Nations University, Stevens directed his first words to Dan Wildcat, co-convenor of the Tribal College Forum and a member of the Climate Institute’s Board of Advisors, to express his gratitude for



being invited as a speaker. He later announced his intention to approach the 184 tribes that are members of NIGA to provide significant support for the Tribal College Climate Leadership effort and related activity, and his commitment to create a Committee on Climate and Clean Energy. The committee chairmanship is shared by Dr. Daniel Wildcat, Director of Haskell Environmental Research Studies Center, and Dr. Henrietta Mann, Emeritus Chair in Native American Studies at Montana State University. A significant component of this support will potentially involve scholarships or fellowships for young Native American Climate Leaders to perform research or develop policy experience.

more *C.I. News* on p. 14



# The Challenges of Producing Food on a Warming Planet

Whether it be the crops we grow, the livestock we raise, or the wild plants and animals that we harvest, every organism that we rely on as a food source depends on a unique confluence of conditions that determine whether it will merely survive, deteriorate, or flourish. These environmental factors can include such things as: access to water and nutrients, temperature, the amount and periodicity of sunlight, and interactions with other organisms within the same ecosystem.

For thousands of years, each of these individual factors has tended to change only slowly or infrequently. Encouraged by this predictability, people have been able to build civilizations around specific food sources. Over time, their sustained and focused attention has led to the great advances in the science and technology of food production that allow humanity to sustain a rapidly growing population.

Now, however, that progress may be coming undone. The accumulation of greenhouse gasses threatens to simultaneously, and in unpredictable and potentially dramatic ways, alter nearly every variable with an input into the grand equation that is our food production system. Because the timing and magnitude of any one of these changes is hard to forecast, and especially because each individual variable is involved in innumerable and complex interactions, it is nearly impossible to predict, on a large scale, just how our agriculture, livestock, and fisheries will respond to the new climate conditions we have created for ourselves. However, by inspecting the following individual effects, a clearer picture may begin to emerge:

## Challenges

**CO<sub>2</sub> Fertilization** – Higher concentrations of atmospheric carbon dioxide allow plants to grow faster and larger. From a food production standpoint, this is generally good news. Yields should

increase, less fertilizer may be needed, and faster growing crops can open new, previously marginal, lands to agriculture. However, not all the effects of carbon dioxide fertilization will prove beneficial. For instance, the magnitude of the CO<sub>2</sub> fertilization effect is different for different types of plant species. Among those that will benefit the most are many weed species, triggering concerns from farmers about competition in their fields and from environmentalists about greater use of herbicides. Plants growing under heightened CO<sub>2</sub> conditions can exhibit abnormal characteristics with regard to the way they absorb and process nutrients. Also, CO<sub>2</sub> fertilization can sometimes cause plants to speed through the growth phase in which they generate their harvestable grains, fruits or vegetable matter. As a result, fields filled with more outright biomass may, at the same time, produce diminished and less nutritious harvests.

**According to some projections, half of all agricultural land in Latin America is likely to be affected by desertification and/or salinization by 2050.**<sup>1</sup>

**Alterations to Hydrology** – Global warming is certain to produce changes in the way water cycles through our oceans, into the atmosphere and over the land. As rising heat drives accelerated evaporation, land and crops growing on them will potentially dry out faster. However, at the same time, more moisture will be drawn from the oceans, causing overall precipitation to increase. Rarely will changes in these countervailing forces simply offset each other to preserve the status quo. Much more frequently, specific localities and the food resources supported there will face new trends in water availability.

Areas that currently derive water from melting glaciers and snow-pack are likely to see some dramatic changes as well. Himalayan glaciers, for instance, which now provide the majority of non-monsoon water flow for some of Asia's most important agricultural regions, are in danger of shrinking or even disappearing completely as a result of global warming. In other areas, where an annual snow-pack serves as an important water resource, rising temperatures will alter the yearly precipitation timing and mix. For instance, in the American West, diminished snow pack and earlier, faster melts are likely to leave many areas regularly facing late summer droughts and an increased incidence of forest fires.

Low water availability and abnormally timed flows disrupt more than agricultural irrigation. They can disrupt travel along the rivers and canals that play a large role in low-cost food transportation, diminish our ability to carry out inland aquaculture, and devastate fisheries (such as salmon) that rely on freshwater rivers for spawning.

**The worst concentration of cumulative impacts of climate change ... appear to be concentrated in 10–15% of the oceans concurrent with today's most important fishing grounds**

(www.unep.org)



**Rising Average Temperatures & Shifting Habitat Ranges** – As global warming increases the baseline



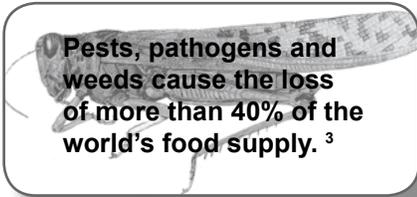
temperature at most locations on our planet, those organisms or populations that are free to move in order to remain in their ideal temperature range, will. At the global level, this will produce mixed effects. Some food producers, especially those at higher latitudes and altitudes, may welcome the opportunity to grow, raise, and harvest plants and animals in areas formerly too cool for that activity. Those in temperate climate zones will be forced to adopt new practices better suited to a more tropical environment. Still others, especially those in the newly superheated tropics, will face an unprecedented climate zone, for which no food producing species have had time to evolve.

On the whole, this phenomenon of range shifting can pose a real danger to fisheries, livestock, and agriculture. To begin with, temperature-induced range changes may push populations into new areas for which they are otherwise poorly adapted. It may render obsolete local cultures, economies, and infrastructure that had been uniquely shaped around specific food resources. Global biodiversity will dwindle as some high altitude and polar climates simply cease to exist. Most menacing of all is the fact that these climate zone shifts are not monolithic, orderly processes that will affect all members of an ecosystem simultaneously. Some species will shift more readily and quickly, while others may experience almost no range shift. This uneven movement of ranges will decouple intricately choreographed intra-species relationships that have developed through thousands, if not millions, of years of co-evolution. The range, migration habits, and life cycles between pollinators and plants, pests and their prey, and wild food-stocks and their predators, will all be affected. It is unlikely that these environmental services can be replaced by human means.

**Extreme Weather Events** – In general, agricultural producers will face less stress from extreme cold events and freezes but higher stress from more frequent and more intense heat waves. As heat energy accumulates in our atmosphere and oceans it may produce more frequent and powerful storms (including,

but not limited to, hurricanes) along with the tornadoes, hail, lightning, high winds, and flooding that they can bring. Each can damage crops, kill or stress livestock, and disrupt or destroy both natural resources and necessary infrastructure.

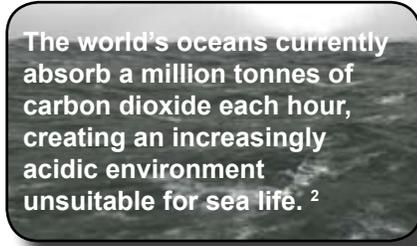
**Parasites, Diseases, Fungi & Other Pests** – These organisms can harm, poison, eat, or otherwise reduce the yield of the species we use as food. All tend to thrive and spread more rapaciously in warmer and more humid climates. Furthermore, as fewer and fewer regions get cold enough for long enough to produce a winter kill-off, populations of these organisms can explode. Keeping them in check will require the use of even more fungicides and insecticides for crops and antibiotics in livestock production and aquaculture.



**Pests, pathogens and weeds cause the loss of more than 40% of the world's food supply.**<sup>3</sup>

**Sea Level Rise** – Global warming is causing ocean levels to rise and is therefore rendering agricultural areas, such as low-lying, but usually very fertile river deltas, and brackish estuaries, which often serve as critical nurseries for commercial fish species, increasingly susceptible to saltwater intrusion and inundation.

**Ocean Acidification** – Atmospheric carbon dioxide has always naturally dissolved into our oceans. Now, however, the rate at which this is happening is increasing and, as a result, the ocean is becoming more acidic. Under these conditions it is more difficult for sea creatures to develop and maintain their calcium based shells and exoskeletons. As a result, populations of certain



**The world's oceans currently absorb a million tonnes of carbon dioxide each hour, creating an increasingly acidic environment unsuitable for sea life.**<sup>2</sup>

species used directly as food sources (such as mollusks and clams) and others that form the foundations of important marine structures and food chains (like corals and some plankton species) will experience stress and could eventually even collapse.

## Adaptations

In the face of these challenges, people around the world must begin to make critical adaptations to our global food production system. Some key areas include:

**Forecasting** – It is important that we develop capacities to better understand global climate trends and extrapolate from them more localized, near-term weather forecasts that can then be used in order to prepare for the coming changes. The accomplishment of this task will require policies and investments that allow for better integration of, and access to, data sets related to climate change and weather. Multi-disciplinary response programs should be instituted to make sure that ranchers, farmers, and breeders have a reasonably accurate understanding of upcoming conditions. At the same time financial experts and policy makers need to make sure food producers have the ability to make changes accordingly.

**Genetic Adaptation** – Once future conditions can be forecasted, scientists can begin to breed, or even genetically engineer, our food sources to have characteristics that make them better suited to their environment. This process, carried out through selective breeding is nothing new and has served humanity well throughout history. Now however, the speed of environmental changes is outpacing our capacity to breed new characteristics through traditional methods. Some see genetic engineering as the answer. Through the use of advanced technology, we can now implant (even from completely different species) the genetic code associated with a desirable genotype directly into a food species. While this technology holds great promise, it is not without its drawbacks. Chief among them is the concern that genetically modified organisms will

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# Reducing Our Food's Impact on Climate Change

On the global scale, food production, the fundamental activity of civilization, is obviously a massive undertaking. It is no wonder that these processes account for over 30% of greenhouse gas emissions. As we have now recognized the deleterious effects of global warming and endeavor to reduce, or mitigate, the emissions fueling it, the food production system must come under close scrutiny. This section will provide an overview of the situation and introduce a series of articles to further elucidate some of the specific complexities of the problem, as well as efforts now being undertaken in order to dull the impact that food production has on climate change.

## Contributors to Climate Change

Our food production system produces sizable emissions of three primary greenhouse gases: Carbon Dioxide, Methane, and Nitrous Oxide. Specific activities related to growing, raising, or harvesting food that have particularly large impacts on global warming include:

**Enteric Fermentation** – In the process of digesting plant matter, bacteria in the guts of ruminants produce and emit large amounts of methane gas. Some amount of mitigation may be achieved by modifying the diet fed to these livestock or by using medical science to alter the bacterial content of their digestive tract. However, the only realistic way to substantially mitigate these emissions is to cut our demand for meat. The article, “Moving Down the Food Chain” on page 8 explores this issue in greater detail.

**Manure** – Livestock also produce manure which emits greenhouse gasses as it decomposes. If the waste is allowed to degrade in the open air, such as in a pasture, aerobic bacteria will dominate the digestion and produce nitrous oxide in the process. In instances where the animal waste is instead pooled or

submerged, as it is at feedlots or in rice paddies, the oxygen available to bacteria is limited. Here anaerobic bacteria break down the material in a process that produces methane emissions.

With the right infrastructure, the methane emitted from the anaerobic decomposition of manure can be captured and used as a fuel. In cases where methane capture is not carried out, aerobic decomposition is generally seen as having a smaller greenhouse warming impact than anaerobic digestion of manure.



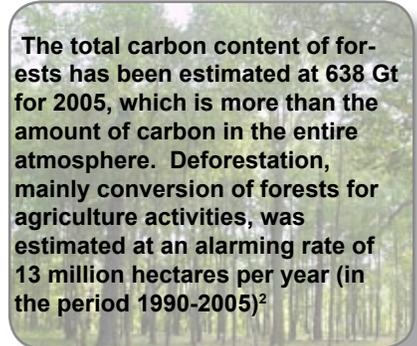
**The USDA estimated that animals in the US meat industry produced 1.4 billion tons of waste in in 1997, 130 times the nation's volume of human waste, or 5 tons of animal waste for every US citizen.<sup>1</sup>**

**Fertilizers** – Artificial fertilizers are used in massive quantities throughout our modern global agriculture system. Many of these chemicals are manufactured from natural gas in a process that produces nitrous oxide. These emissions can best be mitigated by using less chemical fertilizer overall. One way this is being achieved is through the use of better technology and agricultural science that allow for more precise application of these chemicals. Another approach is seen in organic farming, which eschews industrial fertilizers entirely. This process, however, is not without its own problems, for some techniques of organic fertilization of rice can lead to high levels of nitrous oxide and methane emissions. To learn more about how one country is coping with this dilemma, read “Thailand Case Study” on page 9.

**Deforestation & Soil Disruption** – Throughout the world, forests (which act as carbon sinks by absorbing

atmospheric CO<sub>2</sub> in the process of producing biomass) are being cleared, and often burnt, in order to make room for cropland and pastures. In this process, much the carbon content of these habitats, which may have accumulated over hundreds of years, is deposited into the atmosphere in a matter of hours or days. It is important to note that in some areas, the soil itself, not just the living biomass above ground, contains a high level of sequestered greenhouse gasses that can be released into the environment if disrupted.

The most important way to mitigate greenhouse emissions from deforestation is to simply stop the process. Doing so would require that food producers make better use of the land that is already devoted to agriculture. According to this thinking, wasteful practices such as growing inefficient biofuel feedstocks or promoting meat intensive diets must be limited. Other efforts are being made to not only help reduce emissions from soils (by using practices such as no-till farming) but even boost their capacity as carbon sinks (by using products like bio-char -- see article on page 8).



**The total carbon content of forests has been estimated at 638 Gt for 2005, which is more than the amount of carbon in the entire atmosphere. Deforestation, mainly conversion of forests for agriculture activities, was estimated at an alarming rate of 13 million hectares per year (in the period 1990-2005)<sup>2</sup>**

**Fuel consumption** – Our complex world-wide food economy burns tremendous amounts of fuel (and therefore creates large amounts of emissions) in the process of transporting requisite input materials and food products. As

*continued on p.14*



## Cutting Food Miles

Earlier this year, celebrity chef Gordon Ramsay made headlines by suggesting that the British government introduce legislation outlawing the use of anything but locally sourced, in-season produce in restaurants. “I don’t want to see asparagus [on the menu] in the middle of December. I don’t want to see strawberries from Kenya in the middle of March. I want to see it home grown,” he said.

Ramsay may be an extreme example, but the concept of local food – that is, food grown within a small radius, often about a hundred miles, of where it is consumed – is a growing trend, popularized by bestselling books like Michael Pollan’s *The Omnivore’s Dilemma* and Barbara Kingsolver’s *Animal, Vegetable, Miracle*. Not only self-proclaimed “green” retailers like Whole Foods, but also discount supermarkets like Wal-Mart, are adding local selections to their inventories and in 2007, the New Oxford American Dictionary chose “locavore” as its word of the year.

From an environmental standpoint, limiting the distance that food travels from the farm to the plate makes intuitive sense. Enormous quantities of fossil fuels are used during transport from the producer to the consumer, whether food is trucked cross-country or flown in from overseas. Beyond the direct impact on the climate of carbon emissions from fuel combustion, long-distance transports require more packaging materials and refrigeration to preserve the freshness of the food, consuming additional energy and resources. According to a study by the Worldwatch Institute, food typically travels over 1,500 miles from where it is grown before it reaches your table.

The idea, then, is that by seeking out produce with local provenance, now almost as easily available at the grocery store as at the farmers’ market, consumers could drastically reduce their carbon footprint. To make comparison easier, some have advocated calculating “food miles”—the total distance a food item travels from the farm to the grocery store — as a guideline for sustainability.

Of course, the reality is rarely that simple, and a number of confounding factors make food miles a problematic measurement. Likely the most damning is the fact that while

food miles provide an estimate of the carbon emissions caused by long transports, this does not account for differences in production inputs, which can vary widely depending on each farm’s scale and practices. That might include the additional energy needed to heat a greenhouse in an area where the climate is unsuitable for growing certain fruits or vegetables, or the chemical fertilizers and pesticides used in conventional farming. According to one study by researchers at Carnegie Mellon University, a one-kilogram loaf of wheat bread produced with conventional farming methods caused a similar level of carbon dioxide emissions as a loaf of organic bread produced 420 miles farther away. Here,

the reduction in greenhouse gas emissions made possible by using organic rather than conventional wheat offset, to a certain extent, the impact of a longer transport.

Moreover, the exhortation to “eat local” without differentiating between types of food neglects the fact that some are inherently more sustainable than others. According to a 2006 report by the United Nations Food and Agriculture Organization (FAO), the livestock sector generates 18 percent of carbon dioxide emissions worldwide (surpassing the transport sector) and 37 percent of human-induced methane. In other words, where total greenhouse gas emissions are concerned, vegetables flown cross-country may in fact be more sustainable than locally produced beef.

Becoming more aware of the environmental hazards of long-distance transports is without a doubt a step in the right direction, but it is important not to lose sight of the other, sometimes more pressing aspects of food production that contribute to climate change. In an ideal world, we would all take our bicycles to the farmers’ market and purchase only local, organic, vegan produce; in practice, even Gordon Ramsay’s restaurants serve items like “tropical fruit desserts” and “ravioli of Italian winter squash.” However, any serious effort to combat climate change will require a more careful look at where our food really comes from, and the local food movement is a step in the right direction.





## A CLOSER LOOK: BIO-CHAR

Charcoal has traditionally been thought of primarily as a fuel and is still widely used throughout many developing countries for that purpose. However, scientists studying the abundantly fertile terra preta de indio (black soils) of the Amazon now feel that charcoal has been, and perhaps should be again, used for another purpose: as a soil additive. Their evidence seems to indicate that for centuries the indigenous tribes had intentionally mixed charred biomass into the local soils. Findings show that using bio-char (as the agricultural charcoal is being called) in this way not only boosts fertility but also holds great potential as a means to sequester carbon.

Bio-char forms as a result of anaerobic heating of biomass in a process called pyrolysis. While normal combustion (burning) of biomass results in the immediate emission of 97% of its former carbon content into the atmosphere, and biomass left to decompose naturally loses up to 90% of its carbon within 5 to 10 years, biomass subjected to pyrolysis emits only about 50% of its former carbon content and transforms the rest into bio-char in such a way that it will not reenter the atmosphere for an estimated 5,000 years.

While more research has to be done to answer questions

about the ideal composition of biomass feedstock, the optimal amount of bio-char to be added to different types of soil, the potential for making bio-char production from urban waste, and the possible negative effects of bio-char addition on soil (such as leaving less nitrogen available for crops), there is strong consensus that its benefits to soil fertility include increasing water and nutrient retention, attracting microbes, and absorbing ammonia. Weathered, nutrient-poor tropical soils seem to gain the most (up to 80% fertility increase) from bio-char addition.

Since the costs of producing bio-char from scratch currently outweigh the benefits it can provide as a soil enhancer or carbon sink, the key, for now, is in finding ways to produce usable bio-char by modifying processes that would be carried out anyway. For example, by replacing the much maligned but widely used, slash-and-burn method of clearing land with a slash-and-char technique, total anthropogenic carbon dioxide emissions caused by land use could be cut by as much as 12%. Consider also, the case of agricultural waste. While it is now burned or plowed into the earth, it could instead be turned to bio-char. Doing so would not only improve soil fertility and safely sequester carbon in the earth but also, by virtue of the bio-oil, methane, syngas, or hydrogen by-products of pyrolysis, create usable, carbon-neutral energy.

## FOCUS: MOVING DOWN THE FOOD CHAIN

If the U.S. is to undertake a comprehensive attempt to reduce climate change, Americans will have to take a hard look at their eating habits. In 2002, the United States population consumed 275 pounds of meat per capita, up 17 pounds from the previous decade.<sup>1</sup> This protein-heavy diet is staggering when compared with the 88 pounds of meat consumed per capita on average worldwide in 2002.<sup>2</sup> The environmental consequences of meat consumption are far-reaching: every cow, pig, or chicken requires grain, water, land, and energy inputs to convert into protein and the process of raising, feeding, slaughtering, packaging, and transporting meat consumes energy and emits greenhouse gasses.

**Grain** – Producing meat, and especially beef, requires a great deal of grain. For every kilogram of meat protein output, a cow must eat thirteen kilograms of grain. Collectively, the seven billion livestock animals in the U.S. devour five times more grain than the human population eats directly.<sup>4</sup>

**Energy** – When considered in its entirety, meat production is a high-input, multi-staged, transport-intensive process. That all adds up to a lot of energy expenditures and, consequently, fuel use. Every calorie of beef produced requires 40 calories of fossil fuel energy; for a calorie of lamb, make it 57 calories.<sup>5</sup>

**Land** – Livestock production is easily the greatest anthropogenic use of land, accounting for 30% of Earth's land surface.<sup>6</sup> In the U.S., more than 302 million hectares of land are devoted to producing feed for the livestock population.<sup>7</sup>

In Latin America, where the conversion of forests to feedlots is especially high, 70% of Amazon deforestation is for livestock pastures, and much of the remaining 30% is for land to grow feedcrops.<sup>8</sup>

**Greenhouse Gas Emissions** – Livestock activities contribute 18% of total greenhouse gas emissions including 9% of global anthropogenic CO<sub>2</sub> emissions, 35-40% of global anthropogenic CH<sub>4</sub> emissions, 65% of global anthropogenic NO<sub>2</sub> emissions, and 64% of global anthropogenic ammonia emissions.<sup>9</sup>

**Adaptation** – The environmental effects of consuming meat are on par with those of driving a car, and the possibility of reducing one's individual impact is just as tangible. By moving down the food chain from beef to chicken to vegetables, we can reduce the land, water, grain and energy necessary to feed our population.

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## CASE STUDY: AGRICULTURE IN THAILAND

In Thailand, rice agriculture is so much a part of the culture that the verb “to eat” in Thai translates literally as “to eat rice” and it is rare that a meal doesn’t include this staple grain. A common greeting is “gin kow reu yung” which translates as “have you eaten rice yet,” and it is customary to invite someone who has not yet eaten to share a meal.

Rice is also critical to their economy. In 2007, Thailand produced 28 million of the 636 million tons of rice produced worldwide.<sup>1</sup> That year, Thailand exported 9 million tons of rice<sup>2</sup>, more than any other country, giving it the title “the rice bowl of Asia.”<sup>3</sup>

Historically, Thai farmers grew thousands of rice varieties, although genetic modifications have reduced that number drastically. Still, throughout the year, there are dozens of ceremonies using different varieties of rice, including black, yellow, red, white and sticky rice. In fact, following the traditional recipe for a single dish can require up to thirty rice varieties.

The 2008 food crisis demonstrated the effects that rising rice prices or potential shortages can have on global food security. This is no surprise as rice is the only major grain grown exclusively for food and provides over one fifth of the calories consumed worldwide. Worrying politicians and farmers alike is the prospect that climate change has, and will continue to, harm rice yields. A study by Okayama University in Japan found that grain yield declines when the average daily temperature exceeds 84° Fahrenheit (29° Celsius), and grain quality continues to decline as temperatures rise.<sup>4</sup> Complicating the situation further is the fact that some efforts to bolster rice production in the face of this adversity may only make the long-term problem worse.

Rice accounts for 16% of global nitrogen fertilizer use, 13% of phosphate fertilizer use, and 13% of potassium fertilizer use (chemical fertilizer requirements per unit of output for rice are on par with those for maize, but are less than those for wheat and substantially

more than those for soybeans). In 2006-2007, rice crops in Thailand alone required 299,000 tons of nitrogen fertilizer.<sup>5</sup> Chemical fertilizers contribute to greenhouse gas emissions, decrease soil fertility, have harmful health effects, and drive many farmers into vicious debt cycles.<sup>6</sup> However, the common alternative to the heavy use of chemical



fertilizers, organic farming, is no panacea. In this case, organic fertilizers may not help in the way they can with corn and wheat, because methane is emitted through the fermentation of organic matter in flooded paddies.

Methane, like carbon dioxide and nitrous oxide, is a greenhouse gas that contributes to climate change. Although carbon dioxide emissions still pose a greater problem, global methane levels have climbed to 16% of total greenhouse gas emissions.<sup>7</sup> Even more problematic is methane’s potency: by weight, methane can trap 21 times more heat than carbon dioxide.<sup>8</sup>

In 2005, Thailand emitted 91.6 million tons of methane, half of which were due to rice cultivation -- a statistic that is drawing international attention to the climate effects of rice paddies.<sup>9</sup> Organic fertilizer alone doesn’t provide the climate solution for rice (although it greatly improves farmer health and soil fertility), but farmers have adapted other strategies for mitigating rice agriculture’s climate effects.

Many large rice mills burn rice husks for power rather than oil or coal, and some are able to sell electricity back

to the government, such as the plant in Roi-Et province, a pilot project with a capacity of 9.8 MW.<sup>10</sup> Burning rice husks diverts the methane that would be produced by leaving rice husks to decompose in the fields and provides a renewable source of energy with no net carbon dioxide emissions.

Another mitigation strategy is to occasionally drain rice paddies. This reduces emissions by eliminating the bacteria that thrive in the oxygen-free setting and produce methane by decomposing manure or other organic matter. A study by Thailand’s Graduate School of Energy and Environment found that a three day mid-season drainage during the rice flowering period significantly reduced methane emissions while producing only minimal losses in yield and small increases in nitrous oxide emissions. This was suggested as a compromise between the need to mitigate climate change and current socioeconomic realities.<sup>11</sup>

These mitigation strategies, while strong in theory, have yet to be implemented on a large scale.

As rising temperatures and irregular weather patterns harm rice yields, and as growing populations threaten food security, Thai farmers and the Thai government will be forced to further address rice production’s contributions to global climate change.

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# THE BIOFUEL DEBATE: FOOD VS. ENERGY?

In a world increasingly concerned about national security and climate change, the appeal of biofuels [this article will focus on liquid biofuels produced as substitutes for gasoline or diesel] has grown apace. Biofuels hold the potential to: (1) serve as a carbon neutral and renewable replacement for the transport fuels now responsible for 20% of CO<sub>2</sub> emissions, (2) improve national energy security by reducing the US dependency on imported oil, and (3) create new opportunities to revitalize the agricultural sector.

In 2006, biofuel was touted as the “miracle” that would allow the US to solve its energy crisis and environmental challenges. The same year, in his State of the Union Address, President Bush firmly advocated a dramatic increase in production of biofuel, “to replace more than 75 percent of our oil imports from the Middle East by 2025.” This significant shift in policy culminated in December 2007 with the Energy Security Act of 2007 including a Renewable Fuel Standard setting a bold target of 7.5 billions gallons of biofuels by 2012 and at least 36 billion gallons by 2022<sup>1</sup>.

However, during the first three months of 2008, the world experienced an unprecedented escalation of all major food commodity prices and consequent unrest and demonstrations in several Asian, African and Latin American countries. Because biofuels are either made from food/feed crops or directly compete with them for land use, water and other inputs, they have been blamed by many to be a principal cause for soaring grain prices.

Although biofuel production is likely contributing to the rise in commodity price, the nature and extent of its impact on food price is also complex and should not be overestimated. Biofuels have met about 30% of the growth in global demand for liquid transportation

fuel over the past 3 years, but they still account for less than 2% of liquid transportation fuels and are produced on about 1% of the world’s agricultural lands. A combination of unstable government, skyrocketing oil price, and other weather related factors (drought, flooding etc.) have their share in the current turmoil.<sup>2</sup>

Independent of their influence on the food crisis, biofuels have been facing scrutiny for other reasons. Comprehensive studies have recognized that biofuel performance assessments are less favorable once they are made to include not just their actual use in a vehicle, but also the emissions created during the complete life-cycle of that biofuel. When this realization is coupled with other



economic and social concerns surrounding biofuel it becomes evident that our current rush to promote biofuel production may have been hasty.

The advent of second, third, or even fourth generation biofuel technologies should help to relieve biofuel production stress on the world food system as they are derived from non-food feedstock and can be grown on lands that are not suitable for agriculture.

## Current 1st Generation Biofuels: Ethanol & Biodiesel

The two most important biofuels are ethanol or biodiesel.

**Ethanol** – is a type of alcohol made by fermenting the carbohydrates found in its feedstock, which can include grains, cereals, sugar and other starches.

The world’s two largest producers of ethanol are currently the United States (corn-based) and Brazil (sugarcane-based), together producing 90% of the world’s ethanol used for fuel.<sup>3</sup>

The recent UN World Food Summit held in Rome on June 3-5 endorsed the booming Brazilian sugar-based ethanol market over the far less-efficient US corn-based model. Several reasons explain the relative advantage of Brazil’s sugarcane feedstock over corn. First, the process of producing ethanol from sugar is simpler and about twice as efficient as the one used to convert corn into ethanol. Second, sugarcane is a more efficient feedstock, yielding an estimated 650-700 gallons of ethanol per acre compared with roughly 400 gallons per acre for corn<sup>5</sup>.

Despite the fact that ethanol has (by volume) only about two-thirds the energy content of gasoline, using sugarcane ethanol in cars instead of gasoline can cut greenhouse gas emissions 87% to 96%. Using ethanol produced from corn in the same way offers roughly a 10% to 20% reduction.

**Biodiesel** – is a biodegradable, non-toxic and clean burning alternative fuel that can be produced from domestic and renewable resources such as oils or fats using transesterification, a process in which oils are mixed with sodium hydroxide and methanol (or ethanol) to produce biodiesel and glycerol.

Biodiesel contains no petroleum but can be used in compression-ignition (diesel) engines with few or no modifications either straight (B100) or blended with a petroleum based diesel. Today, biodiesel is most commonly made from rapeseed (Europe), soybean (US), palm (Asia), sunflower, and coconut. Because these oil-based feedstocks are denser than starch or cellulose, biodiesel can be viably produced even on a relatively small scale.



While the production of biodiesel may sound like a good idea in theory, in practice environmental damages have usually outweighed benefits -- especially in the case of the palm oil biodiesel being produced in Southeast Asia and Australia. In the process of clearing virgin land for this biofuel crop, the enormous reservoir of carbon, locked-up in forests, peatlands, and grasslands, is being released into the atmosphere. The draining of peatlands (which comprise at least 27% of Southeast Asian oil palm plantations) are causing massive greenhouse gas emissions due to rapid peat decomposition (approx. 70 to 100 tons of CO<sub>2</sub> per hectare per year). Moreover, the drained peatlands are also susceptible to long burning fires that emit huge quantities of carbon dioxide.

### How biofuel production affects food price and food security?

The energy and agriculture markets are both connected as agriculture both consumes and produces energy. However, biofuel comprises only a small percentage of total energy markets, while energy costs make up a large portion of food costs. Much of the controversy surrounding biofuels originated as skyrocketing oil prices suddenly produced growing demand for biofuel feedstocks, which in turn acted to drive-up agricultural commodity prices. In assessing the problem from the perspective of food security, biofuel expansion and pursuit represent an especially menacing force as it affects three of the four factors that are commonly identified with food security: food availability, access, stability, and utilization.<sup>8</sup>

Biofuel development tends to jeopardize the **availability** of food if land, water and other productive resources are diverted from food production to biofuel production. Acreage planted as biofuel feedstock is expected to increase by 17% to 44% by 2020 according to the Gallagher Report published in July 2008.

**Access** to food depends largely on both purchasing power and physical access to food sources. While transportation costs and export restrictions

have both played a large role in the current crisis, they have only a tangential relationship to the production of biofuel. A much stronger case can be made of biofuel's impact on food access by considering how high commodity prices, buoyed partially by the rise in biofuel production, may have increased the income of some farmers, but diminished the buying power of many more people worldwide.

The rise of biofuel has affected food **stability** in two ways. First, it has contributed to the diminishment of worldwide grain reserves. In the past, there was not much that could profitably be done with grain surpluses, so it made sense to either give it away as food aid or store it for use in leaner times. Now, there is less incentive for maintaining grain reserves, since that material can instead be sold as biofuel feedstock. Without these stores to serve as a buffer, individual events, be they political or weather related, now have the potential to affect food availability and price. Additional forces of destabilization emerge from the fact that foodstocks, now being linked into the liquid fuels supply chain, are therefore subjected to some of the price volatility seen in those markets.

Such predictions should be reasonable enough to accelerate the commercial-



ization of next-generation biofuel.

### The Future of Biofuels

The next generation biofuel holds the potential to sidestep many of the pitfalls of today's technologies by avoiding the use of food crops as feedstock and using instead low-maintenance plant matter, such as

## Biofuel Policies in the European Union and the United States

### EU Biofuels Legislation:

- **2003/30/EC Biofuels Directive:** Establishes a 5.75% biofuel target for 2010 (unlikely to be met according to the EU's own reporting) with a view to contribute to meeting climate change commitments and improve security of supply in an environmentally friendly way.
- **2003/96/EC Energy Taxation Directive:** Allows member states to grant tax reductions for renewable fuels up to 50% of the normal excise duty.
- **2003 CAP Reform:** Grants subsidies in the form of the Energy Crop Payment to all energy crops grown on non-set aside land up to a set maximum. In 2008, the abolition of both the energy crop payments and the set-aside land was proposed.
- **2007 Presidency Conclusions of the European Council:** Increases the target for biofuels to 10% by 2020, and sets certain criteria to ensure the sustainable production of biofuels.

### US Biofuels Legislation:

- **Energy Policy Act of 2005:** Mandates the creation of the Renewable Fuel Standard and the introduction of 7.5 billion gallons of renewable fuel by 2012; requires that all federal fleet vehicles be fully capable of operating on alternative fuels.
- **Energy Independence and Security Act of 2007:** Increases the target for biofuels to 36 billion gallons by 2022 (with 21 billion coming from non-cornstarch products); mandates at least a 20% reduction in lifecycle greenhouse gas emissions from new biofuel production facilities; and requests an impact assessment of increased biofuel use on the industry and the environment.
- **Farm Bill - Food, Conservation, and Energy Act of 2008:** Establishes a \$1.01 per gallon tax credit for cellulosic biofuels; lowers tax credits for ethanol from 51 cents to 45 cents per gallon; and provides grants for the construction of biorefineries capable of producing advanced biofuels.



“Biofuels” from p.11

agricultural residues, trees, and grasses.

**Jatropha, a Better 1st Generation Feedstock** – Besides the variety of already exploited biolipids in use to produce biodiesel, other more efficient feedstocks have appeared such as the *Jatropha Curcas*, whose production is being explored in countries like India and the US. A native of tropical regions in the Americas, jatropha was brought to India by the Portuguese almost five centuries ago. Since then, jatropha has been thriving with more than 150 species in sub-tropical regions of the world.

This large shrub or small tree exhibits many qualities that could make it a desirable source of biofuel. To begin with, it is not a food source. It can be grown in areas of low rainfall and can therefore be used in reclaiming eroded areas in arid or semi arid regions. Its seeds have a high oil content (30%-40%) that can be readily used for making biodiesel. *Jatropha* is highly efficient and can yield up to two tons of biodiesel fuel per year per hectare, which amounts to 1,000 barrels of oil per year per square mile. It also requires modest amount of fertilizers and needs to be planted only every 50 years.

**2nd Generation Biofuel, Cellulosic Ethanol** – While ethanol is now produced from the starch contained in grains such as corn and grain sorghum, it can also be produced from cellulose. Cellulose is the main component of plant cell walls and is the most common organic compound on earth. It is more difficult to break down cellulose to convert it into usable sugars for ethanol production, but if science can find a way to carry-out that process cheaply on a large scale, the types and amount of available feedstock material would expand dramatically. Cellulosic ethanol can be produced from native crops including corn stalks, rice straw and wood chips or “energy crops” of fast-growing trees and grasses, or even a variety of materials now regarded as wastes requiring special disposal. Most of these feedstocks require fewer

inputs and can often be grown on marginal lands. Therefore, over their entire life-cycle, they contribute less to GHG emissions and have fewer negative environmental impacts related to land use, water quality and availability, and biodiversity.

While it is certainly appealing to think



Image of a photobioreactor

that the production of cellulosic ethanol can be a panacea for many of our current problems, it is important to remember that the technology to produce cellulosic ethanol on commercial scales has yet to be developed. Additionally, while it is good that cellulosic feedstock can be grown on land not otherwise appropriate for growing food, producing enough biofuel to offset a significant portion of our liquid petro-fuels would still require the use of farmland and/or the clearing of vast areas of currently forested land.

#### **Algae, the Third Generation**

**Biofuel** – One of the most robust organisms on Earth, algae has emerged as a very promising source of fuel. A slimy aquatic organism with a simple cellular structure and a lipid-rich composition, algae has the capacity to grow faster than any other plant on earth in a wide range of conditions including fresh or brackish water, saltwater ponds, enclosed spaces and other marginalized lands.

Algae’s body weight is naturally comprised of up to 60% oil, whereas oil-palm trees—currently the largest producer of oil to make biofuels—yield just about 20% of their weight in oil. Its very high yield of oil per acre of cultivation enables algae to produce up to 15,000 gallons of biodiesel per acre, compared to soybean’s 60 gallons, canola’s 150 gallons and palm oil’s 650

gallons. Recent research suggests that algae could supply enough fuel to meet all of America’s transportation needs in the form of biodiesel using a mere 0.2% of the nation’s land.

Another appeal to the use of algae as a source of biofuel can be found in the fact that it can be fertilized with human and agricultural waste. In this way algae not only makes use of a ubiquitous and free source of raw materials, but also helps us “clean-up” a waste source that would otherwise have to be handled independently.

This technology, however, remains in the development stage and still has some obstacles to overcome. For instance, algae production can be achieved with very limited input but it is vulner-

able to contamination by other microorganisms or bacteria when cultivated in open ponds. Its productivity is also sensitive to fluctuations in temperature and sunlight. So far, these limitations have made cultivation costly and technology-intensive and led to the conception of photobioreactors, a device that houses and cultivates algae while providing a suitable environment for its growth, supplying light, nutrients, air, and heat to the culture.

**Fourth Generation Biofuels** – Scientists are now working to genetically construct microorganisms designed specifically to create biofuels. Unlike 1st through 3rd generation biofuel producers, these bacteria would not need a “feedstock” of organic material to digest in order to produce fuel. Instead, powered only by sunlight or heat, they could produce useful, high-energy fuels directly from water and carbon dioxide.

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*“Food Security” from p.1*

necessary to ship food from factory to consumer, “the food-processing industry in the United States uses about ten calories of fossil-fuel energy for every calorie of food energy it produces.”<sup>6</sup> Global nitrogen fertilizer consumption in 2005 was 90.86 million tons, the production of which required as many tons of fossil fuel.<sup>7</sup> As oil prices increase, the cost of maintaining industrial agriculture rises, thereby driving food prices upward.

The consequences of agriculture’s contribution to climate change, and of climate change’s negative impact on agriculture, are severe. The Intergovernmental Panel on Climate Change reports with high confidence that climate change is increasing the number of people at risk of hunger and predicts that between 40 million and 170 million more people will soon be undernourished.

Climate models predict that the impacts of climate change on agriculture will vary by region, adding to global inequality. Those living in high and mid-latitudes may find that a degree

or two of warming actually improves crop yields. Latin America’s crop and livestock productivity will decrease, Asia’s food security will be threatened by alternating floods and droughts, and sub-Saharan Africa could experience cereal production losses of 33% by 2060.<sup>8</sup> Moreover, the IPCC states that “climate change is likely to further shift the regional focus of food insecurity to sub-Saharan Africa. By 2080, about 75% of all people at risk of hunger are estimated to live in this region.”<sup>9</sup>

The result is a situation in which low-income regions are suffering as a result of high-income, industrialized standards of living that contribute to global climate change, over which they have no control and from which they do not benefit. Policy makers, farmers, and consumers alike need to consider the impact that their decisions and diets have on the environment. Eating locally grown produce and less meat further reduces the demand for resource-heavy industrialized agriculture and livestock production, easing the burden on food prices

and on those who devote the majority of their paycheck to dinner. With greater access to information about food and its effect on climate change, we can hope to make educated choices and prevent future food crises.

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*“Challenges” from p.5*

interbreed with and therefore “pollute” or reduce the diversity in a species’s gene pool. Doing so would limit the variety of traits exhibited by a species and therefore also limit the pool from which desirable traits can be identified and propagated. Special attention must also be given to preserving a wide and diverse gene pool against the threats to biodiversity posed by habitat loss and a growing propensity toward widespread monocropping. Monocropping (a practice in which entire farms or even whole regions of a country are planted with nearly identical seed) may be unwise in the uncertain times that lie ahead. Less genetic variation in our food-stocks means that an increasing percentage of any year’s harvest could be wiped-out by a single common threat. Policies should be derived to incentivise, as a form of food security insurance, the cultivation of more genetically diverse crops even if, individually, they may prove to be less productive.

**A Diversified, Adaptable, and Just Global Food Economy – In**

almost every way, the expected distribution of positive and negative climate change effects has the appearance of being unfair. As we have read, climate change, at least in the short and medium time frame, may produce positive as well as negative effects. However, these effects are not equally distributed. The preponderance of those beneficial effects will occur in higher latitudes, mostly in well-developed Northern Hemisphere countries -- the same ones, incidentally, that have historically played the biggest role in emitting the greenhouse gases that are now causing climate change. By contrast, equatorial regions, populated by less developed countries that not only have the least ability to respond to these challenges, but also are responsible for only a small percentage of historic greenhouse gas emissions, are the most likely to bear the burden of the negative effects of climate change.

In any instance where food is made scarce or prohibitively expensive, and especially in cases where there is some perceived injustice at play, border-crossing problems like political instability,

forced migrations, widespread health emergencies, collapsed markets, and war can quickly follow. To head off these types of scenarios, the international community must help to bolster stable, responsive governments, an informed and interlinked scientific community, adequate access to capital, and suitable infrastructure for all. These improvements are not only positive in their own right, but also required in any region that hopes to successfully cope with climate change.

Regardless of whether this situation is viewed from the perspective of social justice or simple practicality, our global economic and political systems should recognize this phenomenon and take action to ensure a more equitable distribution of risks and rewards in our world-wide food production system.

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Endnotes:

1. Food and Agriculture Organization of the United Nations “Climate change mitigation and adaptation in agriculture, forestry, and fisheries.” June 2008. [www.fao.org/foodclimate](http://www.fao.org/foodclimate)
2. Source: Food and Agriculture Organization of the United Nations “Climate change and transboundary pests and diseases.” June 2008. [www.fao.org/foodclimate](http://www.fao.org/foodclimate)
3. *ibid.*



## CLIMATE INSTITUTE NEWS CONT.



### Tom Casten and John Noel move energy recycling onto US agenda

Two Climate Institute Board members- Thomas R. Casten, Chairman of Recycled Energy Development, and John H. Noel, Chair of the Southern Alliance for Clean Energy- have played a pivotal role in moving energy recycling (also called cogeneration) front and center in North

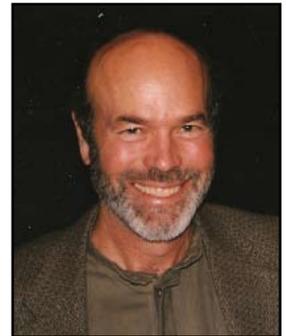
American energy discussions. In late December 2007 they briefed Tennessee Governor Phil Bredesen and top officials of the Tennessee Valley Authority (TVA) on the potential for simultaneous large-scale reductions in greenhouse gases and air pollutants that could be realized by removing barriers to cogeneration, all while also achieving huge savings to industries and consumers. Casten has projected the potential savings in the US to be as much as \$70 billion annually while also achieving about a 20% reduction in US carbon dioxide emissions.

Tennessee and TVA both decided to embark on a pioneering effort to promote energy recycling. The Tennessee Legislature enacted legislation signed by the Governor fast tracking permit approvals for TVA energy recycling facilities in the State. TVA has begun preparing a Clean Energy Standard Offer Program (CESOP) under which the multi-state utility would calculate cost of new facilities, looking at generation and transmission costs, and provide long range contracts to qualified industrial energy recyclers or other clean energy providers that could come in well below those

cost estimates.

Governor Bredesen also created a Task Force on Energy Policy charged with making Tennessee a leader in clean energy. John Noel has been a driving force behind this effort that seeks to remove barriers to clean energy and have the State Government become a leader in clean vehicles, fuels and buildings.

Meanwhile, Noel, after being titled Conservationist of the Year in 2007 by the Daughters of the American Revolution (DAR) for his work in saving a several hundred year old stand of white oaks in Hickman County, Tennessee, received additional recognition this past May when the Bon Aqua Woods, where these white oaks still flourish, were named the John H. Noel State Nature Area.



At the same time, Casten has begun to receive recognition in national news media for his remarkable blend of business savvy and policy advocacy. Articles, "Waste Not" in the May 2008 Atlantic, and "Gray is the New Green" in the September 15 Forbes, describe Casten's work and his message. It's a message that is apparently also having an imprint in North America outside the US. Like TVA, the Province of Ontario is considering using a CESOP. Concurrently, Luis Roberto Acosta, who leads Climate Institute Programs in Mexico and Latin America, drew an enthusiastic response in his May 2008 speech to the US/Mexico Chamber of Commerce calling for energy recycling to move to the top of the energy policy agenda in both Mexico and the US.

*"Reducing CC Effects" from p. 6*

our article "Reducing Food Miles" (on adjacent page) explains, one way to mitigate these emission is to discourage the purchase of non-local, out of season, or heavily processed and packaged foods.

### Moving Forward

In contrast to other aspects of our food/climate relationship, the situation involving efforts to reduce this sector's negative contribution to climate change is rather straightforward and well-understood. Furthermore, much of the necessary mitigation can be carried out with existing, relatively inexpensive technology. The major hurdles, therefore, are not so much technical as they are socioeconomic.

Until now, mitigation practices have not been carried out largely because

there has never been an incentive or mandate to go through the extra trouble. The "costs" that these practices would have offset (like having a degraded environment and warming planet) were instead simply externalized. Many people believed that the Earth had a nearly endless capacity to absorb the burden of producing cheap food without limit. The reality of global warming and the specter of even larger environmental collapse are now proving that assumption false. The fact that policy makers throughout the world are now considering the implementation of various schemes to put a price on the emission of greenhouse gases is proof that we now know that it is untenable to simply coast into the future with same attitudes and technologies that worked in the past. However, overcoming both inertia

and our sense of entitlement will not be easy. As we move forward, we should be reminded that we can still produce good, nutritious, satisfying food for the world's population while also mitigating greenhouse gas emissions. That goal is attainable. But we can not do so without making serious commitments to restructuring our economic systems, partaking in large scale collaborative efforts to develop and implement new food technologies, and adjusting our cultural assumptions about the role of food in daily life.

### Endnotes

1. US Senate Committee on Agriculture, Nutrition & Forestry. Animal Waste 105th Congress, 1st Session. Pollution in America: An Emerging National Problem. Report compiled for Sen. Tom Harkin. December 1997.
2. "Reducing Emissions from Deforestation in Developing Countries" UN Framework Convention on Climate Change. [http://unfccc.int/files/press/backgrounders/application/pdf/fact\\_sheet\\_reducing\\_emissions\\_from\\_deforestation.pdf](http://unfccc.int/files/press/backgrounders/application/pdf/fact_sheet_reducing_emissions_from_deforestation.pdf)



## OUR INTERNS --SUMMER 2008

The Climate Institute would like to thank our Summer 2008 interns for all their hard work and dedication. They contributed greatly to the Institute's operations and we wish them all the best in their future endeavors.



### Elisabeth Ericson

Elisabeth joined us following her freshman year at **Dartmouth College** where she is pursuing a double major in Geography and Studio Art. While at the Climate Institute, she translated various topics on our website into French, helped create a new section on climate impacts on Native American lands, and assisted with articles for this *Climate Alert*. In her free time, Elisabeth likes to play board games, cook elaborate meals, and make art. Although she is a Swedish citizen, she grew up in Washington, DC.

### Tomáš Jagelka

Hailing from Slovakia, Tomáš is a student of **Dartmouth College** where he will return this autumn as a sophomore to work toward a degree in either Economics or Engineering. His hobbies include skiing, sightseeing, and airplanes. At the Climate Institute, Tomas prepared the newsletter for the GSEII (Global Sustainable Energy Islands Initiative), drafted case studies on energy cogeneration in Europe and carbon sequestration, and assisted with articles for this *Climate Alert*.



### Corinne Kisner

Corinne is soon to be a graduate of **Georgetown University** where she has majored in Science, Technology, and International Affairs. As an intern, she produced a report on climate adaptation and mitigation strategies in Thailand (where she recently lived as part of a foreign study program), contributed to the development of a new feature for CI's website, and produced several pieces of writing for this issue of *Climate Alert*. Corinne is a native of New Hampshire and enjoys hiking, reading, and photography.

### Eric Schultz

Eric came to us from **Georgetown University** where he is a candidate for a Master in Public Policy degree. Having previous experience in nonprofit management, he was able to play a lead role in writing, editing, and supervising the development of this *Climate Alert* issue. As a native Floridian, and more recent resident of California, Eric's hobbies include watersports such as surfing and sailing.



### Yiming Zu

Yiming is currently working toward her Master of Arts degree in Global Environmental Policy at **American University**. This summer, she was able to help the Climate Institute build inroads into her home country, China, by producing translations of various topics on our website. She also wrote a case study on climate adaptation and mitigation strategies. In her free time, Yiming enjoys reading, yoga, and outdoor sports.

# CLIMATE INSTITUTE

**F**ounded in 1986, the Climate Institute was the first non-profit organization established primarily to address climate change issues. Working with an extensive network of experts, the Institute has served as a bridge between the scientific community and policy-makers and has become a respected facilitator of dialogue to move the world toward more effective cooperation on climate change responses.

The Climate Institute mission is to:

**CATALYZE** innovative and practical policy solutions toward climate stabilization and educate the general public of the gravity of climate change impacts.

**ENHANCE** the resilience of humanity and natural systems to respond to global climate change impacts especially among vulnerable groups.

**WORK** internationally as a bridge between policy-makers, scientists and environmental institutions.

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## **Climate Alert**

Published periodically  
by the Climate Institute  
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ISSN 1071 -3271

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Printed digitally on 100% post-consumer recycled, processed chlorine free paper produced using 100% wind power in a carbon neutral process

