

Food Production

04 April 2007
33rd class meeting



READINGS

Wednesday 04 April:

Food Production:

[Levidow 1999](#); [Rifkin 1992](#); [Burgers and Flies](#)

[Other optional readings](#)

Friday 06 April:

Pesticides and Pseudoestrogens:

[Colborn 1997](#); [Gore 1994](#)

Environmental Biology (ECOL 206)
University of Arizona, spring 2007

Kevin Bonine, Ph.D.
Anna Tyler, Graduate TA

http://eebweb.arizona.edu/courses/Ecol206/206_Page2007.html

Lab 04/06 April:
meet in **COMPUTER lab**
(CC311)

1

Natural Remodeling for the Not-So-Green House:

Bringing Your Home into Harmony with Nature

A Southwest book tour with author Carol Venolia, April, 2007

To have a home that's more in touch with the earth, you don't have to start from the ground up! Carol will take you on an inspiring journey to help you transform your current home into an eco-paradise—on any budget. Her presentation, illustrated with beautiful images from the book, will introduce you to a strategy for working with the natural elements to bring you, your home, and the earth to greater vitality. For more information on the book and upcoming events, visit

www.naturalremodeling.com.

Carol Venolia has been an eco-architect and educator over thirty years. Named a Green Design Trailblazer by Natural Home Magazine, she has designed numerous context-responsive homes of straw, earth, and good wood and consulted on schools, healing centers, and eco-villages. She is also the author of *Healing Environments: Your Guide to Indoor Well-Being*, *Design for Life* columnist for Natural Home Magazine, and Director of the EcoDwelling program at New College of California.

4/5 (Thursday)

Tucson, AZ

Originate Natural Building Materials

7:00 pm

Originate Showroom,

526 N. Ninth Avenue

Natasha Winnik

520-792-4207

natasha@originateNBM.com <<mailto:natasha@originateNBM.com>>

2

ENVIRONMENT

States Sue Over Global Warming

In a legal gambit aimed against global warming, the attorneys general of eight states last week sued the five largest emitters of carbon dioxide in the United States for creating a public nuisance. The states are asking that the electric utility companies cut emissions by 3% each year for a decade. Legal experts predict the states' case will be an uphill battle.

Carbon dioxide litigation is heating up. In 2002, environmental groups sued the Overseas Private Investment Corp. and the Export-Import Bank of the United States for not conducting environmental reviews on the power plants they financed. And last year, Maine, Massachusetts, and Connecticut sued the Environmental Protection Agency for not regulating CO₂ as a pollutant under the Clean Air Act. Now, the states have taken the first legal action directly against CO₂ emitters.

The plaintiffs—California, Connecticut, Iowa, New Jersey, New York, Rhode Island, Vermont, and Wisconsin, along with the

City of New York—claim that the CO₂ that utility companies release contributes to global warming, which will harm state residents. The alleged ills include increased numbers of deaths from heat waves, more asthma from smog, beach erosion, contamination of groundwater from rising sea level, and more droughts and floods. "The harm to our states is increasing daily," Eliot Spitzer, the attorney general of New York state, said at a press conference.

The defendants together spew about 650 million tons of CO₂ a year. Their 174 fossil fuel-burning plants contribute roughly 10% of the anthropogenic CO₂ in the United States. The suit maintains that annual cuts of 3% are feasible through making plants more efficient, promoting conservation, and using wind and solar power—without substantially raising electric bills. "All that is now lacking is action," Spitzer said.

That claim irks American Electric Power

of Columbus, Ohio, a defendant. Spokesperson Melissa McHenry says that the company had already committed to reducing its emissions by 10% by 2006. "Filing lawsuits is not constructive," she says. "It's a global issue that can't be addressed by a small group of companies."

It will also be a tough suit to win, says Richard Brooks of Vermont Law School in South Royalton, who studies the legal issues of air pollution. The fact that global warming is a planetwide phenomenon will make it difficult to establish how much these companies are contributing to the claimed harm. And under public-nuisance law, the plaintiffs must show that their citizens are suffering significantly more than the nation as a whole. "I would be totally amazed if the court gave this a serious response," Brooks says. "This makes me imagine that this is more of a symbolic suit."

—ERIK STOKSTAD

CREDIT: COURTESY OF THE ENVIRONMENTAL PROTECTION AGENCY

590

30 JULY 2004 VOL 305 SCIENCE www.sciencemag.org

3

US 'must regulate car pollution'

The highest court in the US has ruled that the government was wrong to say it did not have the power to regulate exhaust gases from new cars and trucks.

Twelve states and 13 campaign groups brought the landmark case against the Environmental Protection Agency (EPA). The US Supreme Court said the EPA had offered "no reasoned explanation" for refusing to regulate carbon dioxide and other harmful gas emissions from cars. The ruling was close, with five judges voting in favour and four dissenting. The justices had been asked to consider whether carbon dioxide (CO₂) should be defined as a pollutant and therefore subject to a law regulating emissions. The states and environmental groups who brought the case said the US government had a legal duty, under the Clean Air Act, to restrict greenhouse gas emissions. The EPA had argued that the 1970 Act did not give it the powers to impose limits because CO₂ was not deemed to be a pollutant.

Vehement opposition

This is one of the most important environmental cases to reach the Supreme Court in decades, says the BBC's Vanessa Heaney in Washington. Greenhouse gases - which occur naturally but which are also emitted by vehicles - have risen sharply over the past century, and many scientists believe they are contributing to global warming. The Bush administration has consistently rejected capping greenhouse gas emissions, saying such a move would be bad for business.

The court action was also vehemently opposed by car manufacturers and states where the car-making industry is important. The ruling has been welcomed by US environmental campaigners, however, who have been fighting for greater regulation in a nation which accounts for a quarter of all greenhouse gas emissions.

'Capricious' position

In arguments before the court, the EPA, backed by 10 states, four motor trade associations and two coalitions of utility companies, argued that it did not have the authority to control greenhouse gas emissions.

However, Supreme Court Justice John Paul Stevens, giving the majority ruling, wrote that the EPA's position was "arbitrary, capricious or otherwise not in accordance with the law". "Because greenhouse gases fit well within the Clean Air Act's capacious definition of 'air pollutant', we hold that the EPA has the statutory authority to regulate the emission of such gases from new motor vehicles," the court ruled. The justices also rejected the administration's argument that the situation was so serious that it could not be resolved by a court ruling. "While it may be true that regulating motor-vehicle emissions will not by itself reverse global warming, it by no means follows that we lack jurisdiction to decide whether the EPA has a duty to take steps to slow or reduce it." The EPA said it was reviewing the court's decision in order to determine the most appropriate course of action. The Alliance of Automobile Manufacturers, an industry group representing the chief carmakers in the US, responded by calling for "a national, federal, economy-wide approach to addressing greenhouse gases".

Story from BBC NEWS:

<http://news.bbc.co.uk/go/pr/ft/-2/hi/americas/6519923.stm>, Published: 2007/04/02 19:40:20 GMT

4

1997 Kyoto Protocol

<http://unfccc.int/2860.php>

Adopted 1997 (amended 2001 Marrakesh Accords)
United Nations Framework Convention On Climate Change (UNFCCC).

Sets basic, legally binding rules for emissions controls (**reduce green-house gas emissions**)

Goal is an overall emissions reduction by at least 5% from 1990 levels by 2008-2012.

Protocol has not yet “entered into force”, as it takes 55 member parties to ratify the protocol, including enough Annex I countries to encompass 55% of that groups carbon emissions. After the US pulled out, that figure could only be reached with the support of Russia, which accounts for 17% of world emissions.

On 18 November 2004, Russia deposited its instrument of ratification with the United Nations. This marked the start of the ninety day count down to the entry in force of the Kyoto Protocol, an international and legally binding agreement to reduce greenhouse gases emissions world wide.

Within 90 days of Russia's ratification, Kyoto signatories must start making cuts that will reduce emissions of six key greenhouse gases to an average of 5.2% below 1990 levels by 2012.

Countries which fail to meet the targets will face penalties and the prospect of having to make deeper cuts in future.

Many experts believe Kyoto will be largely ineffective as the world's two biggest emitters, the US and China, will not cut their outputs. Although China did sign the protocol, as a developing country it is not yet required to begin reducing emissions.

<http://news.bbc.co.uk/2/hi/europe/3943727.stm>

5

Arizona Daily Star[®]
www.dailystar.com[®] @www.azstarnet.com[®]

Published: 03.27.2006

Ariz. temps on the rise in winter for last 70 years

By **Tony Davis**

ARIZONA DAILY STAR

Winter nights have warmed significantly across Arizona over 70 years, raising questions about whether human-caused global warming is part of the cause, said a University of Arizona researcher.

From 1931 to 2001, average wintertime low temperatures rose by as little as 0.03 a of a degree per decade in Safford to as much as 1.11 degrees in Mesa, according to the UA-analyzed data.

Tucson's average winter low rose by about 0.7 of a degree per decade — or nearly 5 degrees over 70 years. That placed it sixth among 25 cities and towns analyzed.

All but Miami, Tombstone and Douglas showed higher temperatures over this period, according to the new analysis by UA's federally financed Climate Assessment for the Southwest program.

The warming's effects could ultimately range from the benign to the serious, according to several research-ers. There already are indications that growing seasons have lengthened and that a winter's first frost comes later and the last frost comes earlier in some parts of the state.

Arizona's warming trend

● Monitoring station/ degree increase per decade over last 70 years

Mesa: 1.11 degree

St. Johns: 0.89

Sacaton: 0.87

Williams: 0.85

Kingman: 0.83

Tucson: 0.70

Fort Valley: 0.50

Whiteriver: 0.49

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At Organ Pipe National Monument, for instance, the frost-free period has increased by a month since 1945. Eight of the 25 stations monitored for 70-year temperatures were found to have statistically significant longer growing seasons.

But researchers are also concerned that warming can aggravate the effects of drought by inducing more evaporation, and reducing the amount of moisture in soil. They say it could increase the length of the wildfire season and reduce the amount of runoff into rivers and streams and the recharge of rainfall into the aquifer.

"It's not just water. It's not just ecology. It's not just fire," said Gregg Garfin, a climatologist and program manager for the UA's Institute for the Study of Planet Earth, which monitors and studies climate change. "It's when you add it up, it's mutually reinforcing."

He plans to write up his temperature analysis for a report to be submitted later this year by a Forest Health Advisory Committee to Gov. Janet Napolitano's office.

That temperatures have jumped in big cities is no surprise. Researchers already know that buildings, roads and other man-made structures can cause an "urban heat island effect" when steel, concrete and other materials absorb the sun's heat. That causes temperatures to rise.

But in this case, the winter temperatures rose in many towns as sparsely populated as Sacaton and Seligman. Only two of the 12 top-ranked locations, Mesa and Tucson, were in urban areas.

The heat island effect can't be ruled out as a factor, said Garfin. Part of the increase can be explained by natural, decade-to-decade variations in the

Arizona's warming trend

Monitoring station/ degree increase per decade over last 70 years

Mesa: 1.11 degree
St. Johns: 0.89
Sacaton: 0.87
Williams: 0.85
Kingman: 0.83
Tucson: 0.70
Fort Valley: 0.50
Whiteriver: 0.49
Buckeye: 0.49
Seligman: 0.45
Holbrook: 0.45
Wickenburg: 0.42
Lee's Ferry: 0.37
Yuma: 0.34
Cryn de Chelly: 0.28
Roosevelt: 0.25
Parker: 0.25
Prescott: 0.20
Grand Canyon: 0.16
Childs: 0.11
Ajo: 0.08
Safford: 0.03
Tombstone: -0.10
Douglas: -0.10
Miami: -0.15

Arizona's warming trend

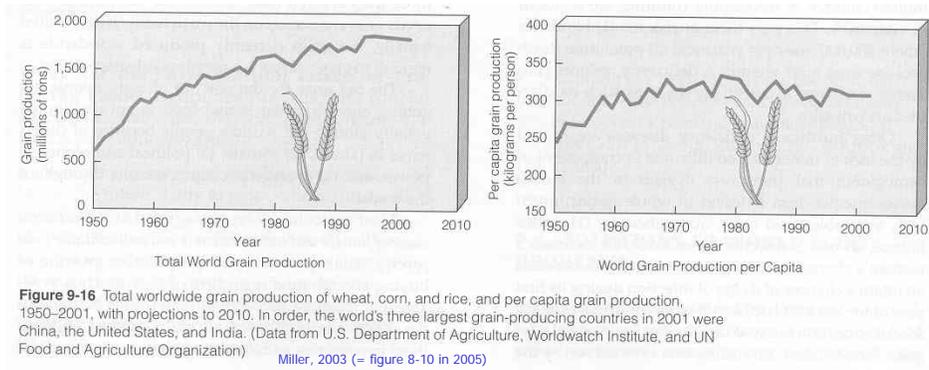
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FOOD PRODUCTION

Soil Nutritional Value

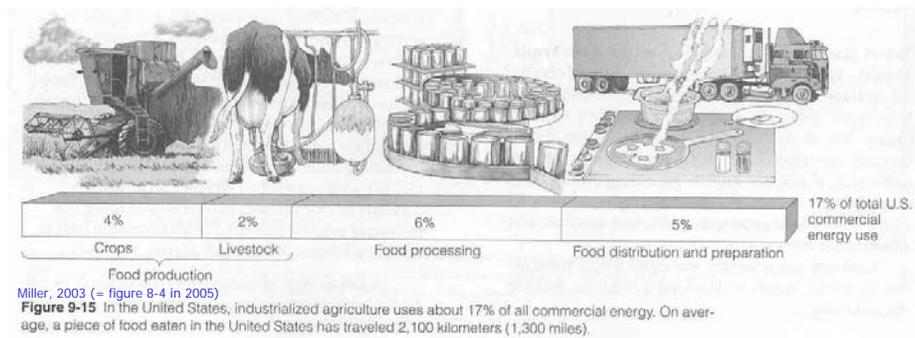
Feeding the World...



30 crops → 95% human's calories
 (50% from wheat, rice, and corn)
 418-1,400 species for native peoples

9

Industrialized Agriculture Energy Inputs



1,300 miles!

10

Miles to Go Before You Eat

Why it pays to buy locally grown food

The energy-efficient refrigerator is almost empty, so you gather up the canvas shopping bags and ride your bike to the grocery store. OK, let's see, what have they got? The pineapples look delicious, you always need bananas, and the kids love those green grapes—and you can get them all organically grown. You pat yourself on the back and cycle home with a contented smile on your face.

You're doing good, but you could do better. As consumers increasingly reach for environmentally friendly alternatives, the market is taking notice. If people are willing to pay a few cents more for organic bananas, for example, more of them will appear on the shelves—in fact, sales of organic bananas are growing by 20 percent a year.

But why stop there? The next frontier for discriminating eaters in a rapidly warming world may well be "food miles," the dis-

tance products must travel to get to your market. Recently, Richard Progg and others at the Leopold Center for Sustainable Agriculture at Iowa State University have been studying food transport, fuel usage, and the resultant greenhouse-gas emissions. In one study, they worked out how much energy it takes to transport various items from their points of origin to Des Moines, Iowa. (See sierraclub.org/sierra/200605/decoder.asp for details.) The sometimes surprising results are pictured below (calculations are based on the weight of the produce shown).

The easiest way to cut down on your food's gas bill is to eat locally grown fare. Progg is also looking into the feasibility of food labels indicating point of origin and miles traveled. Meanwhile, it wouldn't hurt to ask how far (and fast) those strawberries had to travel to get to your table in January. Remember to take into account your own location: As they say, your mileage may vary.



PINEAPPLE (COSTA RICA) 0.3 gallons of gasoline

PINEAPPLE (HAWAII) 2.8 gallons of gasoline

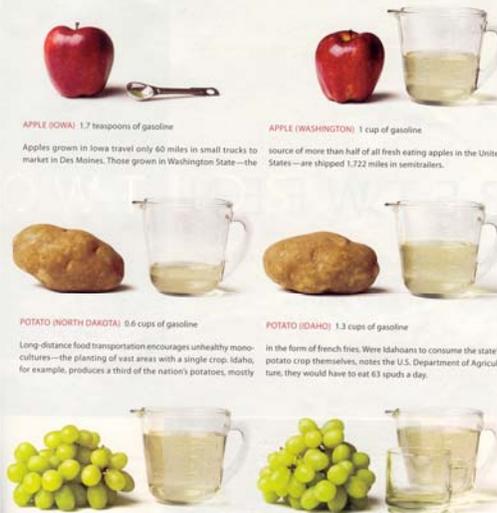
Pineapples are a fuel splurge, but those from Costa Rica are relatively less so than their Hawaiian counterparts—because half their journey is by sea, an extremely efficient mode of

transportation. Hawaiian pineapples, however, demonstrate that the most inefficient way to get produce from point A to point B is by air.

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BY PAUL BAUBER



APPLE (IOWA) 1.7 teaspoons of gasoline

APPLE (WASHINGTON) 1 cup of gasoline

Apples grown in Iowa travel only 60 miles in small trucks to market in Des Moines. Those grown in Washington State—the

source of more than half of all fresh eating apples in the United States—are shipped 1,722 miles in semitrailers.

POTATO (NORTH DAKOTA) 0.6 cups of gasoline

POTATO (IDAHO) 1.3 cups of gasoline

Long-distance food transportation encourages unhealthy monocultures—the planting of vast areas with a single crop. Idaho, for example, produces a third of the nation's potatoes, mostly

in the form of french fries. Were Idahoans to consume the state's potato crop themselves, notes the U.S. Department of Agriculture, they would have to eat 63 spuds a day.

GRAPES (CALIFORNIA) 1.9 cups of gasoline

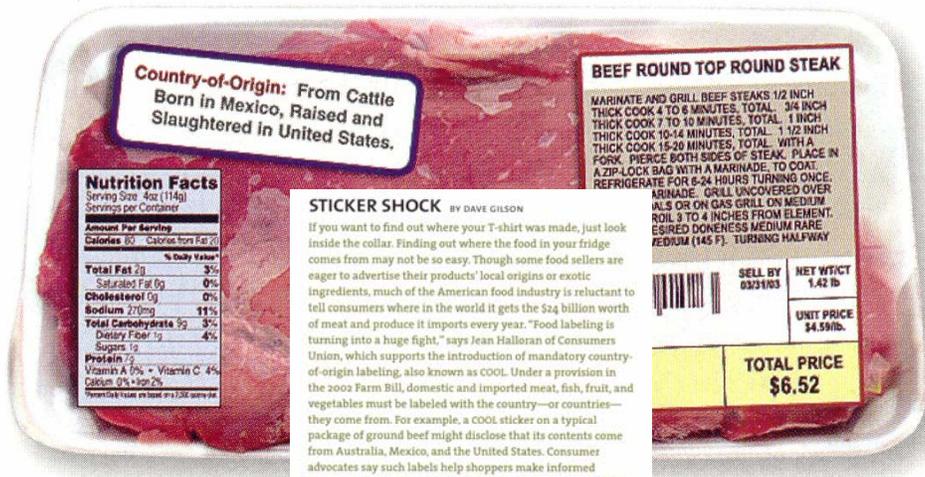
GRAPES (CHILE) 2.2 cups of gasoline

There's more to judging the environmental impact of transporting food than knowing the absolute distance. Even though California is more than 5,000 miles closer to Iowa than Chile is, the energy savings of its grapes are only marginal. Why? Because Chilean grapes are sent to the Golden State by sea. From there

they continue on to Iowa by truck, the same as Californian grapes. (This effect is obviously dependent on the endpoint: The closer the destination is to the port in Los Angeles, the greater the relative energy cost of the Chilean grapes.) But good news! Grape production in Iowa is increasing fast.

SIERRA • 35

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STICKER SHOCK BY DAVE GILSON

If you want to find out where your T-shirt was made, just look inside the collar. Finding out where the food in your fridge comes from may not be so easy. Though some food sellers are eager to advertise their products' local origins or exotic ingredients, much of the American food industry is reluctant to tell consumers where in the world it gets the \$24 billion worth of meat and produce it imports every year. "Food labeling is turning into a huge fight," says Jean Halloran of Consumers Union, which supports the introduction of mandatory country-of-origin labeling, also known as COOL. Under a provision in the 2002 Farm Bill, domestic and imported meat, fish, fruit, and vegetables must be labeled with the country—or countries—they come from. For example, a COOL sticker on a typical package of ground beef might disclose that its contents come from Australia, Mexico, and the United States. Consumer advocates say such labels help shoppers make informed choices, and point to the use of COOL by eight states and 48 of the United States' trading partners. But the meatpacking and food-processing industries claim the requirement unfairly targets imports and would raise food prices; the Produce Marketing Association claims the program offers "no benefits to consumers." So far, the food industry has convinced Congress to backtrack: House Republicans have twice postponed COOL's rollout for meat and produce, leaving diners in the dark until September 2008.

44 MOTHER JONES | MAY/JUNE 2006

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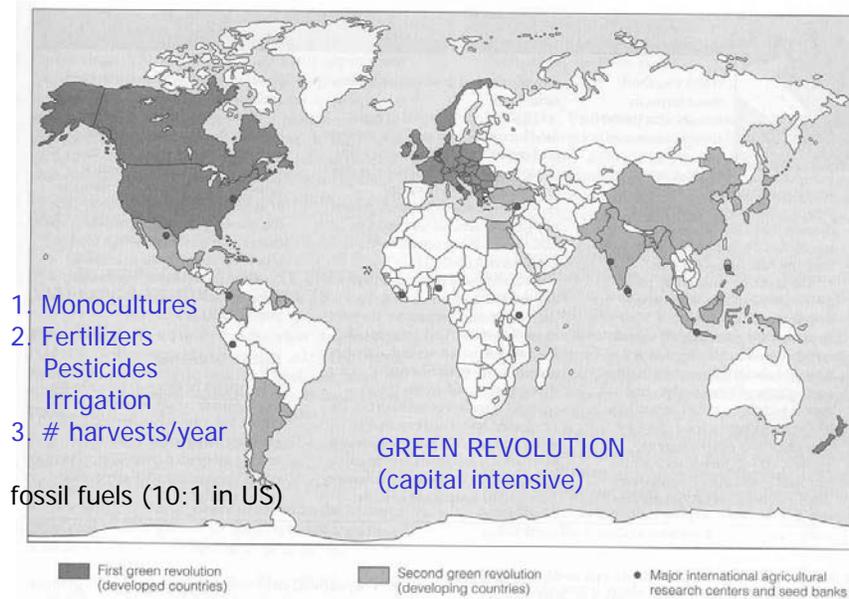


Figure 9-14 Countries whose crop yields per unit of land area increased during the two green revolutions. The first took place in developed countries between 1950 and 1970; the second has occurred since 1967 in developing countries with enough rainfall or irrigation capacity. Several agricultural research centers and gene or seed banks play a key role in developing high-yield crop varieties. Miller, 2003 (= figure 8-3 in 2005)

Feeding the World's people:

Under nutrition:

Malnutrition:

Overnutrition:

Subsistence Farming vs. Cash Crops

Poverty, Consumption, Equality

15

Pesticides

PRO

- DDT saves lives (malaria etc.)
- Increase Food Supplies
- Increase Profits
- Work Quickly
- New Technologies safer

CON

- Genetic Resistance to Pesticides
- Kill natural predators
- Pesticides move in environment
- Harm wildlife
- Harm human health

1. Reduced Pesticide use is feasible and may increase crop yields
 - rice in Indonesia
 - tomatoes in Mexico
2. Integrated Pest Management (IPM; more ecological approach)
3. Chemical Industry Lobby
4. Environmental Justice (What goes around comes around)

16

CORN



A combine works its way through the [CornCam](#) field in East Central Iowa. Yields in this part of the state are up over 9 percent from last year.

17

[Kingcorn.org](#), also known as the Corn Growers' Guidebook, is a World Wide Web site devoted to more profitable corn management systems. The Guidebook has been available on the Web since 1994!

<http://www.agry.purdue.edu/ext/corn/about.htm>

Grass, *Zea mays* ssp.
Domesticated 6,000 years ago by mesoamerican civilizations in [tropical mexico](#)
- still a region of genetic diversity

[456.2 million tons/year](#)

- Food
- Animal Feed
- Pharmaceuticals
- Industrial Production

<http://maize.agron.iastate.edu/maizearticle.html>

18

CORN

If you are looking for the world famous **Chat 'n Chew Café**, then look **no farther than** www.kingcorn.org/cafe.

Questions about **drought stress and crop production**? Check out **Purdue's Agronomic Drought Stress Information site** at <http://www.agry.purdue.edu/ext/drought>

Searching for **corn hybrid performance data**? Check out the **North Central Crop Evaluation Committee page** at <http://www.ksu.edu/kscpt/nccec/>

Interested in **'biotech' issues**? Go to the archive of 'biotech' issues at www.kingcorn.org/cafe/biotech.html

Want to build a **corn maze**? Check out what others have done at www.kingcorn.org/cgg5/maze.htm.

Looking for **smut**? Check out the **edible corn smut recipes** at www.kingcorn.org/cgg5/recipes.htm.

Need some corny ideas for your **classroom activities**? Go to the **head of the class** at www.kingcorn.org/cgg5/classroom.htm.

19

Corn Blight

USA 1970s, 15% corn died, \$1 billion lost

Fix:

Mexican heirloom varieties and traditional cross breeding

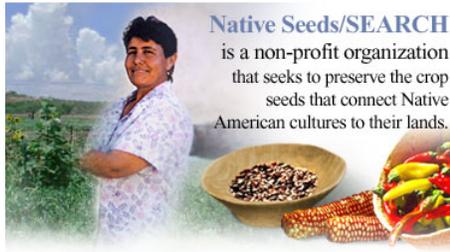
Similar stories (peruvian tomato contribution)

(see discussion in McPherson, KtN, chapter 5)

Teosinte



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Contact Us
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Fax: (520) 622-5591
info@nativeseeds.org

Mailing Address
Native Seeds/SEARCH
526 N. 4th Ave.
Tucson, AZ 85705-8450

<http://www.nativeseeds.org/>

-To conserve, distribute and document the adapted and **diverse varieties** of agricultural seed, their wild relatives and the role these seeds play in **cultures** of the American Southwestern and northwest Mexico.

-We safeguard **2000 varieties of arid-land adapted** agricultural crops. Some, like watermelons, were adapted from seeds brought by early Europeans. Most of our collection consists of varieties of **indigenous crops** developed over centuries or millennia to suit the needs of their human partners.

-We promote the use of these ancient crops and their wild relatives by distributing seeds to traditional communities and to gardeners world wide. Currently we **offer 350 varieties** from our collection, grown out at our Conservation Farm in **Patagonia, Arizona**.

-We also work to **preserve knowledge about the traditional uses** of the crop we steward.

-To **protect biodiversity and to celebrate cultural diversity**: crop loss means an inevitable reduction in genetic diversity: thousands of years of evolution down the drain. The loss, in human terms, ²¹ equally severe.

(...define pest)

Pesticides

biocides, herbicides, insecticides, fungicides, etc.

Chemical arms race is hundreds of millions of years old!

Some banned in US but still produced here and exported.

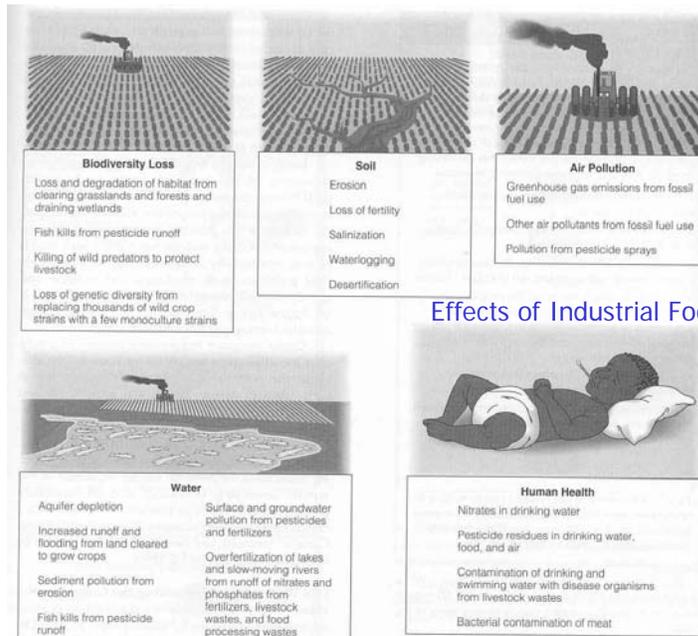
Ethical implications?

Ideal:

1. kill only target pest
2. not lead to genetic resistance
3. disappear or breakdown into harmless components
4. more cost effective than doing nothing

US: Pesticide use up 33x since 1942, but lose more crops to pests than in 1940s (37% vs. 31%; Miller p. 166) ²²

40% of all photosynthesis towards human consumption



Effects of Industrial Food Production

Figure 9-17 Major environmental effects of food production.

Miller, 2003 (= figure 8-11 in 2005)

23

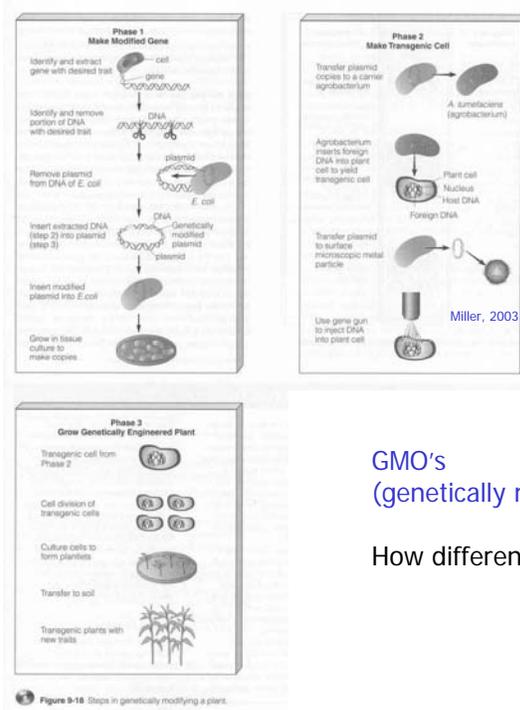


Figure 9-18 Steps in genetically modifying a plant.

GMO's
 (genetically modified organisms)

How different from cross breeding?

See Levidow 1999 24

Projected Advantages		Projected Disadvantages
<p>Need less fertilizer</p> <p>Need less water</p> <p>More resistant to insects, plant disease, frost, and drought</p> <p>Faster growth</p> <p>Can grow in slightly salty soils</p> <p>Less spoilage</p> <p>Better flavor</p> <p>Less use of conventional pesticides</p> <p>Tolerate higher levels of herbicide use</p>		<p>Irreversible and unpredictable genetic and ecological effects</p> <p>Harmful toxins in food from possible plant cell mutations</p> <p>New allergens in food</p> <p>Lower nutrition</p> <p>Increased evolution of pesticide-resistant insects and plant diseases</p> <p>Creation of herbicide-resistant weeds</p> <p>Harm beneficial insects</p> <p>Lower genetic diversity</p>

Miller, 2003 (= figure 8-12 in 2005)

Figure 9-19 Projected advantages and disadvantages of genetically modified crops and foods.

Continuing the Green Revolution?

GMO's
(genetically modified organisms)

See Levidow 1999

25

Levidow 1999 (Regulating **Bt Maize** in the U.S. and Europe)

Bt = *Bacillus thuringiensis* bacterium
(contains gene that codes for protein toxic to some insects)
Genetically Modified Crops (cotton, potatoes, maize)

Costs and Benefits

- Yields and Fewer Agrochemicals
- Agriculture, Environment (Monarchs), Humans
- Resistance, Arms Race, 'Genetic Treadmill'
- **Herbicide and Ampicillin markers**

IRM = Insect Resistance Management
"High-Dose/Refuge" Strategy
3-5 year time window

Solutions

Crop Rotation, IPM etc.

EPA, EU

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Monarch Butterfly *Danaus plexippus*

- Lepidoptera (order)
- Papilionoidea
- Danaidae
- Milkweed Butterflies



Monarch, w. 3½-4", p 758



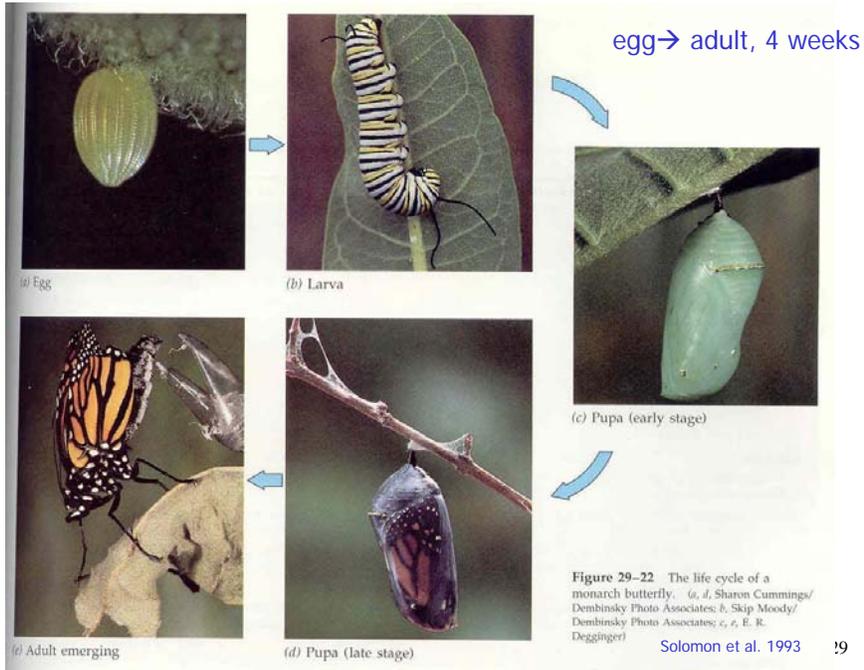
Figure 52-4 Emigration (movement away from a specific area) and immigration (movement into a specific area) are important factors in the population sizes of migratory animals. Shown here is a population of monarch butterflies spending the winter in the mountains of central Mexico. Monarch butterflies migrate into the United States and Canada for the summer months and return to Mexico for the winter. A round trip often involves several generations. Somehow, individual monarchs know where to winter in Mexico without having seen the sites before. (William E. Ferguson)

Solomon et al. 1993

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Migration - 2000 miles
Canada <--> Mexico
(Hawaii, Australia)
Millions
Multiple Generations!



Milkweed
(foliage, flowers, buds, fluid)
Poisonous cardenolides



Bacillus thuringiensis
Bt corn pollen -->
milkweed³⁰

27

Ecological Colonialism

Jeremy Rifkin
Beyond Beef
1992

186

BEYOND BEEF

the temperate regions of the world. Cattle grazing is a primary cause of the spreading desertification process that is now enveloping whole continents. Cattle ranching is responsible for the destruction of much of the earth's remaining tropical rain forests. Cattle raising is partially responsible for the rapid depletion of fresh water on the planet, with some reservoirs and aquifers now at their lowest levels since the end of the last Ice Age. Cattle are a chief source of organic pollution; cow dung is poisoning the freshwater lakes, rivers, and streams of the world. Growing herds of cattle are exerting unprecedented pressure on the carrying capacity of natural ecosystems, edging entire species of wildlife to the brink of extinction. Cattle are a growing source of global warming, and their increasing numbers now threaten the very chemical dynamics of the biosphere.

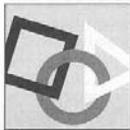
Rifkin 1992 (Beyond Beef, Ecological Colonialism)

Domesticated Cattle

- Soil **Erosion** (vs. soil formation)
- Desertification

- Tropical Rainforest Depletion
- Global Warming

- Nonnative grasses**, weeds, grains
- Old --> New World
- Ecological Change**



CONNECTIONS

Some Environmental Consequences of Meat Production

The meat-based diet of affluent people in developed and developing countries has the following environmental effects:

- More than half of the world's cropland (19% in the United States) is used to produce livestock feed grain (mostly field corn, sorghum, and soybeans).
- Livestock and fish raised for food consume about 36% of the world's grain production (65% of U.S. production).
- Livestock use more than half the water withdrawn from rivers and aquifers each year, mostly to (1) irrigate crops fed to livestock and (2) wash away manure from crowded livestock pens and feedlots.
- Manure washing off the land or leaking from lagoons used to store animal wastes is a source of water pollution that kills fish by depleting dissolved oxygen.

- About 14% of U.S. topsoil loss is directly associated with livestock grazing.
- Overgrazing of sparse vegetation and trampling of the soil by too many livestock is the major cause of desertification in arid and semiarid areas (Figure 9-6).
- Cattle belch out about 16% of the methane (a greenhouse gas about 25 times more potent than carbon dioxide) released into the atmosphere.
- Some of the nitrogen in commercial inorganic fertilizer used to grow livestock feed is converted to nitrous oxide, a greenhouse gas released from the soil into the atmosphere.
- More than one-third of all raw materials and fossil fuels consumed in the United States are used in animal production.
- Livestock in the United States produce 20 times more waste (manure) than is produced by the country's human population. Only about half of this nutrient-rich

livestock waste is recycled into the soil.

Some environmentalists have called for reducing livestock production (especially cattle) to reduce its environmental effects and to feed more people. This would decrease the environmental impact of livestock production, but it would not free up much land or grain to feed more of the world's hungry people.

Cattle and sheep that graze on rangeland use a resource (grass) that humans cannot eat, and most of this land is not suitable for growing crops. Moreover, because of poverty, insufficient economic aid, and the nature of global economic and food distribution systems, very little if any additional grain grown on land used to raise livestock or livestock feed would reach the world's hungry people.

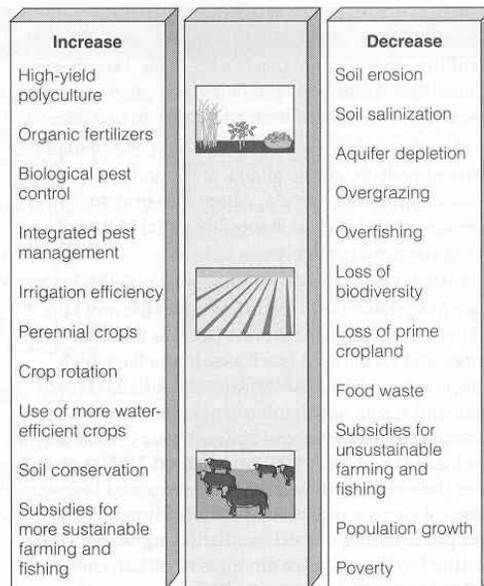
Critical Thinking

Are you willing to eat less meat or not eat any meat? Explain.

Miller, 2003
Chapter 9 (= p. 160 chapter 8 in 2005)

See Rifkin 1992

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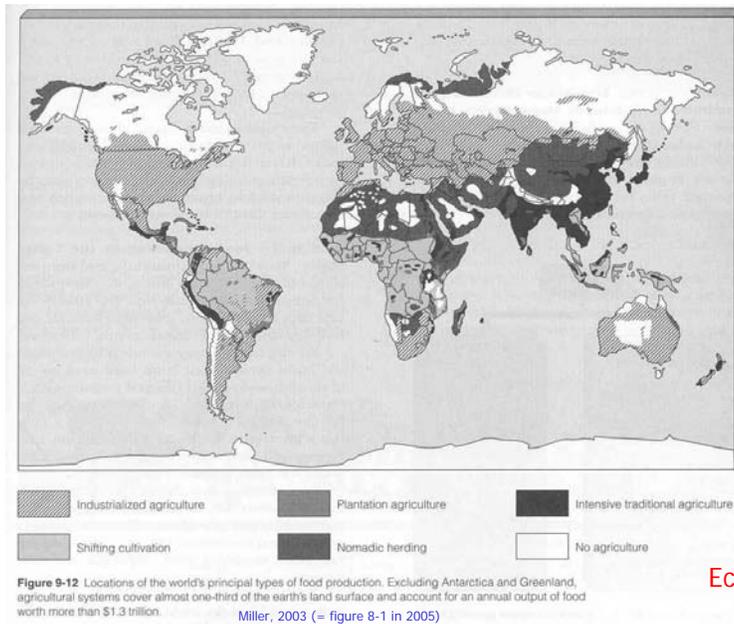
Toward Solutions

Figure 9-24 Components of more sustainable, low-throughput agriculture.

Miller, 2003 (= figure 8-18 in 2005)

34

Food Production



Monoculture

Polyvarietal

Interplanting/
Intercropping
- >1 crop

Polyculture
-diff't times

Agroforestry
-with trees

Ecological Theme
35

Local Ideas:

Tucson CSA (community supported agriculture)
food from Organic farm in Glendale

Terra Cycle Farms (located near Rio Rico)?

Tucson COOP (4th Ave.)

17th Street Market

Farmers Markets

CONSUMER DRIVEN CHANGE!

Flies, Manure & Industrial Meat Production

Antibiotic Resistance

Horizontal Gene Transfer

creature, not only does it make sounds to

Burgers and Flies

Grab that flyswatter! Public-health entomologists have discovered antibiotic-resistant bacteria lurking in the guts of houseflies buzzing around fast-food joints. Ludek Zurek and Lilia Macovei of Kansas State University in Manhattan, Kansas, captured more than 200 houseflies at five restaurants in a northeastern Kansas town. The entomologists isolated and cultured bacteria from the flies' guts, then exposed the bacteria to antibiotics. Two-thirds of the bacteria survived treatment with a single common antibiotic, and, of those, half survived treatment with two or more antibiotics. Zurek and Macovei also identified genes that confer immunity in most of the resistant bacteria's DNA.

The houseflies may have come from farms, the entomologists say. In the U. S., livestock are regularly dosed with antibiotics to encourage growth, and so their gut bacteria often evolve resistance to the drugs. Houseflies that develop in and feed on the animals' waste swallow bacteria when they eat. Then, being long-distance aviators, they can fly to town—hence their nickname in Zurek's lab: "flying manure."

Houseflies enjoy many of the same foods people do, including cooked meat and sweets. And they go to the same restaurants. They eat messily, spitting and regurgitating on their meal before digging in. In the process, a house-

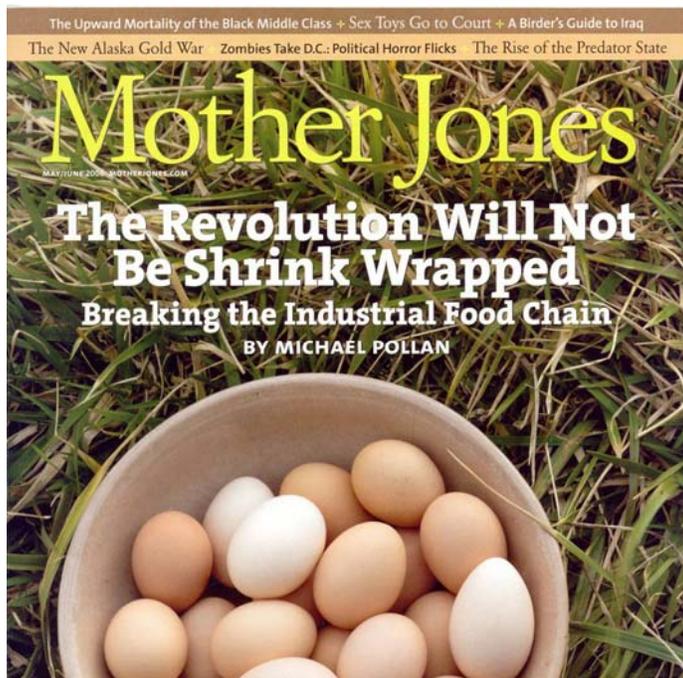
babbles, the pups' vocalizations were similar to adults' calls, and the pups made them without regard for social context, typically while alone. Intriguingly, pups of both sexes practiced parts of the courtship and territorial songs sung in adulthood only by males. Babbling, the authors contend, may be essential for any animal to master a large vocal repertoire. (*Naturwissenschaften*, DOI 10.1007/s00114-006-0127-9, 2006)

—S.R.

fly's lunch—which may be your lunch, too—is doused with the contents of the fly's gut, including any bacteria, antibiotic-resistant or not, that the fly is carrying.

As unappetizing as that may sound, most gut bacteria from flies are relatively harmless, so their immunity to antibiotics might not seem alarming. But bacteria readily exchange genes, so the gut bacteria could pass resistance genes on to nastier species, which houseflies also carry. And those little monsters can prove immune to current medical treatments—a mounting concern for physicians. (*Applied and Environmental Microbiology* 72: 4028–35, 2006)

—Ciara Curtin





FEATURES

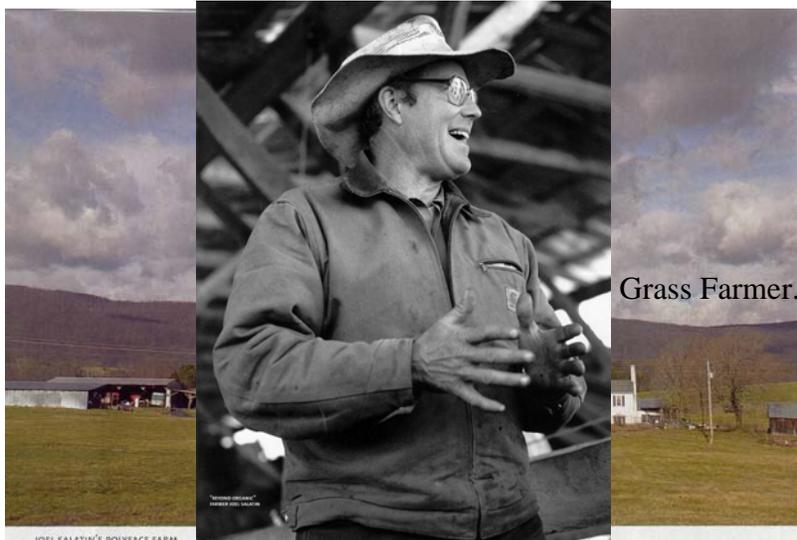
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