Contemporary Food Habits: Industrialization

Thomas Robert Malthus

- Essay on Population (1789)
  - If population is unrestrained by natural causes, it will double every 25 years
  - Population growth has a tendency to grow faster than food supply
  - Famine and poverty are the natural outcomes

Why didn't Malthus' prediction about the world's population outstripping world food production come true?

Increasing Agricultural Productivity

Why did agricultural production increase?

- Crop rotation
- Natural and chemical fertilizers
- Commercial seed production
- Winter feeding of animals
- Improved transportation routes

The "Green Revolution"

- Began after WWII
- New high yielding crop varieties, fertilizers, pesticides, & mechanized equipment
- Changed architecture of plants:
  - new varieties of wheat and rice with high grain-to-straw ratio
  - increased proportion of nutrient uptake going into grain vs. straw

Green Revolution - PROs

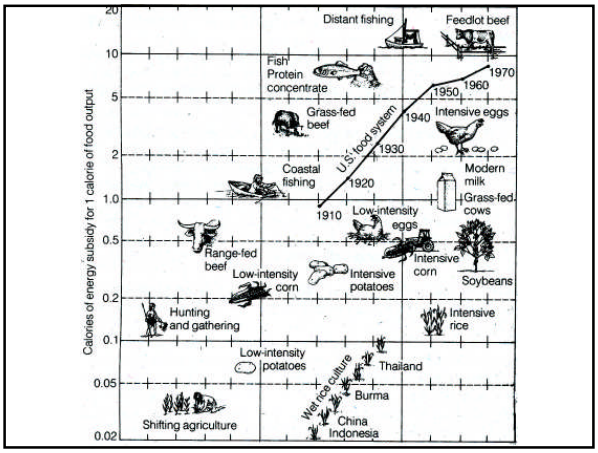
- 1950 – 1985: world grain supplies increased from 620 to 1660 metric tons
- Countries that had regular famines prior to Green Revolution now hold grain reserves in supply for lean years (e.g., India)
- Goal - increase production to end world hunger

" If farmers of the Third World today used the same cereal varieties as in 1963-64, and everything else were unchanged, then tens of millions of people would this year die of hunger."

Lipton (1985)

Green Revolution - CONs

- Technology not spread evenly
- Many subsistence farmers can't afford to buy seeds, fertilizers, equipment, and fuel
- Africa benefited least, as its major crops are millet, sorghum, cassava and chickpeas
  - Little work done on improving these crops
- Failure to address unequal access to food and food-producing resources



Estimated area planted to high-yielding varieties of wheat and rice in the major regions of the developing countries, 1982-83

Region	Area (million ha)	Proportion (per cent)
Asia	104.1	54.6
Near East	7.7	29.6
Africa	0.7	13.3
Latin American	10.8	59.0
Total	123.3	52.9

Environmental Costs

- Environmental degradation
  - ¼ of all agricultural nitrogen leaches into groundwater
- Lose species variety $\rightarrow\rightarrow$ monoculture
- Lose indigenous agricultural knowledge, e.g. agro-forestry and crop rotation

Agribusiness

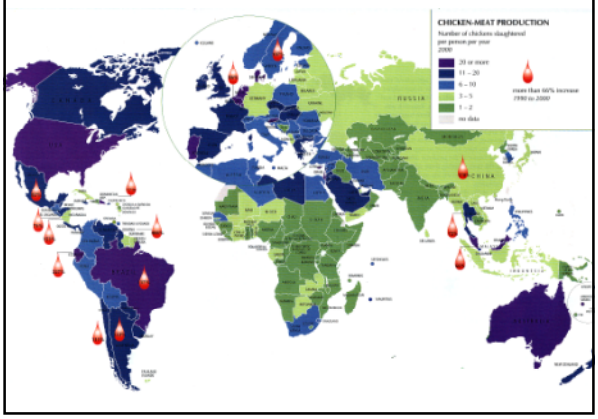
- Began in 19th century with industrial revolution
  - As people moved to urban areas to participate, production, processing, and transportation systems had to change to meet needs
- Rise of urban population
  - By 2005, ½ of world will live in urban centers
- In North America, 15 - 20% of all farms produce 80% of agricultural produce

Agribusiness - PROs

- Efficient
- Food can be enhanced by fortification
- Can be transported over long distances
- Can lead to an increase in food variety and availability
- Enables more people to get away from food production
  - Ever decreasing number of farms, larger acreage
- Food is regulated by government
  - Quality checks and mass treatment of food
    - Pasteurization of milk, etc.

Agribusiness - CONs

- Farmers at mercy of world markets, e.g. prairie farmers in U.S. and Canada
- Yield and profit are paramount - must compete using latest technologies
- Food can be adulterated and contaminated
  - Increased use of antibiotics and growth hormones
  - Food may have hidden fats, sugars, salt
- Some low nutrient foods become replacements for high quality foods
- Food becomes not a right but a privilege that must be purchased
- Can decrease food variety



Hormones

- Bovine Somatotrophin (BST) or Bovine Growth Hormone (BGH)
  - Increases milk production 10-15%
  - Not approved for sale in EU countries and Canada
- Monsanto produces recombinant DNA BGH (rBGH)
  - Monsanto's lobbying efforts have kept BGH milk on the market in most of the U.S.
- Emphasis on yield and profit over sound food policy

BGH Risks

Potential Risk to Cows:

- Increased infertility
- Increased udder infections
- Increased lameness
- More antibiotics used

Potential Risk to Humans:

- Increased IGF-1
  - May be linked to cancer
    - No studies showing BGH milk consumption link
- Possible allergic reactions

Antibiotics

- Antibiotics are usually included in cattle feed so that the animals will not become infected
  - Leads to faster growth and weight gain
- In 1991, the Centers for Disease Control (CDC) released a startling statistic
  - Approximately half of the fifteen million pounds of antibiotics produced annually in America are used to treat livestock and poultry

Agribusiness increases production

But at what cost to human and environmental health?

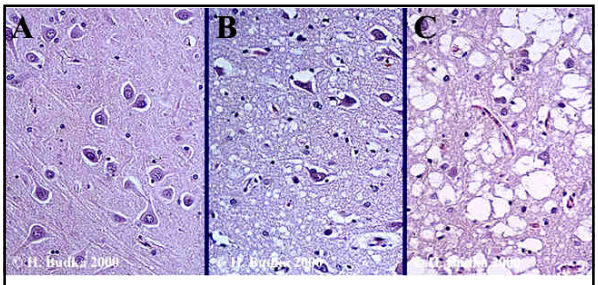
Bovine Spongiform Encephalopathy

Mad Cow Disease

- Bovine Spongiform Encephalopathy (BSE)
  - One of the family of Transmissible Spongiform Encephalopathies (TSEs)
    - Kuru, Creutzfeldt-Jakob Disease (CJD), and vCJD (variant CJD) in Humans
    - Scrapie in Sheep
- Progressive and fatal nervous system disorder

Creutzfeldt-Jakob Disease (CJD)

- Rare, fatal brain disease associated with presence of prions in the brain
- Prion = Proteinaceous infectious particle
- Long incubation, up to 30 years in humans
- Once symptoms appear, patient rapidly deteriorates
- No known cure
- Normally occurring variety usually affects people over 50 years of age
- Kills 1/1,000,000 every year, worldwide



Brain changes with vCJD:

A. Normal
B. Slight or moderate
C. Severe changes

Mad Cow takes off

- 1995 - British teenager dies of CJD
  - No risk factors for normal CJD
- 1994 – 1995 10 people, all under 50 contracted CJD in the UK
  - Over the next decade: Median Age at death ranges from 25.5 to 34 years
- January 2006 - number of definite or probable cases (dead or alive) is 159
  - (CJD surveillance unit, www.cjd.ed.ac.uk)

Year	Onset	Death	Median age at death
1994	8	0	-
1995	10	3	-
1996	11	10	30
1997	14	10	26
1998	17	18	25.5
1999	29	15	29
2000	24	28	25.5
2001	17	20	28
2002	14	17	29
2003	5	18	28
2004	9	9	26
2005	1	5	34
Total	159	153	28

BSE and Mad Cow Disease

- Believe cows contracted it from sheep
- In 1995, scientists began wondering if humans could contract vCJD from cows with BSE
  - It didn't take long to answer that question in the affirmative
- It's now clear that some forms of TSE can jump the species barrier from one host to another

How did this happen?

- Slaughtered animal meat is processed for human consumption
- The rest, called offal (entrails, hooves, brain), is rendered using high temperatures and then fed as bone meal to other animals
- Prions are resistant to high temperatures, ionizing radiation, drying, etc., therefore passed from animal (likely sheep) to animal (cows) to human

Impact on the Beef Industry in Britain

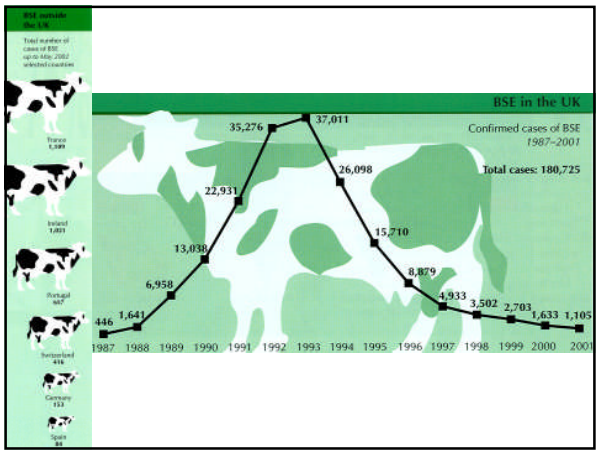
- 1996 beef crisis - government announced possible link between beef and CJD
- Overnight collapse - all beef exports banned
- Cost European market $5 billion US in subsidies to beef industry and to slaughter cows

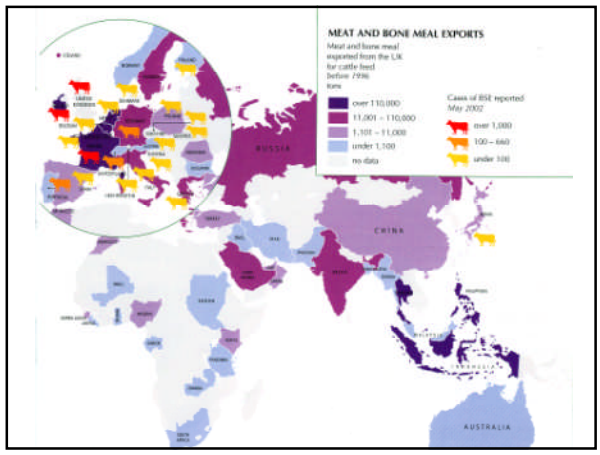
Reaction in North America

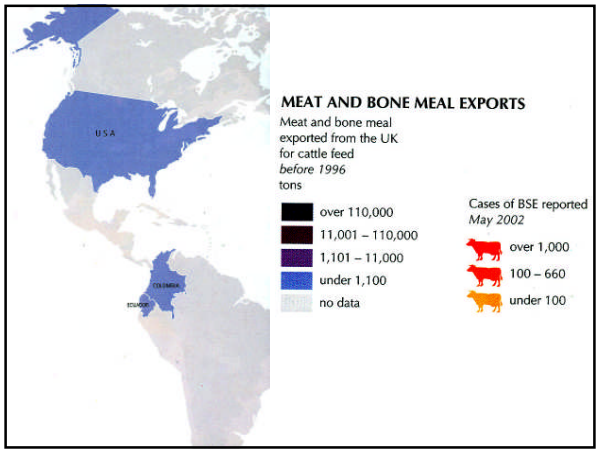
- 1996 All British beef products taken off the shelves
- 1997 FDA in US proposed an official ban on feeding rendered meat to cows
- Canada followed suit because of the threat of trade sanctions

To date...

- Confirmed reports of BSE in several other European countries
  - No vCJD not traceable to the UK yet
- Blood donation programs
  - Screening out people who have lived in the UK or France for a total of 6 months since 1989
  - No simple blood test available yet
    - Joaquín Castilla, Paula Saá, & Claudio Soto published a possible blood test in Nature Medicine, 11:982 - 985 (28 August 2005) Detection of prions in blood
    - Several years away from human use







BSE in North America

- 2003 - Ban on Canadian cows/meat to U.S. Mexico, Japan, & South Korea
- January 2005 – Canada reported BSE in two cows from Alberta
- Three U.S. cases to date
  - Washington (2003), Texas (2004), and Alabama (2006)
- New questions about our testing procedures in North America

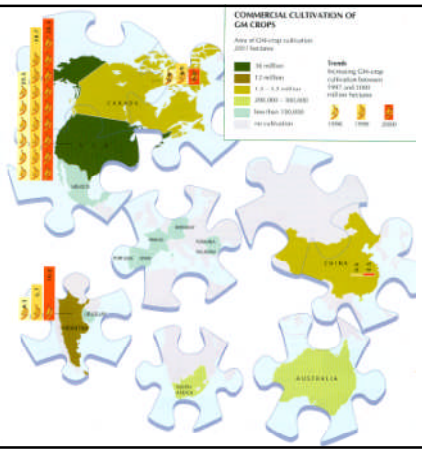
Biotechnology, the 21st Century: GM Food

Food and Technology

- Technology to preserve food:
  - Temperature
  - Removal of water & oxygen
  - Chemical preservatives
  - Irradiation
- Technology to enhance food supply
  - Traditional breeding
  - Modern biotechnology

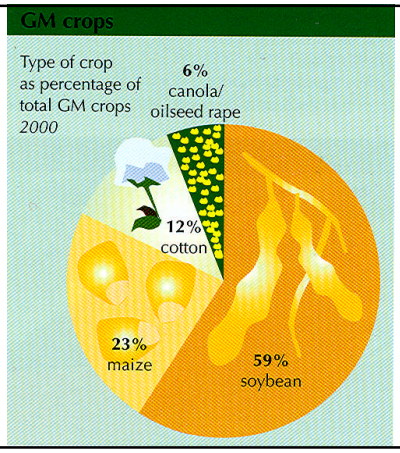
What are GM foods?

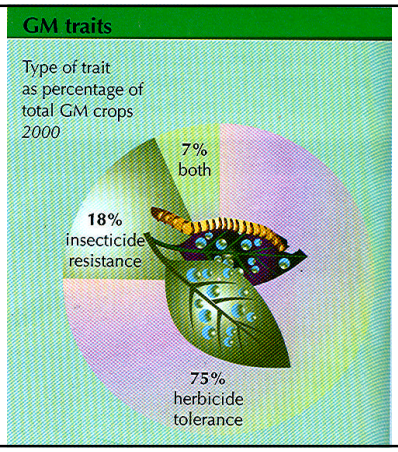
- Foods are modified by “gene splicing”
- US, Canada and Argentina are biggest producers of GM foods in the world
- Canada has approved 42 different GM foods for cultivation:
  - Corn/Maize: corn, corn starch, corn oil, corn syrup
  - Soya: soya beans, flour, oil, sauce, tofu
  - Tomatoes: tomato paste, puree, sauce
  - Rapeseed (Canola) oil



Examples of Crops Produced by Bioengineering

Food	Alteration
Cherry tomato	Taster, color, texture
Corn	Insect protection, herbicide resistance
Squash	Virus resistance
Potatoes	Potato beetle resistance, virus resistance
Tomato	Thicker skin, altered pectin content
Sugar beets	Herbicide resistance
Papaya	Virus resistance

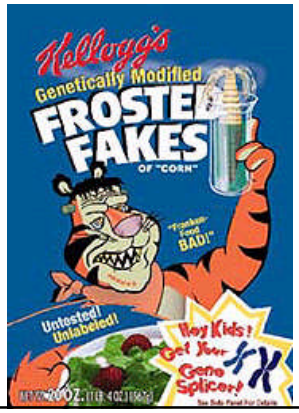




Public Reaction to GM Foods

- Very contentious, particularly in Europe and Japan
  - GM foods banned in many countries
- Large food stores in Britain have banned GM foods altogether
- Iceland will not develop them and have banned them from the country

Greenpeace Frankenfoods Campaign



GMOs: Another step in the evolution of agriculture?

- Haven't we always been breeding selectively?
- Isn't this is just a 21st century version of selective breeding?
- Are we just afraid of new technology as we always have been in the past?

Crop Evolution

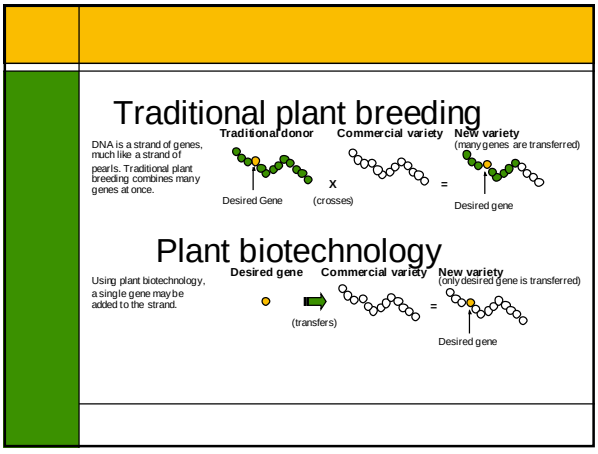
- **Humans Have Always Guided the Evolution of Crops!**
  - A small sample of wild plants were chosen and domesticated
  - ~10,000 years of Selection
- All crops we grow today were once wild plants
  - But no crop would survive in the wild any more
- Crops, strains, and genes have moved around the globe

Improving Our Crop Plants

- Developing Modern Varieties of Crops
  - Hybridization
    - Crosses with Wild Relatives
    - Hybrids
  - Mutation
    - Irradiation
    - Chemicals

Modern Genetic Modification

- Inserting one or few genes to achieve desired traits
- Transfer of Genes into Crop Plants
  - Relatively Precise and Predictable
  - Changes are Subtle
  - Allows Flexibility
  - Expeditious



Are GM Foods Safe?

- Genetically Modified (GM) food is as safe or even safer than conventionally produced food
- GM foods represent a very minor, precise and known change
- GM foods are subject to intense pre-market testing
- GM foods are subject to stringent regulatory oversight

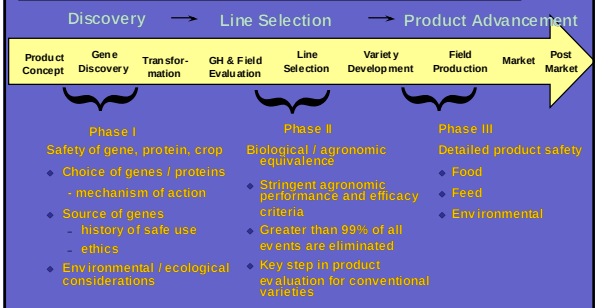
Safety of GM Foods…

- Every Product Tested on Case-by-Case basis
- Over Billion Acres Grown Since 1996
- More than 10,000 Food Products Contain GMOs
  - Not One Single Instance of Hazard
- Dozens of Scientific Societies and International organizations attest to the safety

Regulation of GM Crops and Food

- **The Department of Agriculture** (USDA), through its Animal and Plant Health Inspection Service (APHIS), oversees field testing of biotech seeds and plants to make sure their release causes no harm to agriculture and the environment
- **The Food and Drug Administration** (FDA) assesses the safety of all biotech plant products intended for consumption by humans and animals
- **The Environmental Protection Agency** (EPA) evaluates biotech plants' environmental safety
  - Such as pesticide properties, possible effect on wildlife and how plants break down in the environment
  - The agency also must approve any herbicide use with herbicide-tolerant crops

Safety Testing of GM Crops



GM Food Debate

PROs:

- Improve crop yields
- Herbicide resistance
- Insect & disease resistance
- Improve nutritional quality
- Improve food quality & food safety

GM Food Debate continued...

CONs:

- Allergenicity
- Don't know long-term health effects
- Environmental concerns
  - Diversity
  - Superweeds
  - Superbugs

Agriculture and the Environment

- Research is supported by industry promoting seed and herbicides (e.g., Monsanto, Dupont)
  - Heavy production of bT Plants resistant to Monsanto's Roundup®
- May not be used to help people in developing countries, as there is no profit
  - Creating greater have vs. have-not gap
- Ethical concerns about tampering with food and nature
  - This one is not high on my list, but if you hit the internet you'll find people just freaking out