

LECTURE 2\_10:

FEB. 6, 2014

# **AGRICULTURE**

## **CURRENT AGRICULTURAL SYSTEMS AND THEIR IMPACTS**

Text Reference: Dearden and Mitchell (2012), Ch. 10, pp. 332-347.

T. Randall, Lakehead University, WA 2014

# Outline

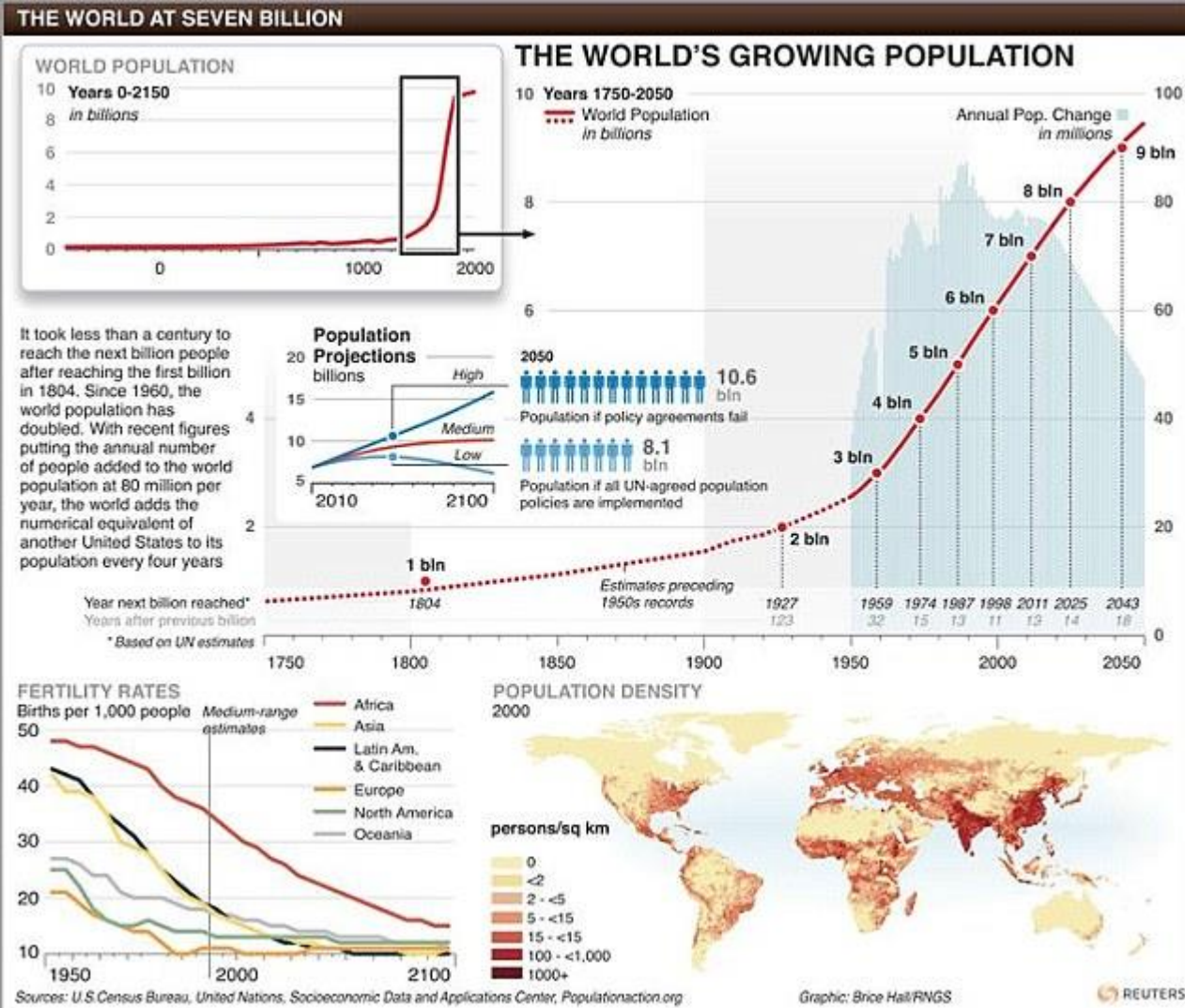


Chapter 10  
Agriculture

*From: Dearden and Mitchell (2012)*

- Preamble – challenges around feeding an increasing population
- Arable Land
- Impacts of Global Climate Change
- Intensification of Production
- Competition for viable agricultural land
  - With urbanization
  - With bio-fuel production

# Rise in global population



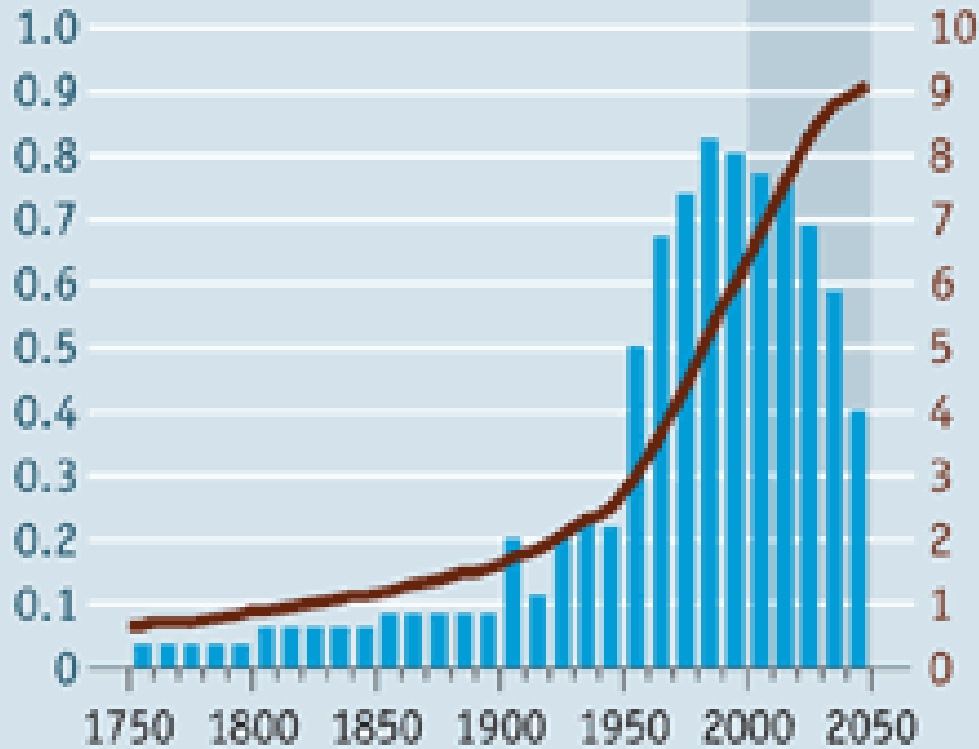
# Rising, but falling

1

World population

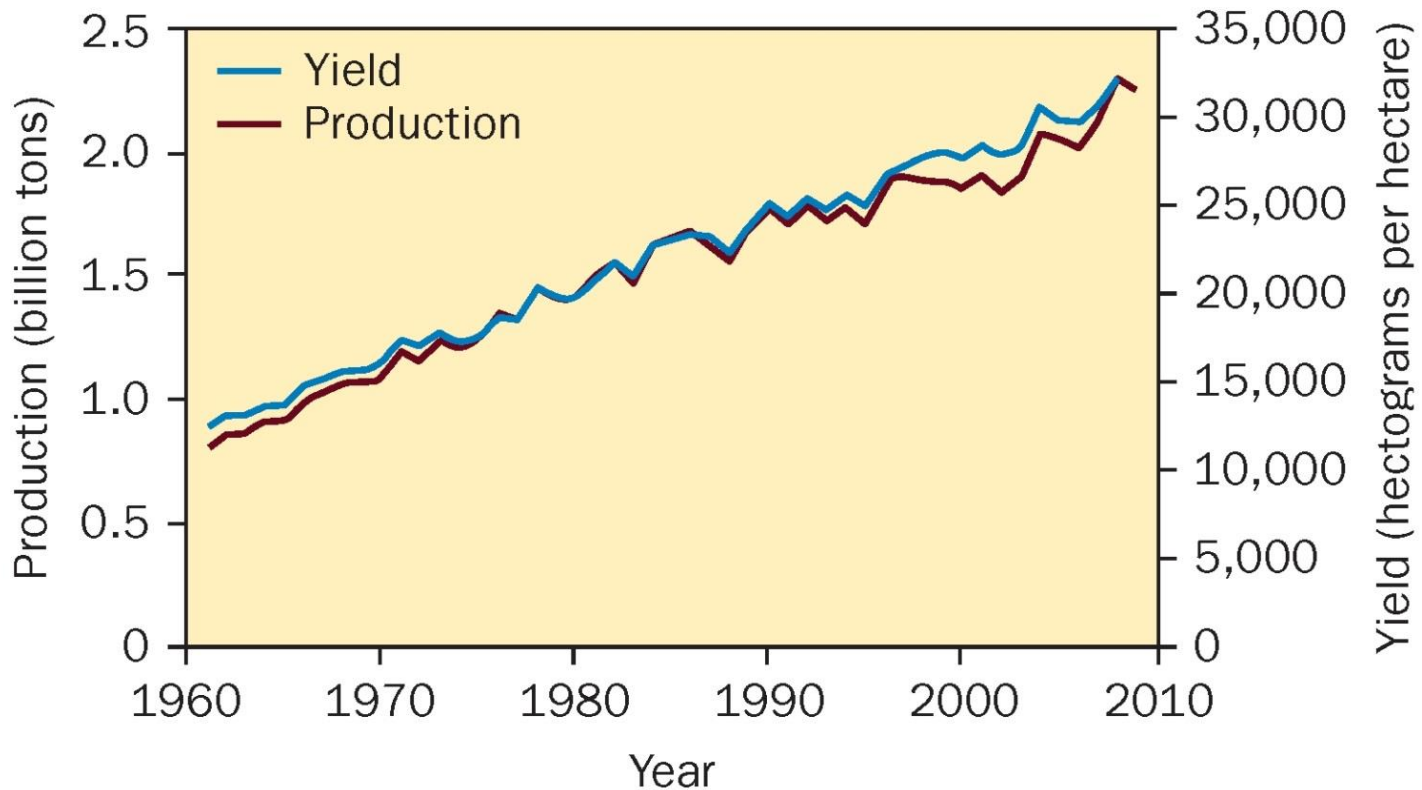
Ten-year increments, bn

Total, bn



Source: UN Population Division

<http://www.americanlivewire.com/wp-content/uploads/2012/04/world-population-growth-and-forecast.gif>



**Figure 10.1** | World grain production and yield, 1961–2009.  
 Source: *Worldwatch Institute (2011: 56)*.

# Modern Farming Systems in the Industrialized World

## The Green Revolution

- Combination of inputs or agricultural techniques that has increased food production per unit area (includes the introduction of **higher-yield seeds** and a **reliance on auxiliary energy flows – i.e., fertilizer**)
- The development and commercialization of higher-yielding seeds through **hybridization** led to significant grain yields throughout the world
- **Hybridization** is the crossbreeding of two varieties or species of plants and animals
- Without the GR, many more people in the world would be suffering chronic food shortages

# Dramatic rise in use of fertilizers in Canada

- Western Canada, a five-fold increase 1970 to 2000;
- Rates of application (kg per hectare) in Canada (see table) still lower than 2000 values for US (103.4); Australia (151.7); and Japan (301.0);

	1970	1980	1990	2000
<b>Canada</b>	18.4 kg/ha	42.4 kg/ha	45.1 kg/ha	<b>54.2</b> <b>kg/ha</b>

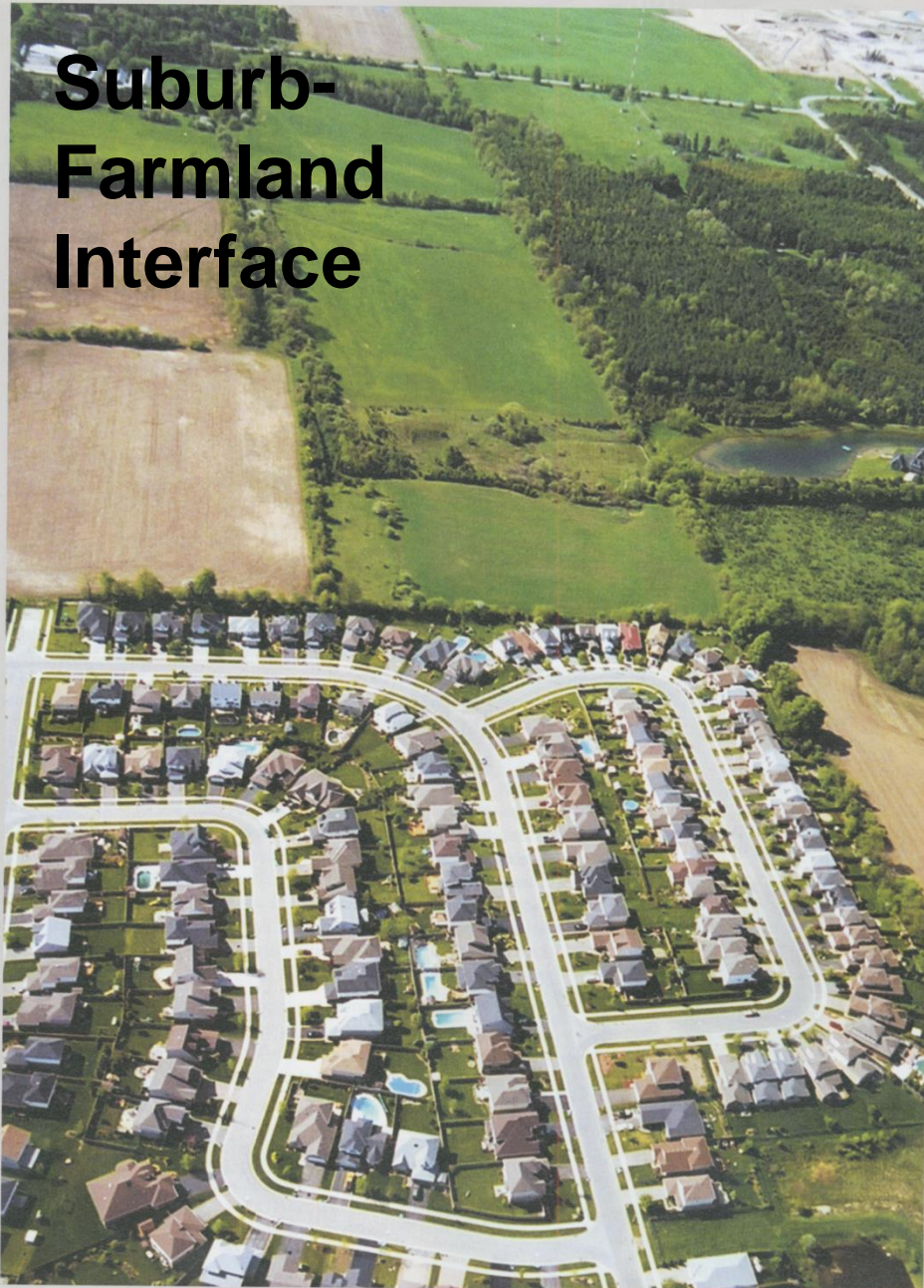
# Competition for a limited land resource



- ❑ Encroachment of cities, suburbs, on productive rural landscapes or valuable forest
- ❑ Food versus Fuel production (Biofuels)



# Suburb- Farmland Interface



University of Guelph

1954



1963



1976

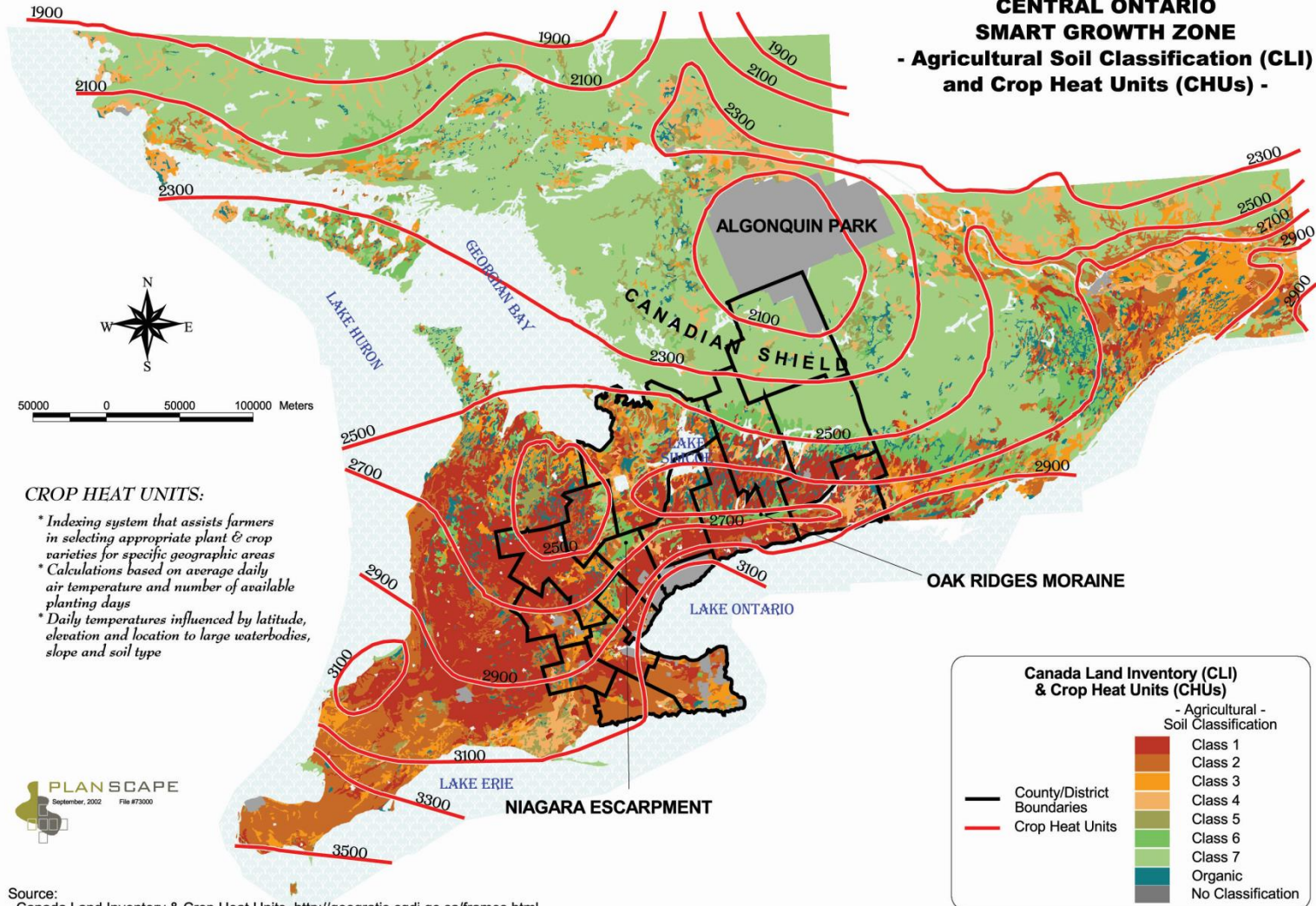


2008

South Richmond, BC

Photo credits: *Alternatives Journal* Vol. 34 Issue 3, 2008

**FIGURE 2**  
**CENTRAL ONTARIO**  
**SMART GROWTH ZONE**  
**- Agricultural Soil Classification (CLI)**  
**and Crop Heat Units (CHUs) -**



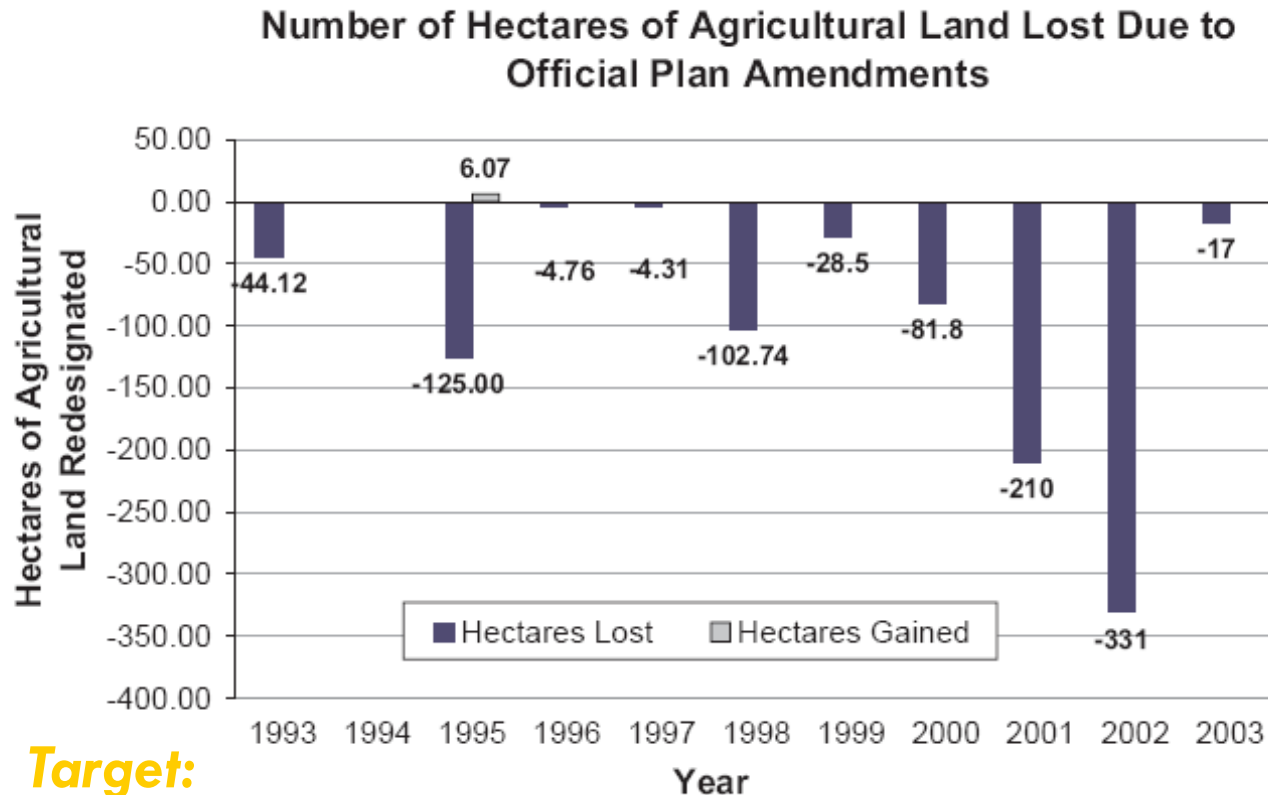
Source:  
 Canada Land Inventory & Crop Heat Units <http://geogratis.cgdi.gc.ca/frames.html>  
 National Atlas Bases Data <http://geogratis.cgdi.gc.ca/frames.html>  
 Ontario Municipal Directory, Ontario Ministry of Municipal Affairs, 2002.

NOTE: Area in white not available digitally.

Only 0.5% of it (Canada's land base) is Class 1. The **Central Ontario Zone** is fortunate to contain a significant portion of this very limited resource.

Source: [www.neptis.org](http://www.neptis.org)

# Agricultural Land Lost (Region of Hamilton Wentworth, 1993 to 2003)

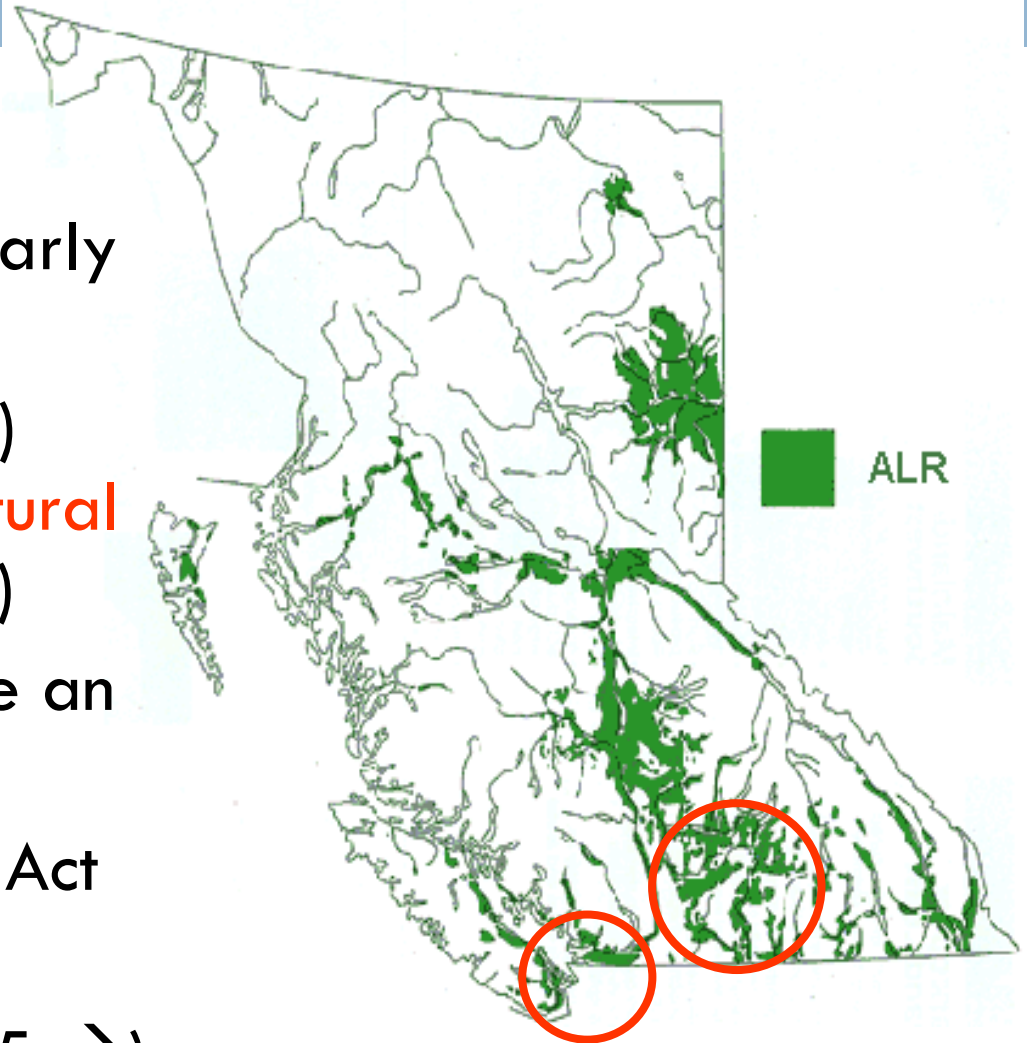


## Target:

- No loss of land. A decrease in the amount of land removed from agricultural designation is a positive step.

# BC's Agricultural Land Reserve (ALR)

- Established by Dave Barrett (BC Premier early 1970s)
- Lack of (or waning of) **protection for agricultural land** (recent BC govts)
- Not all provinces have an **ALR**;
- QC: Agric. Protection Act
  - (1978 →)
- ON: Green Belt (2005 →)



# Quebec Agricultural Protection Act

- Cropland <2% of Quebec's land base
- Much of it **concentrated around the Province's six largest urban centres**; thus face land use pressure for use other than agricultural
- Originally passed in 1978

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Québec 

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Updated to 1 January 2014  
This document has official status.

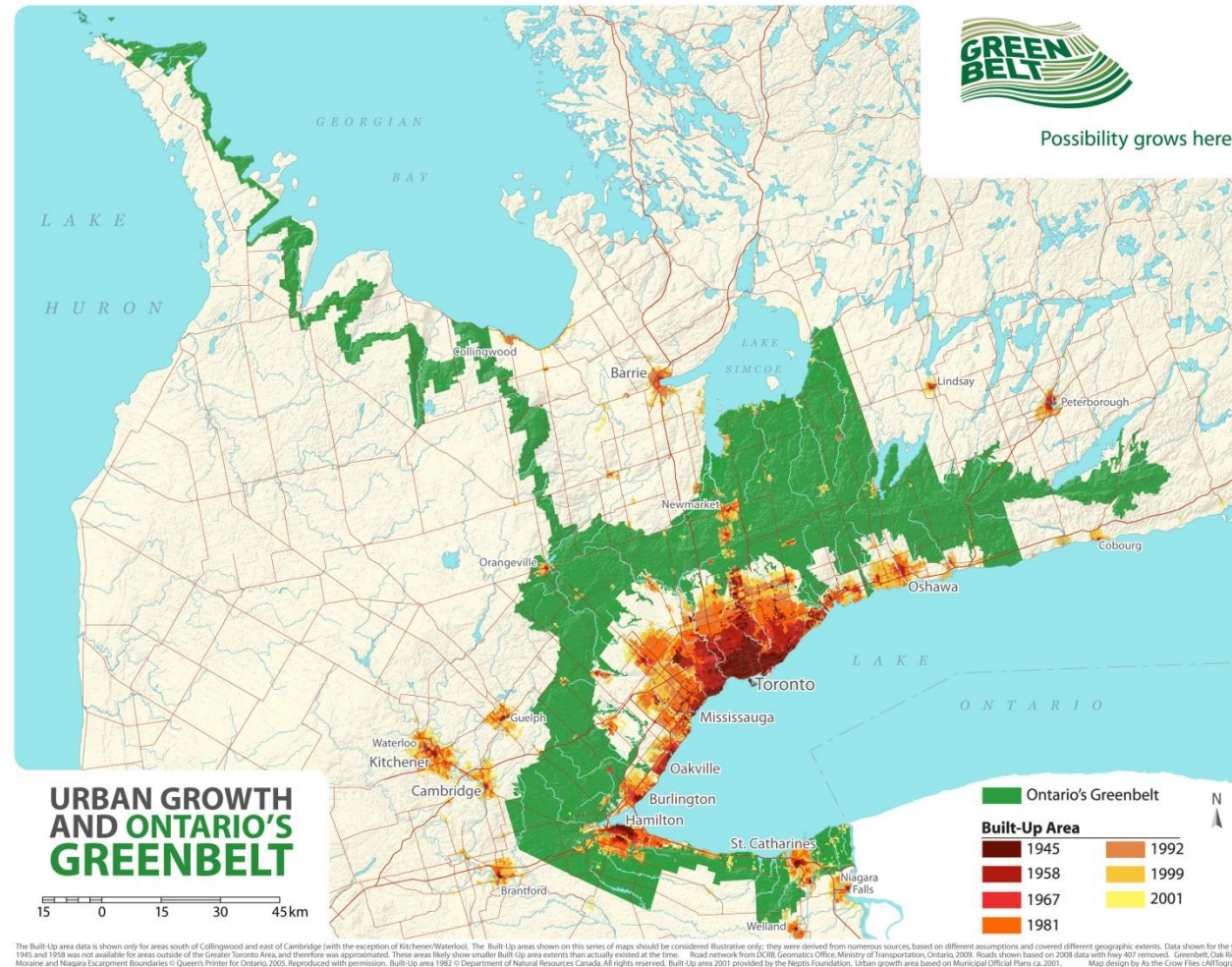
chapter P-41.1

**AN ACT RESPECTING THE PRESERVATION OF AGRICULTURAL LAND AND  
AGRICULTURAL ACTIVITIES**

[http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=2&file=/P\\_41\\_1/P41\\_1\\_A.html](http://www2.publicationsduquebec.gouv.qc.ca/dynamicSearch/telecharge.php?type=2&file=/P_41_1/P41_1_A.html)

# Ontario Green Belt (Greater Golden Horseshoe)

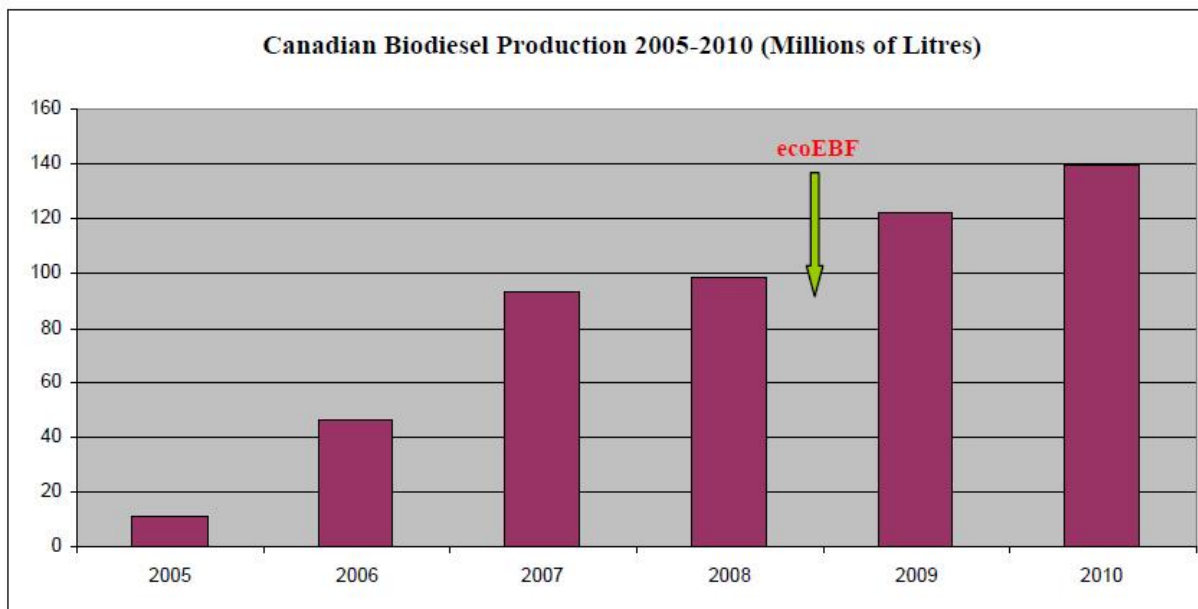
- Created 2005
- Includes: Oak Ridges Moraine; Niagara Escarpment; and other valuable agricultural lands



Possibility grows here.

# The Biofuel Revolution

- Biofuel production has become **more feasible in light of the rising cost of crude oil** and the availability of **improved processing technologies**
- **Biofuels** are derived from plants and other organic material; appear to have great potential to help curb GG emissions



NR Canada (2012)  
<http://www.nrcan.gc.ca/evaluation/reports/2012/792>

# The Biofuel Revolution

## □ *Advantages of biofuel:*

- a fraction of the pollutants of traditional petroleum-based fuels,
- reduce foreign oil dependency
- lower fuel prices
- increase income for farmers
- provide new jobs

## □ **Critiques:**

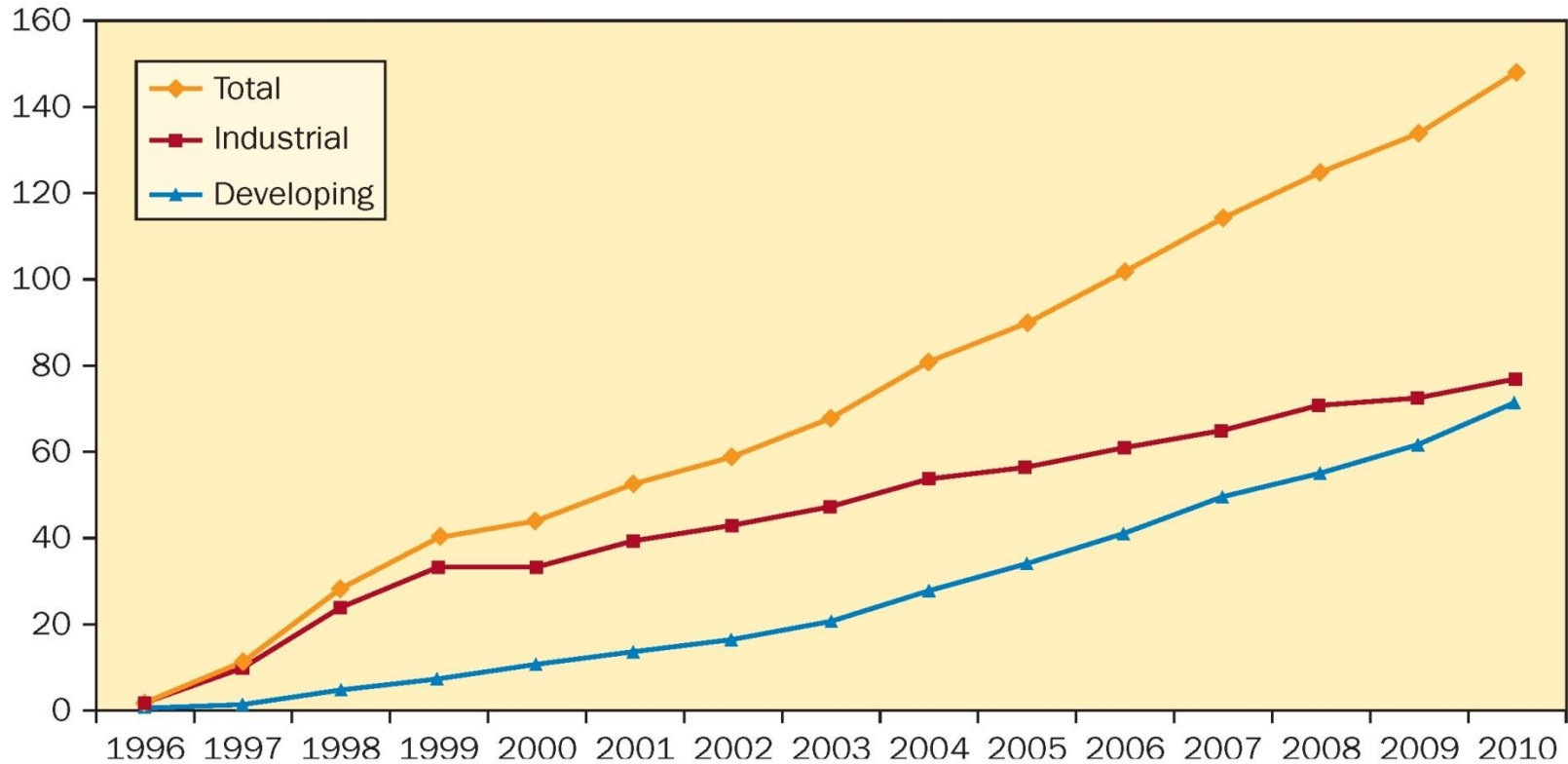
- inputs used to grow many of the crops used for biofuels
- More profitable biofuel production removes land from food production
- large-scale biofuel production can threaten biodiversity



# Agriculture's Impact on the Global Landscape

- A variety of impacts associated with the development of agriculture and modern farming systems:
  - ▣ Humans ... the major influence on species distribution
  - ▣ large areas of **monoculture cropping**
  - ▣ Monoculture cropping is the **cultivation of one plant species over a large area**, which leaves the crop highly susceptible to disease and insects, especially when all of the individual plants are genetically identical
  - ▣ Genetically-modified organisms (GMO) – dramatic growth since 1995 (post Rio'92); Canada a lead player

# Global area of transgenic crops



**Figure 10.3** | Global area of biotech crops, industrial and developing countries (million hectares).  
Source: James (2010).

## Box 10.4 (GMOs, course text) (p.341)

- Several areas of uncertainty remain with use of GMOs:
  1. **Pleiotropic effects:** unexpected side effect suffered by target organism (Q: is there an effect when U Guelph scientists engineer a pig that produces feces 20-50 times less Phosphorus?)
  2. **Environmental effects:** impacts on natural processes (e.g., pollination; reproduction; biogeochemical cycles or unintended “gene flow” to other organisms)
  3. **Unintentional spread:** from transgenic crops to lands where they are not intended to grow (Q: potential contamination of organic farmers)

# Other impacts associated with modern agriculture

- **Need for irrigation systems** (→ large-scale water diversions) resulting in changes in groundwater, soil characteristics, precipitation patterns, and water quality
- **Soils** are changed chemically and physically, while natural food chains are truncated
- **Processes of Natural succession** are altered or suppressed in agricultural landscapes ;
- A greater number of **domesticated herbivores** compared to natural herbivores
- The **industrial system of livestock production** directly affects land, air, water, and biodiversity through the emission of animal waste, use of fossil fuels, and substitution of animal genetic resources

# To summarize ... issues with our Agricultural Systems

- High energy and capital intensive
- Globally-integrated
- Increasingly economically-consolidated
- Environmental Degradation and Economic Disaster for:
  - ▣ Family Farms
  - ▣ Community Processes
  - ▣ Downstream Businesses
- “People have become disconnected from their source of sustenance” ... is this a problem?

Source: (Feenstra 2002)

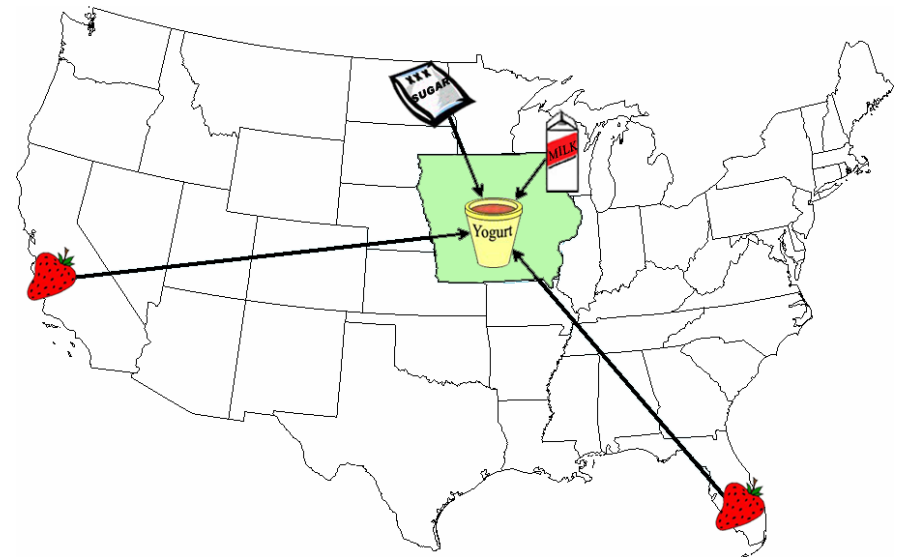
# To summarize ... issues with our Food Systems

- **Food is our fundamental input**, and ... as the saying goes ... “You are what you eat”
- **Food quality is degrading** (genetically-altered, laced with chemicals, overly processed, ...)
  - ▣ Q?? Need we be concerned about potential **long-term health implications** ...
- Food travels **immense distances to reach us** (average product in a US supermarket travels 2000 km between production and point of consumption) → **enormous energy demands** !!

## Weighted Average Source Distance (WASD)

Table 1. Comparison of local versus conventional source WASD (food miles) for produce

Produce Type	Locally grown WASD (miles)	Conventional Source Estimation WASD (miles)
Apples	61	1,726
Beans	65	1,313
Broccoli	20	1,846
Cabbage	50	719
Carrots	27	1,838
Corn, Sweet	20	1,426
Garlic	31	1,811
Lettuce	43	1,823
Onions	35	1,759
Peppers	44	1,589
Potatoes	75	1,155
Pumpkins	41	311
Spinach	36	1,815
Squash	52	1,277
Strawberries	56	1,830
Tomatoes	60	1,569
WASD - for all produce	56	1,494
Sum of all WASDs	716	25,301



From: Pirog and Benjamin (2003, 2005) – study on the Food Odometer done for Iowa

# Troubling Points about Sustainable Agriculture

- In cold climates like Thunder Bay, we are **reliant on distal sources** like Florida, California, S. Ontario ...
- Precious **local farmland continues to be lost** to residential and development (e.g., California, southern Ontario)



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# Looking Ahead to the **Mid-term Exam**

**Thursday, February 13<sup>th</sup>, 2014**

- Type of Questions (multiple choice, map literacy question)
- Content (to be discussed on Thursday, February 6<sup>th</sup>)
  - Chpt 15 (portion on `global perspectives`)
  - Chpt 7 (climate change)
  - Chpt 8 (oceans and fisheries)
  - Chpt 9 (forests)
  - Chpt 10 (agriculture, up to and including lecture 2-10 only,  
Feb 6<sup>th</sup>)

# Example Questions (Midterm)

choose the best answer ...

1. How many terrestrial ecozones does Canada have?
  - a) 15
  - b) 5
  - c) 10
  - d) 20
  
2. The warmest average temperatures in Canada are found in which ecozone?
  - a) Pacific Maritime
  - b) Atlantic Maritime
  - c) Montane Cordillera
  - d) Boreal Cordillera
  
3. What is the falldown effect?
  - a) The impact of falling trees on local wildlife
  - b) The drop in timber volume between old growth and second growth forests
  - c) The reduction in age at maturity of harvested species
  - d) None of the above

# Looking Ahead to the next lecture

Read ahead (Chpt. 10, 347-364, Agriculture)

“Trends in Canadian agriculture and related environmental challenges.”

# References

- Dearden, P and Mitchell, B. 2012. Environmental Change and Challenge, Fourth Edition, Don Mills, Ontario: Oxford University Press {Chapter 10: 'Agriculture'}