Sustainability in Agriculture

Geog 4771 – Fall 2017
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Early Agriculture

- Hunter-gathering
- Origins of agriculture

  - when, where, what, how, and why?

- Crop domestication
- Important crops of the world

Hunter-gatherers used food sources that they found (60-80% plant-based)

Wild rice, millets, oats, other grasses, root crops, nuts, wild fruits

Oils came mostly from animal sources, but also from some plants (coconut, oil palm, shea butter, olive oil)

How did our ancestors avoid toxic plants?

Origins of agriculture?

Gift from the gods?

Propinquity theory (domestication by crowding)

Invention and discovery
Garbage dumps

Fishing link (Carl Sauer)

- When? About 10,000 years ago - after the Ice Age

- Agriculture spread to or was invented on several continents within a short period

Early Agriculture: Earliest locations

Mesopotamia 8,000-9,000 B.C.

Wheat, barley, lentils, chickpeas, oats, dates, grapes, olives, almonds, figs, pomegranates

Central Africa 4,000 B.C.

Coffee, sorghum, millet, cowpeas, yams, oil palm

China 4,000 B.C.

Millet, hazelnuts, peaches, apricots, soybeans, rice, mulberries, chestnuts

Southeast Asia / Indonesia 6,000 B.C.

Rice, sugarcane, coconut, banana, mango, citrus, yams, taro

Early Agriculture: Earliest locations

Mexico/ Cen. Am.) 5,000-7,000 B.C.

Corn, sweet potato, tomato, cotton, pumpkin, peppers, squash, beans, papaya, avocado, pineapple

South America 6,000 B.C. and earlier

Potato, peanut, cacao, pineapple, cashew, Brazil nut, tobacco, guava, manioc, yam

American Indians grew crops from Mesoamerica

Native American crops: grapes, plums, pecans, chestnuts, hickory nuts, hazelnuts, black walnuts, persimmons, blueberry, raspberry, blackberry, cranberry, sunflower, hops, Jersusalem artichokes.

How did agriculture begin?

-Earliest evidence is for vegetatively propagated plants such as grape, fig, olive, mulberry, pomegranate, and quince

“Best” plants could be identified and multiplied

Other vegetative crops: sugarcane, pineapple, potatoes, sweet potatoes, bananas, dates.

Seed propagation

Keeping seed for planting the next crop could result in selection for higher yielding plants

Non-shattering types of plants would be favored

Close planting selects for vigorous plants

Larger seeds often produce more vigorous seedlings

Truly domesticated plants can not survive without humans involvement.

Some consequences of domestication

- More ‘yield’ of desirable part.
- Non-shattering - seed are easier to harvest.
- Bigger seeds - domesticated bean seed are larger as their wild relatives.
- Improved quality - remove or lower toxic substances.
- Increased protein, oil, sugar concentration, which results in improved flavour and storage.

Thirty Major Food Crops of the World

1. Wheat
2. Rice
3. Corn
4. Potato
5. Barley
6. Sweet potato
7. Cassava
8. Grapes
9. Soybeans
10. Oats
11. Sorghum
12. Sugarcane
13. Millets
14. Banana
15. Tomato
16. Sugar beet
17. Rye
18. Oranges
19. Coconut
20. Cottonseed oil
21. Apples
22. Yam
23. Peanut
24. Watermelon
25. Cabbage
26. Onion
27. Beans
28. Peas
29. Sunflower
30. Mango

Areas with wild relatives and primitive versions of modern crops can provide sources of genes for plant breeders and geneticists.

Introduction

- Sustainable Development "meets the needs of the present without compromising the ability of future generations to meet their own needs." (Brundtland Report 1987)
- Gibbon *et al*. (1995) "Sustainable development: a challenge for agriculture"

Agricultural perspective . . .

- "management and conservation of the natural resource base, and the orientation of technological and institutional change … Such sustainable development conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable" (FAO, Food and Agricultural Organization 1991, cited in Gibbon *et al*. 1995)
- speaks to all 3 pillars of sustainability

Agricultural perspective …

- "A sustainable land management system is one that does not degrade the soil or significantly contaminate the environment, while providing the necessary support to human life", (Greenland 1994 cited in Gibbon *et al*. 1995)
- "A cropping system is not sustainable unless the annual output shows a non-declining trend and is resistant, in terms of yield stability, to normal fluctuations of stress and disturbance" (Swift *et al.* 1991 cited in Gibbon *et al*. 1995)

Common Themes in the Literature

- **Conservation** of land, water, plant and animal resources},
- Agricultural Land Reserve, ALR
  - Green Belts

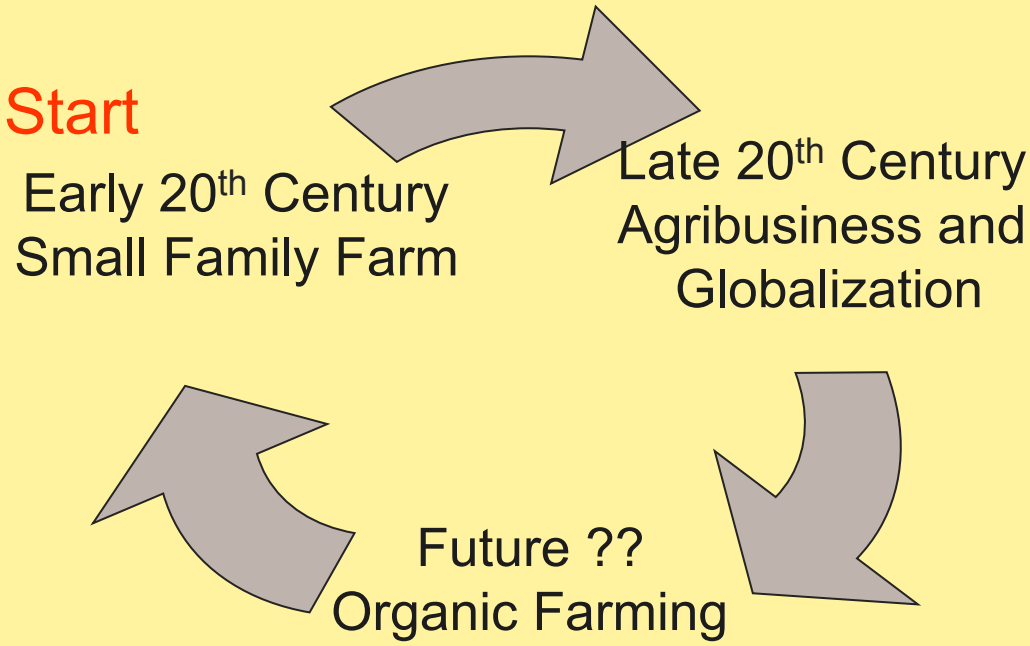
- **Biodiversity and preservation** of genetic material vs. “Frankenfoods”

Basic Components of Agricultural Sustainability

1. Sustainability as **long-term food sufficiency**
   - Systems should be ecologically-based
2. Sustainability as **stewardship**
   - Systems conscious of our relationship to nature and future generations
3. Sustainability as **community**
   - Systems that are equitable

Source: (Douglass 1984)

Evolution of Agriculture



• With increasing urbanization over the 20th Century has come decreasing nature opportunities and lessening awareness of our connections to nature

Problems with our food network

- 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)

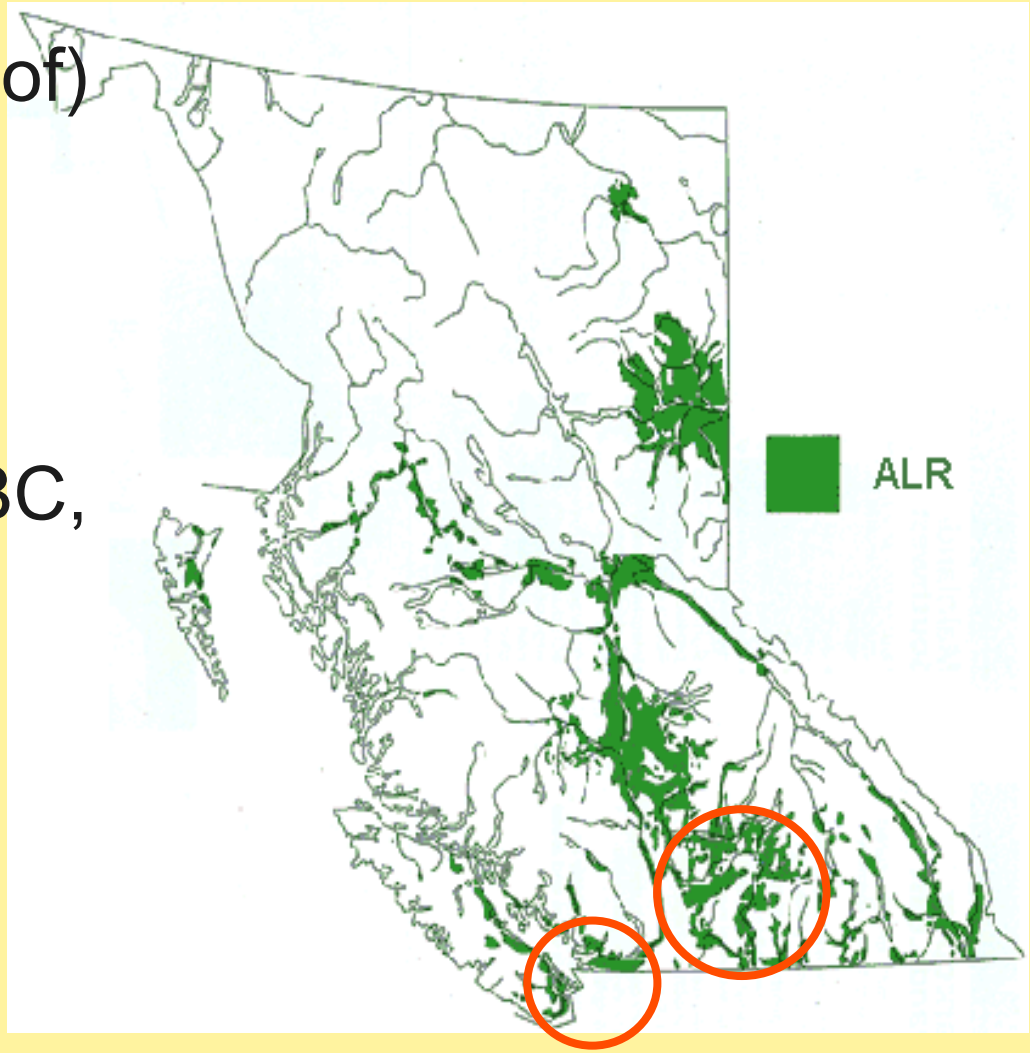
"Today's Salad Dressings: French, Ranch and Rocket Fuel"

- water from Colorado River used on farms for lettuce production contains high levels of perchlorate (30 times more than what EPA defines as safe)
- Perchlorates have well known health effects (e.g., brain damage in babies; can cause fatal anaemia in adults)
- Bush administration's reaction
  1. gag order on the EPA
  2. turned down a request of $200,000 to fund study for more background research;
- *"If they can spend $1 million on a cruise missile, it seems kind of ridiculous they won't spend $200,000 to see if our food is contaminated with rocket fuel,"* said Renee Sharp, a scientist with Environmental Working Group.

Source: *Wall Street Journal* (May 2003)

Problems (cont'd)

- Lack of (or waning of) protection for agricultural land (erosion of UGBs)
- Not all provinces have an **ALR** like BC, but even it has its problems (enter Gordon Wilson, 'Liberal' Premier since 2001)



Problems (cont'd)

- **Frankenfoods**, genetically modified foods;
- To label or not to label

Source: (Greenpeace)

Alternative Food and Fibre Systems

- What kinds of solutions?

1. Cooperative agricultural marketing programs
   - Educate consumers about eating regionally and seasonally ("Community Supported Agriculture")

2. School Districts tha om local producers using su ractices
   - Helping children lea from and the importance of h

Source: (Feenstra 2002)

Photo source: http://sweta-chakraborty.blogspot.ca/2011/12/kenya-strawberry-bowl-of-africa-simply.html (Oct 31, 2012)

Opportunities for Urban Agriculture

- Idle urban land and water surfaces could be brought to agricultural production
- Alternative uses for parks and community green spaces:
  - Community Gardens
  - Food and Timber Production (e.g., nut trees)
- Closing of ecological loops by using wastewater and urban solid waste as inputs for urban agriculture (Smit and Nasr 1999)

(Smit and Nasr 1999) Agriculture: urban agriculture for sustainable cities: using wastes and idle land and water bodies as resources In: The Earthscan Reader in Sustainable Cities

Community Gardens along Railway Corridors (Vancouver)

Maple Avenue (above) and SkyTrain (bottom)

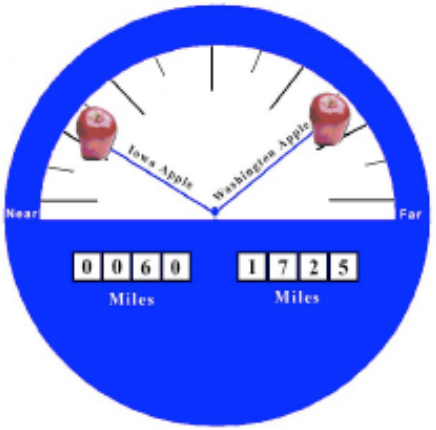
Troubling Points about Sustainable Agriculture

- 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, …)
- 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 !!

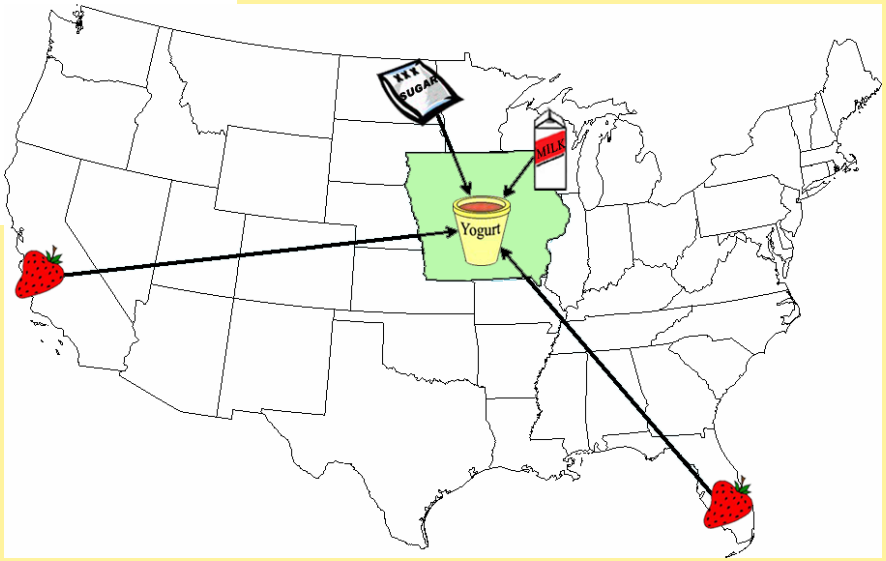
Weighted Average Source Distance (WASD)

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

Produce Type	Locally grown	Conventional Source Estimation
	WASD (miles)	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

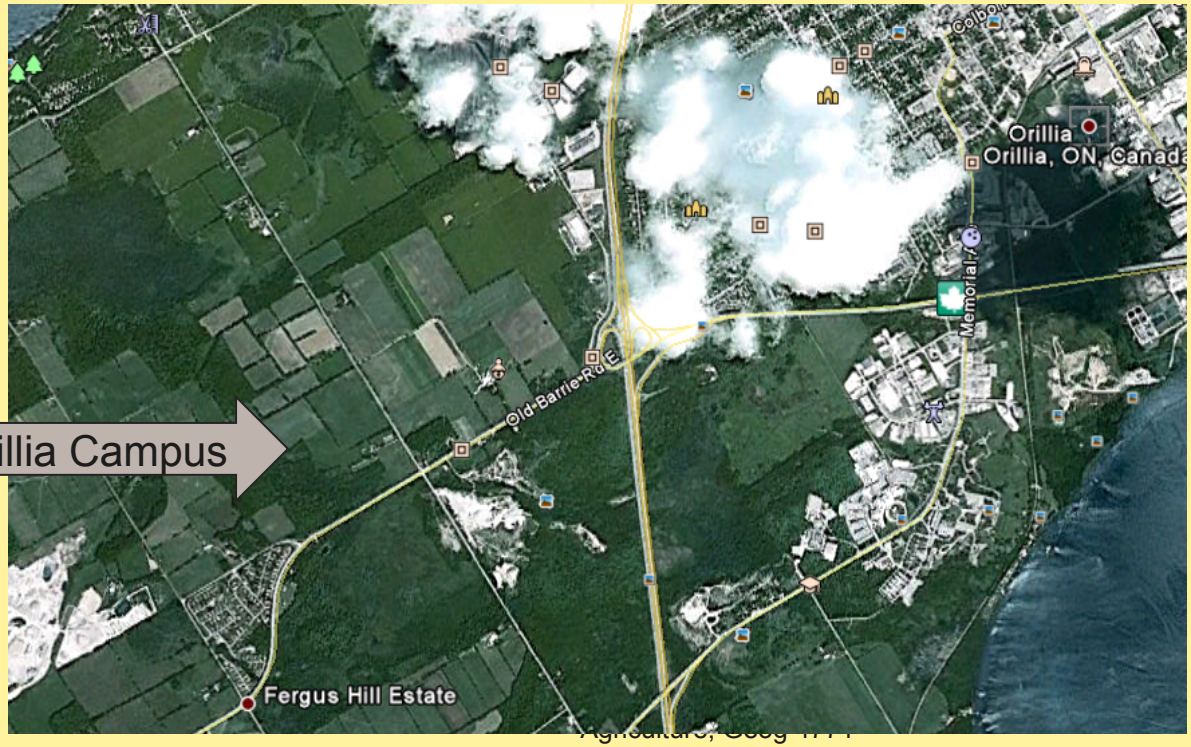


From: Pirog and Benjamin (2003, 2005) – *study on the Food Odometer done for Iowa*



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)



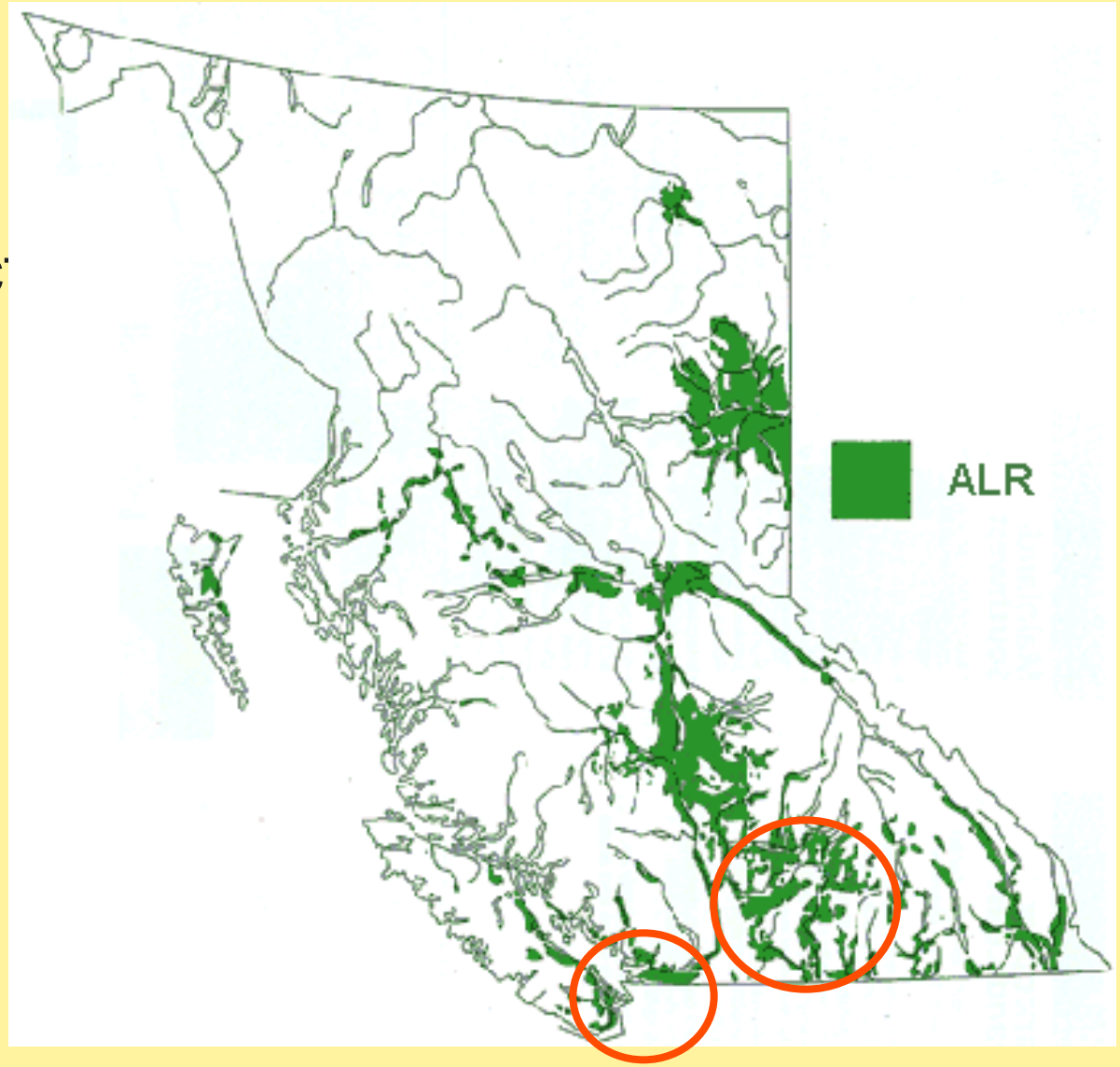
Google Earth (2010)

Discussion Questions

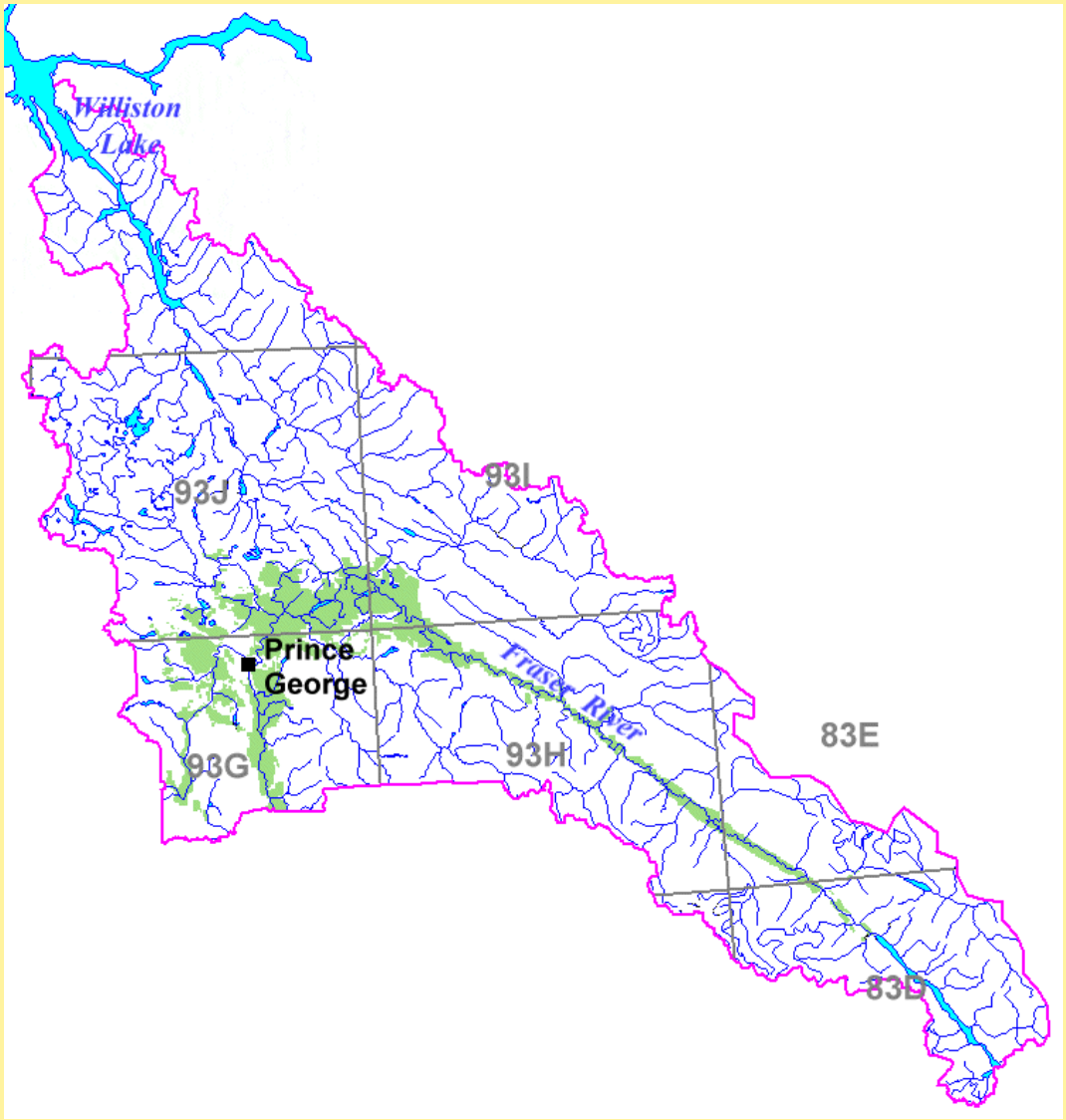
1. Should we care about having locally produced food? Why or why not?
2. How do we decrease our reliance on California, Florida, Morocco, Chile, etc?
   - Diversify crops grown in Thunder Bay?
   - Change diet to reflect what is grown here?
   - Will fuel costs be the driving force?
3. What do you see as the future of agricultural production? In Thunder Bay, in Ontario, in Canada
4. Do you think the public will demand more organic / GM-free food in the future?

BC's Agricultural Land Reserve (1974 – present)

- 4.7 million hec



ALR in Fraser Fort George Regional District



Mole Hill Community Gardens - in a Downtown Vancouver laneway