Climate Change and Food

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What lies ahead; challenges and opportunity
Outline

Impacts on global and BC food systems

Other factors impinging on food security

Bioregional food systems- an appropriate response
Climate and weather dictate what crops are grown where

Temperature- range and extremes
Growing season- duration
Precipitation- quantity and pattern
Superior soil forms over millennia
Agriculture- 11,000 years old

Developed under relatively constant and predictable climate and weather patterns

Industrial agriculture- 50 years old
Our food system is the foundation of our sustainability

No sustainable food system, no sustainable humanity
Only land based agriculture will feed the world.
The evidence is unequivocal: the global climate is changing and becoming warmer, BC no exception, and the scope, scale and pace is exceeding anything projected

British Columbia Agriculture and Climate Action Initiative, 2012
Crawford and Beveridge, 2012
Global climate change

Mean temperatures have increased 1° F since 1970

Business as usual- will increase 11° F (6° C) by 2100

Greater warming in higher latitudes (Canada)

10-15% (staple) yield reduction for every 1° C increase
Agriculture contributes 10-25% of GHG emissions—up to 50% for the whole agri-food system

B.C. provincial government mandate—all municipalities must reduce GHG emissions by 80% by 2050

Moreau, Moore and Mullinix, 2011
Global climate change a food system wild card

Precipitation patterns/ snow pack
Irrigation water availability
Insect and disease incidence
Unpredictable and severe weather
Crop plant adaptation
Sea encroachment
Ice and snow

Glaciers receding, snow pack reduction (40-70% in western US and Canada)

Disrupt hydrologic patterns and irrigation water availability

Greenland ice sheet melting > rising sea levels (23ft) will inundate major agriculture regions

Delta and Surrey?
Drought

Rising temperatures and reduced precipitation

Mid-latitude Canada to be severely affected

California today- 72% of state in drought, 22% extreme
With CO$_2$ levels at 450 ppm

“world will face irreversible dry-season rainfall reductions much like the Dust Bowl era”

National Academy of Sciences 2009 (from Brown, L. 2012)
Heat waves expected to be frequent and intense

U.S. 1988- grain harvest reduced by 1/3 (120 million tons)

Western Europe 2003- post-harvest but killed estimated 52,000 people

Russia 2010- Reduced grain harvest 40%, exports banned

Texas 2011- 100° F for 40 days, 1 million acres not harvested
Fresh water increasingly a limiting factor

60% of U.S. fresh water used for agriculture

Many areas of B.C. routinely face water shortages

Water the limiting factor in expansion of BC agriculture
For example: 400,000 acres in Colorado dried up, more in California.
Peak water

Excessive surface and aquifer water use

Gap between water use and availability

Agriculture vs. urban and industry

Water shortage = food shortage

International trade in food= trade in water

Fruits and vegetables 90% water, grains 12%
Insect and disease pest incidence will increase.
What can British Columbians expect - the studies

the “common assumption that a warming climate will be a boon for agriculture production in northern climates is now recognized as false”

Crawford and Beveridge, 2013
British Columbia highly vulnerable

High level of crop/ stock diversity

Prevalence of small, family owned farms

Low agriculture revenues

Aging farmers

Unusually limited land base (less than 5 %)

Intense development pressure on prime lands

Research gaps- pests, cultivars, farming methods

Highly dependent on imported food- California

Crawford and Beveridge, 2013
Ostrey et al. 2011
Provincial Report, 2012
British Columbia experience

Increased precipitation - 22%, most in spring and winter

Increased extreme summer dry and wet

Increase in extreme hot events

Decrease in extreme cold events
What BC can expect - 2020

Continued warming, more frost free days- more in north than south

Precipitation increase- 7% fall, winter, spring; reduced in summer

More runoff and winter flash flooding

Significant snowfall/ snowpack reduction most regions

Early peak water flow and far less predictable

Low summer flow with lengthened dry periods- impacts irrigation

Increased extremes- hot and cold events

Sea level rise 80-120 cm (3-4 ft.) by 2100
BC response?

Three regions, Delta, Peace and Cowichan have developed agriculture adaptation strategies.
Recommendations- governance

Integrate mitigation and adaptation strategies into land use planning

Protect farmland, invest in infrastructure

Revamp government management and policy structures
Recommendations - food system

Support agriculture and food system research and extension

Enhance training and support for new and existing agriculturists

GHG emissions reduction - manure, processing, transport

Phase out fossil fuel dependence

Be more regionally self-reliant, break from industrialized chain
Two important distinctions

agriculture is not the ‘food system’
adaptation is not mitigation
Far cheaper to avert climate change than to adapt to it

Monbiot, G.
The Guardian
Mar. 31, 2014
Intergovernmental Panel on Climate Change - April 1, 2014

“breakdown of food systems” and ocean acidification “a fundamental challenge to marine organisms and ecosystems”

From, The Economist
April 4, 2014
Business as usual not a prudent, viable option

Let’s examine critical characteristics of our agri-food system
The Production Paradigm

AKA: modern, conventional, industrial, commoditized, trans-national, green revolution
Modern, industrial agriculture is not ecologically stable

Overly simplistic ecosystems (monocultures)

Low ecological buffering capacity/ resiliency

Requires substantial intervention (i.e. propping up)
Industrial agriculture lacks genetic diversity hence adaptability

Loss of regional/local genotypes

We feed the world with:

- 12 grain species
- 25 vegetable species
- 35 fruit species
Agro-ecosystem resilience

Nicaragua after Hurricane Mitch
440 paired farm sites
conventional vs. ‘organic’

On ‘organic’ farms:

• Average 40% more topsoil.
• Average 20% more vegetative cover.
• Average 49% lower landslide incidence, 47% less rill erosion, 69% less gully erosion.

Holt-Gimenez
2002
Input/ energy intensive pesticides, fertilizers, fuels, irrigation, processing, distribution
Agriculture’s negative energy return on energy invested (EROEI)

1:5 on average
1:10 or greater for many
1:50 for your hamburger

Formerly agriculture represented a positive EROEI (2.5:1 in 1940)
Money, machines and fossil fuels replaced natural processes, strong backs and big hearts, and denied our young the noble, rewarding profession of farming.
Critical loss of place-based knowledge

(just when we are going to need it)
Food costs outpacing inflation

Canadian inflation 2008

Overall- 1.2 %
Food overall- 7.3 %
Cereal products- 12.4 %
Fruits/ vegetables- 26.9 %
Global food security outcome

Feeding more people that ever before

Enough grains, fruits, vegetables and meat for > 3,200 calories daily/ person

1.2 billion people food insecure

1 million children starve to death annually

8 % of B.C. households food insecure

1.5 billion are overfed

Food First, 2006; Lang and Heasman, 2009; Patel, R. 2007
Canadian and B.C. food security

9.2% Canadian households food insecure

50% in lowest income group

B.C. reports slightly higher rates

3 sub-populations predominate

- Families headed by single women
- Marginally housed and homeless
- Aboriginal peoples (particularly on reservations)

Ostrey, A. 2010
Food for Thought
Provincial Health Services Authority
Corporate hegemony

4 corporations- 80% of beef packing
3 corporations- 75% of pork packing
4 corporations- 62% flour milling
4 corporations- 62% Canada food retail
5 corporations- 80% of world crop seed
2 corporations- 100% world turkey breeding and egg laying stock

National Farmers Union, 1999
Office of Consumer Affairs, Canada 2013
Vancouver Sun, 2008
Heffernan W., 2003
Market forces fail to address or rectify food system challenges

Food system requires a much longer planning horizon and goals other than short term economic gain
The other big game changer
Hubbert’s Peak: Global Oil Depletion

Hubbert Curve Projection of Global Oil and Natural Gas Liquids Production

Guinness Atkinson Peak Year Estimate

Source: The Association for the Study of Peak Oil and Gas, C.J. Campbell, June 2004
Tar sands EROEI about 3:1
No replacement for oil on the horizon

Recall agri-foods negative EROEI
‘End of transnational-global agri-food system’

‘Resurgence of local agriculture, bottling, canning, processing eminent’

M. Simmons
Global Oil Depletion and Implications for the Pacific Northwest, 2006
How can we feed the world without industrial-global agri-food?
## Competing paradigms battling it out

<table>
<thead>
<tr>
<th>Life Science</th>
<th>Ecological</th>
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<tr>
<td>Dependence</td>
<td>Independence</td>
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<td>Centralization</td>
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<td>Competition</td>
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<td>Domination of nature</td>
<td>Harmony with nature</td>
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<tr>
<td>Specialization</td>
<td>Diversity</td>
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<td>Exploitative, external costs ignored, short-term benefits</td>
<td>Restraint, full accounting, long-term benefits</td>
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<td>High input</td>
<td>Renewable resources, conserve for future</td>
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Lang and Heasman
2009
“Our challenge as planners, developers and policy-makers of the built environment in an era of climate change is to figure out how to strengthen agriculture systems and biodiversity of our farmlands, and connect them to livable cities and their consumers.”

K. Benefield
2009
“... find ways to address these issues... scale back our use of non-renewable resources, through connectivity and a new regenerative agriculture.”

Pearson and Nasby
Guelph University,
2008
Targeted empowerment and support for small scale farming and food infrastructure/ business

J. Hodges (FAO retired)
BCIA Innovations in Agrology Seminar
Vancouver, 2013
J. Pretty et al., 2011
The question we need to ask and answer

What kind and configuration of agriculture and food system is appropriate for my life place?
The opportunity
capture a significant portion of the food market, for the regional economy, create jobs and SMS business opportunity, enhance our communities, and steward the environment

$6.3 billion market in southwest B.C.
Making and keeping food dollars at home

“When non-local corporations... [dominate our food system]... most of the dollars leave the community by the close of the business day”

conversely

“Most dollars generated in local communities change hands three or four times before they leave...”

W. Heffernan
Rural Sociology, U. of Missouri
In Mullinix, 2003
“Local food systems increase business innovation and entrepreneurship, foster regional economic development, and support employment.”

J. O’Hara
Market Forces Report
2011
A “puzzling omission”

“Food is a sustaining and enduring necessity. Yet among the basic essentials for life—air, water, shelter, and food—only food has been absent over the years as a focus of serious professional planning interest. This is a puzzling omission…”

American Planning Association
Policy Guide on Community and Regional Food Planning
2007
Municipally Supported Agriculture

MSA Municipalities take a leadership role in facilitating a local, community focused agri-food system.

Credit: Michael Marrapese via Farm Folk/City Folk
25 acre urban agriculture research, production and demonstration farm - Langley, BC
Farm Schools- Richmond and Tsawwassen First Nation

Agriculturists teaching and aspiring neo-agrarians learning

Combination of classroom and experiential teaching

No entrance/eligibility requirements

No assignments, papers, exams, grades

No credential awarded

Access to incubator farm land and tech support for three years
Economic and food production potential of Surrey’s underutilized ALR land

25% of Surrey land base in ALR

30% fewer farms over past 20 years

ALR highly parceled

High incidence of “rural residential”

Less diversification
Potential

1/3 of Surrey ALR (7,500 acres) is underutilized

3,300 acres available for farming

Satisfy 100% of Surrey consumption of 27 crop and animal products for six months/year

Satisfy 100% of 24 crop and animal products year round with proper processing/ storage

Create over 1,600 FTE jobs

Generate $173 million return to management

38 strategic and policy recommendations
Project goal

Engage stakeholders in the design of a realistic, practical, bioregional food system design and plan

3 year, $1.5 million project
www.kpu.ca/isfs
Bioregions, our life places

Areas that shares similar topography, plant and animal life, and human culture
Design and planning horizon
2030 to 2050
Regional agri-food systems

- Pre-production
- Agriculture (crop/ stock production)
- Indigenous (traditional) foods
- Processing/ storage
- Distribution
- Sales
- Waste
Predicated upon

Smaller scale farming and businesses
Low input, human intensive
Environmentally sound
Alternate market channels
Community centered
Local economy focused
System/ design objectives

Significantly enhance the regional economy

Create good jobs

Maximize regional food self-reliance

Support Indigenous Peoples traditional foods

Identify production and business opportunities

Address critical environmental issues (GHGs, biodiversity, nitrate contamination, habitat destruction)

Eco footprint reduction

Build community/ social capital
Food System Design

*Design of each FS component is informed by domain research and key indicators

Food System Components
- provisioning
- production
- processing
- distribution
- consumption
- waste management

Geographic (Bioregion) Context
- Environment: geography, natural resources, climate, soils, water, energy, biodiversity
- Economy: population, employment, supply/demand, import/export, transportation, infrastructure
- Socio-Cultural: community, culture, First Nations, public health, governance, policy & planning
- Food: production, provisioning, processing, distribution, consumption, waste management

Design Elements
- Ecology
- Economics
- Community Dynamics
- Health & Nutrition
- Resource Systems
- First Nations Planning

Evaluation of Potential
*Specific evaluation will be informed by community engagement, design elements & sustainability platform

Food Security | Food Sovereignty
---|---
Resilience | Social Capital
Policy Environment

Platform of Sustainability: Environmental Integrity, Economic Integrity, and Socio-Cultural Integrity

Implementation and Ongoing Evaluation
- Governance Structures
- Policy Objectives
- Planning Principles
- Monitoring and Evaluation Plan
Potentials fully delineated
Planning

Planning principles
Policies
Tools
Strategies
Governance
Time frame
Evaluation methods
Stakeholder engagement critical in design and planning

Communities
Non-government organizations
Municipal and Provincial Government
Indigenous Nations Government/ leaders
Agri-food sector
Business
A roadmap

Clear, realistic

Practical, doable

Values based, data driven

For and about our communities
Sustainable food systems is a people and community proposition.
50 million farmers needed in Canada and U.S. for post peak oil agriculture

R. Heinberg
Post Carbon Institute
2006

20% of our population
A post-industrial food system will require more than a new generation of farmers
It will require sustainable food system leaders and builders

Farmers
Business persons
NGO staff/ activists
Planners/ municipal govt. staff
Civil servants
Researchers/ professors
Consultants/ extension agents
Politicians/ policy makers
Spiritual/ faith community
Unique in North America

KPU Bachelor of Applied Science-
Sustainable Agriculture and Food Systems
Integrated, multidisciplinary

- Sustainability studies
- Food systems
- Crop/stock production (the science and art)
- Sciences
- Political Science/governance
- Communications
- Economics and business
- Ethics
A 21\textsuperscript{st} century, post-industrial food system vision

A network of bioregional agri-food systems around the globe