

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 fed 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)

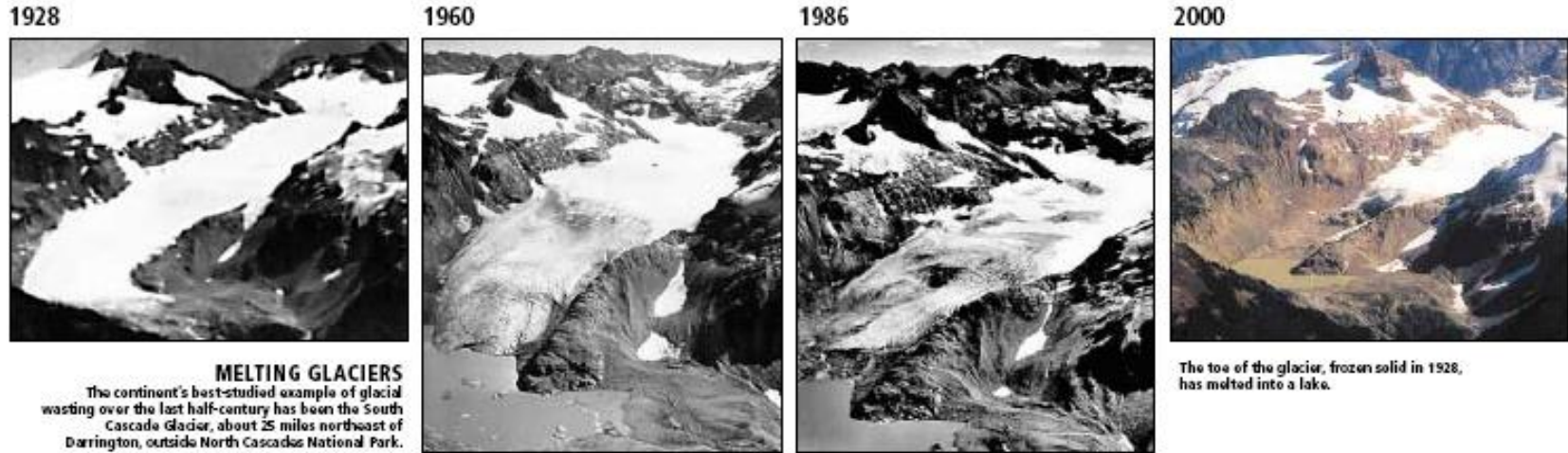
10-15% (staple) yield reduction for every 1° C increase

Agriculture contributes 10- 25 % of
GHG emissions- up to 50% for the
whole agri-food system

Moreau, Moore and Mullinix, 2011

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

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 CO₂ 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

1. Climate Action Initiative. 2010. *BC agriculture climate change action plan 2010-2013*.
2. Crawford, E. and R. Beveridge. 2013. *Strengthening BC's agriculture sector in the face of climate change*. Pacific Institute for Climate Solutions.
3. Crawford , E and E. McNair. 2012. *Climate change adaptation, risk + opportunity assessment. Provincial report*. BC Agriculture and Food Climate Action Initiative.
4. Ostrey, Miewald and Beveridge 2011. *Climate change and food security in British Columbia*. Pacific Institute for Climate Solutions.
5. Lee, Barbolet, Adams and Thompson. 2010. *Every bite counts. Climate justice and BC's food system*. Canadian Centre for Policy Alternatives.
6. Moreau, Moore and Mullinix. 2012. *Planning for climate action in British Columbia, Canada: Putting agriculture greenhouse gas mitigation on local government agendas*. Journal of Agriculture, Food Systems and Community Development.
7. Moreau, Moore and Mullinix. 2012. *Mitigating agricultural greenhouse gas emissions: A review of scientific information for food system planning*. Journal of Agriculture, Food Systems and Community Development.

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

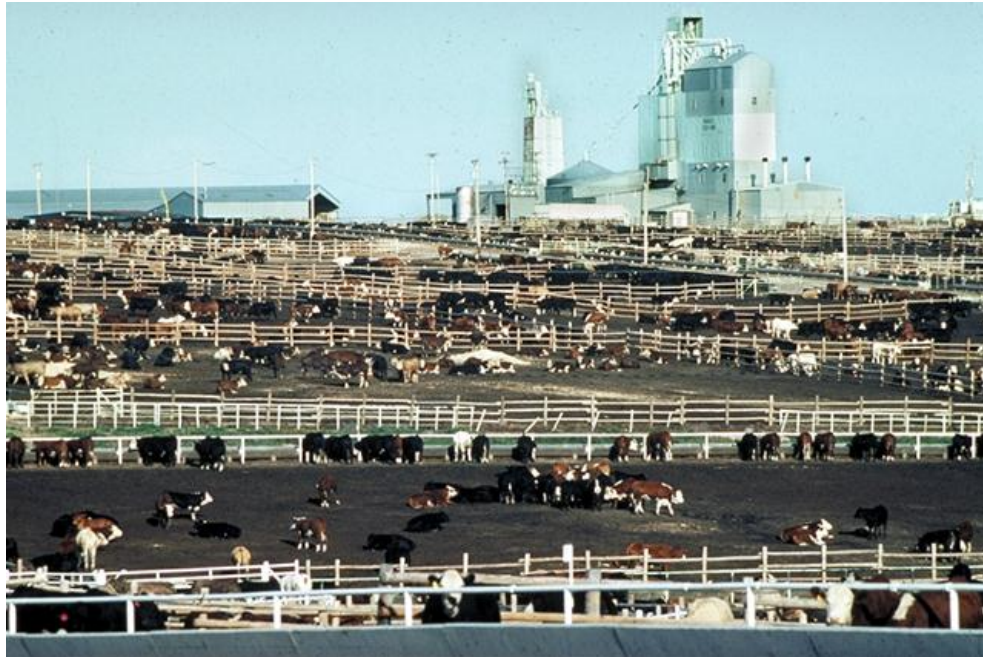
“breakdown of food systems” and ocean acidification “a fundamental challenge to marine organisms and ecosystems”

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.

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



www.conservancy.bc.ca/imagecatalog/UBC-Farm.jpg

| | |
|---------------------|--------|
| Overall- | 1.2 % |
| Food overall- | 7.3 % |
| Cereal products- | 12.4 % |
| Fruits/ vegetables- | 26.9 % |

Canadian Broadcasting Corporation News, 2009

Global food security outcome

Feeding more people than 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

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)

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

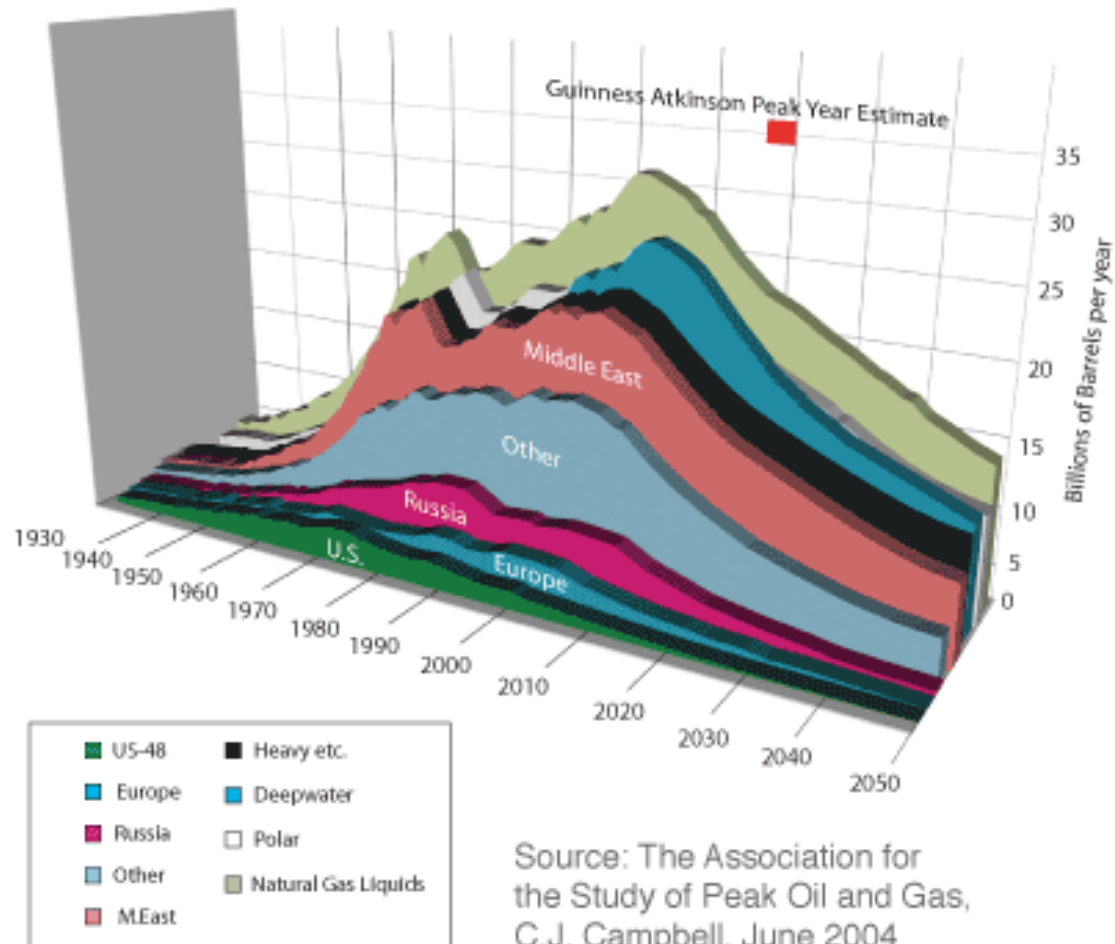
Market forces fail to address or rectify food system challenges

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



Tar sands EROEI about 3:1



Alberta Tar Sands

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

Life Science

- Dependence
- Centralization
- Competition
- Domination of nature
- Specialization
- Exploitative, external costs ignored, short-term benefits
- High input

Ecological

- Independence
- Decentralization
- Community
- Harmony with nature
- Diversity
- Restraint, full accounting, long-term benefits
- Renewable resources, conserve for future



“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...”

“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

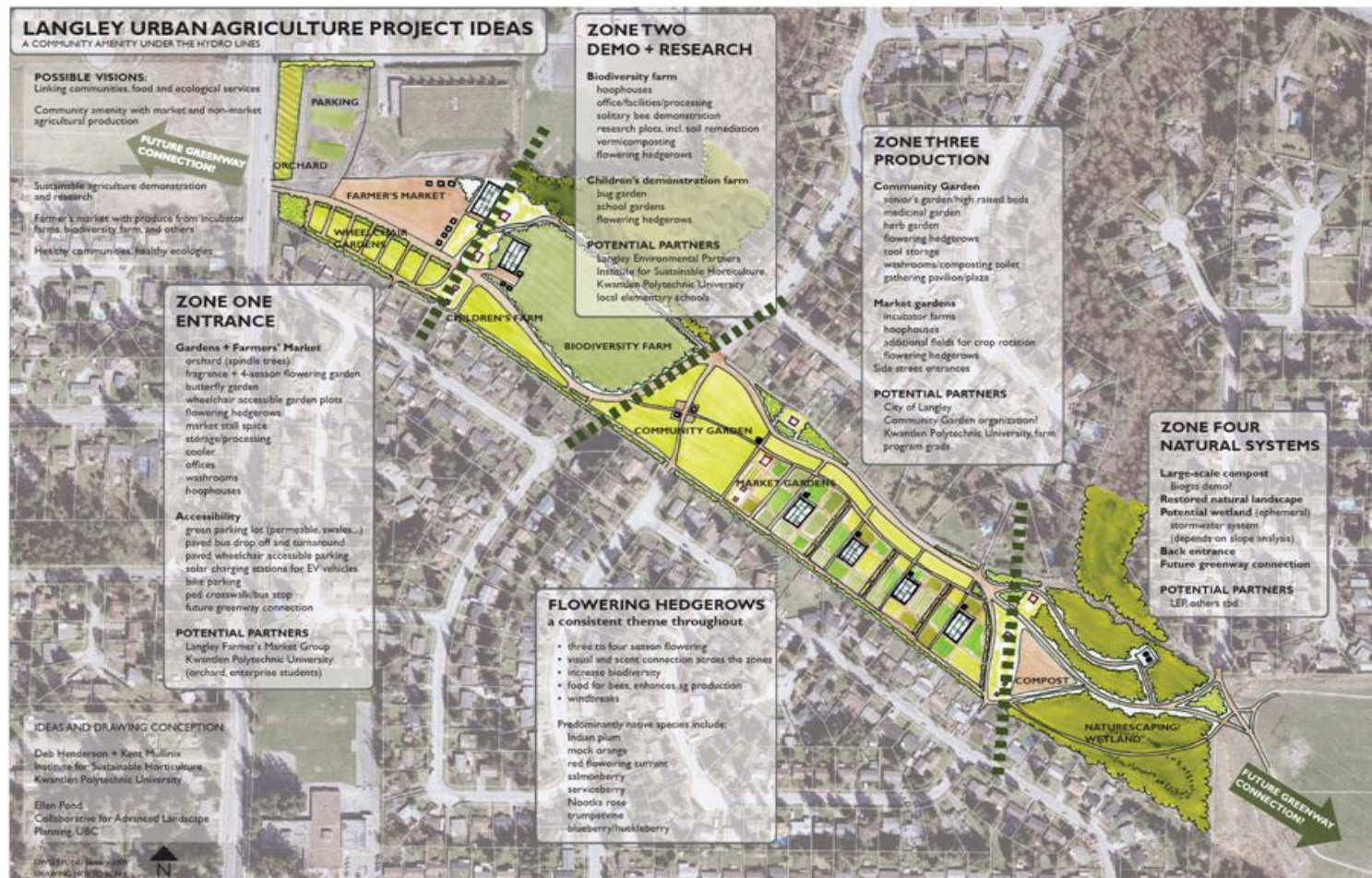


Credit: Michael Marrapese via Farm Folk/City Folk

MSA

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

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

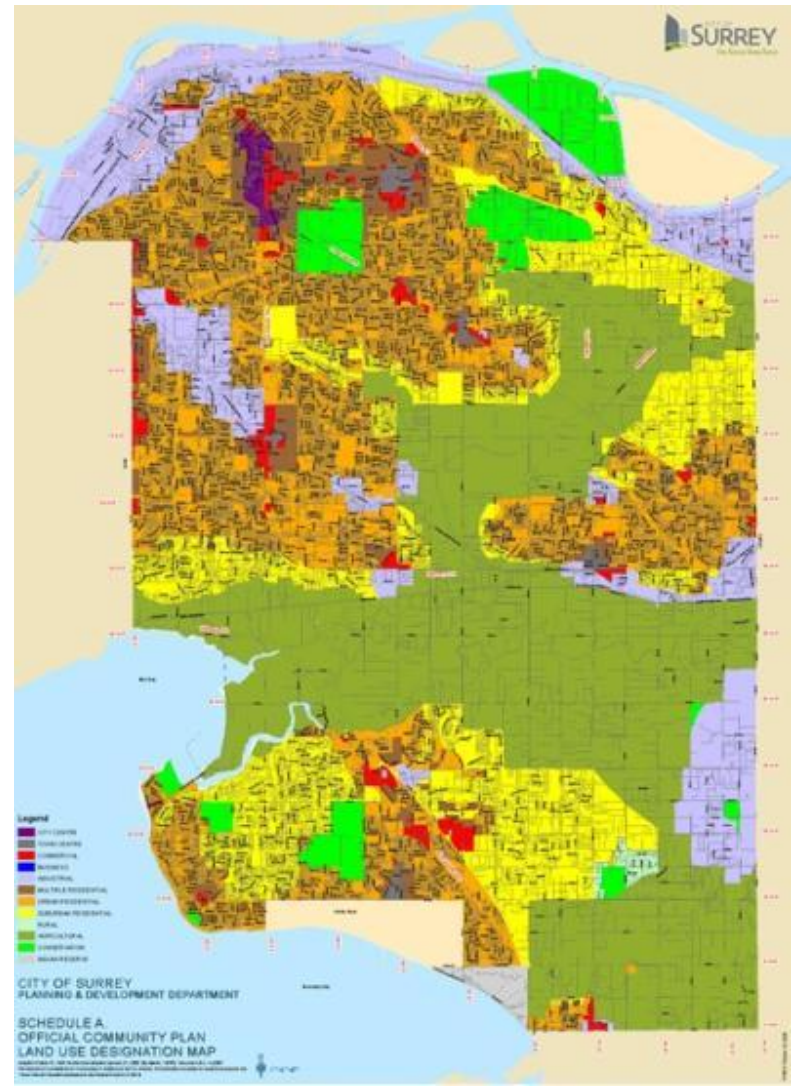
25% of Surrey land base in ALR

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

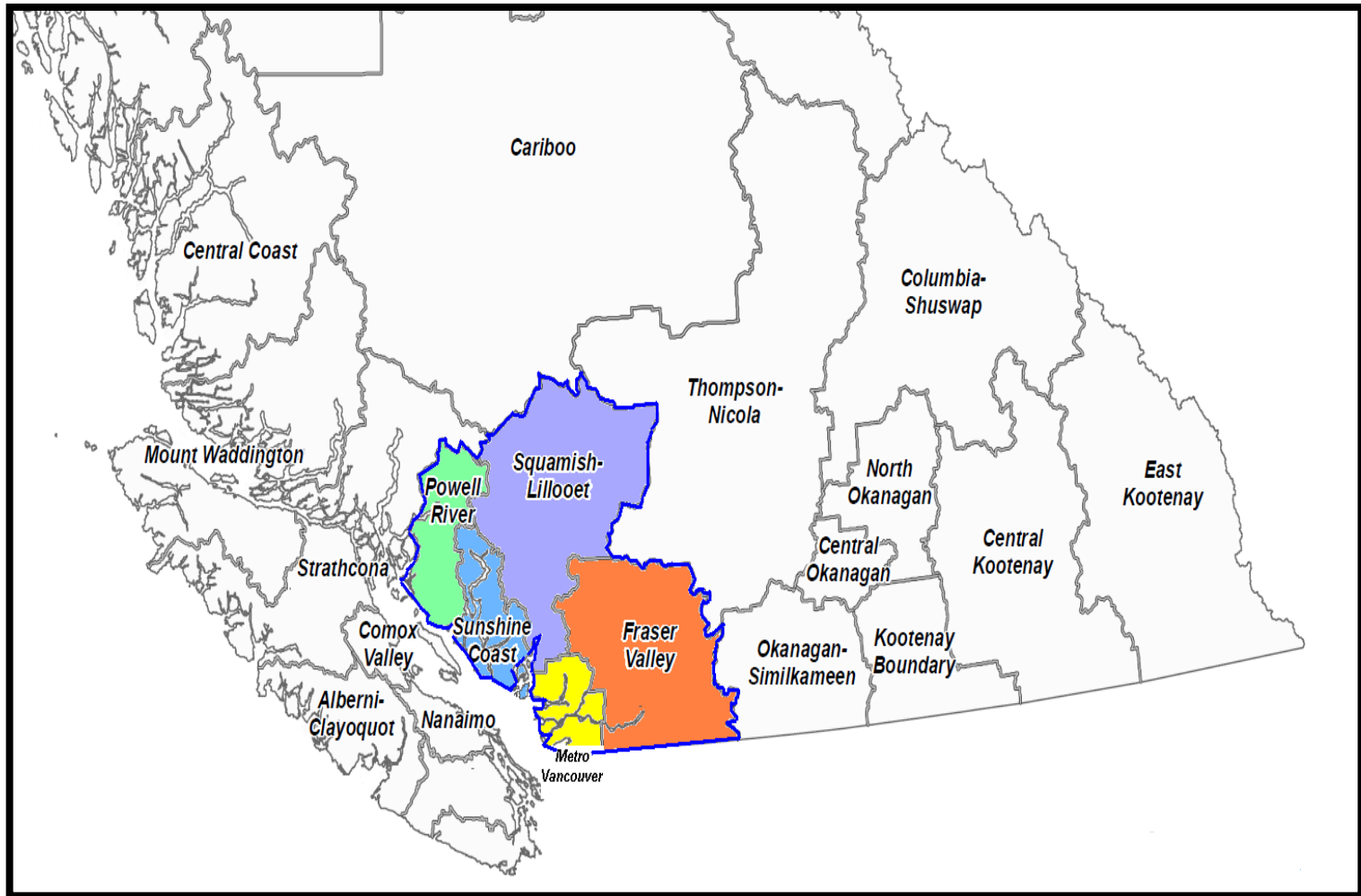
Satisfy 100% of 24 crop and animal products year round with proper processing/ storage

Create over 1,600 FTE jobs

Generate \$173 million return to management

38 strategic and policy recommendations

South-west British Columbia Bio-regional Food System Design and Plan



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

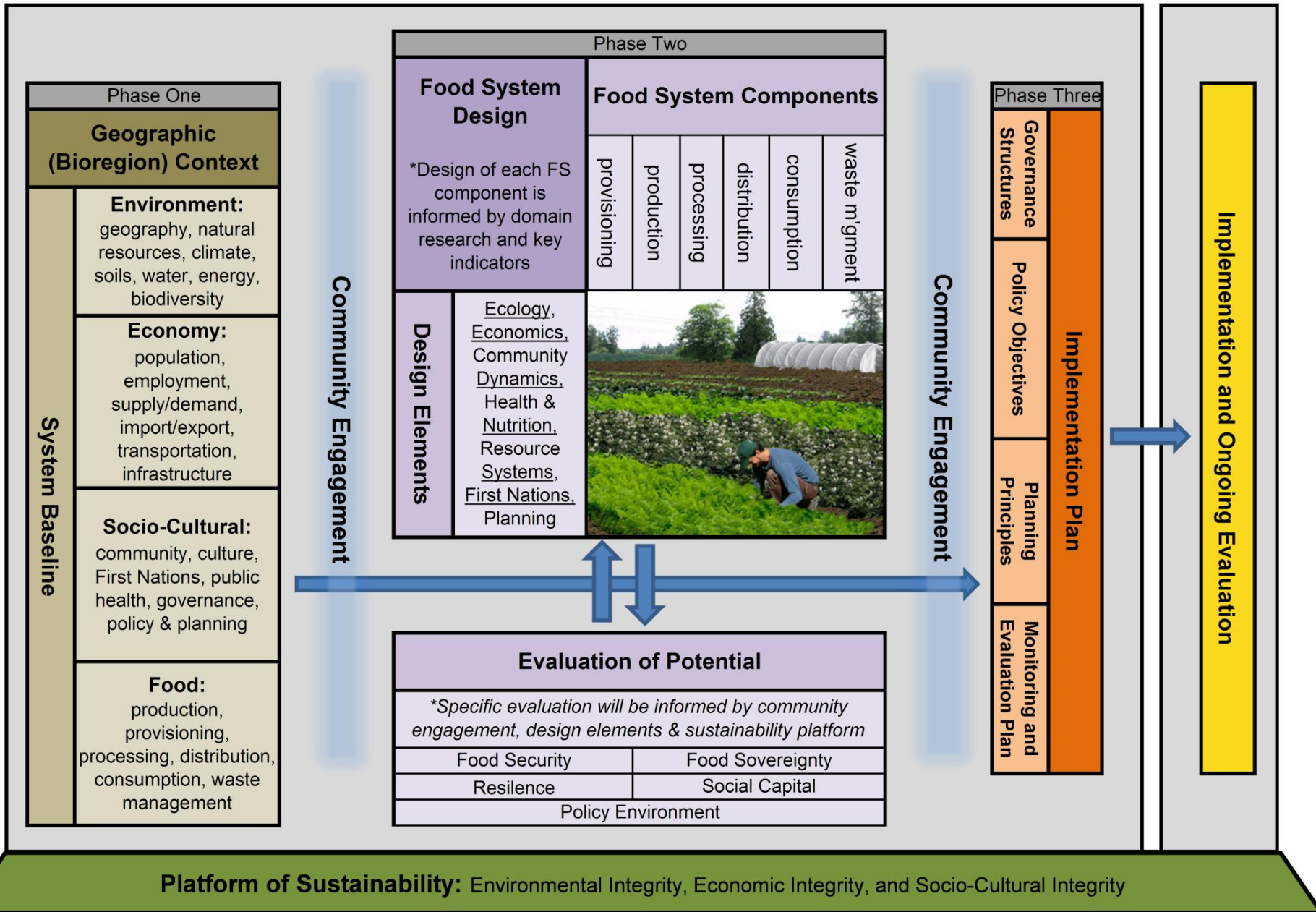
Support Indigenous Peoples traditional foods

Identify production and business opportunities

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

Eco footprint reduction

Build community/ social capital



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 21st century, post-industrial food system vision



A network of bioregional
agri-food systems around the globe