

# A Systems Approach to Organic Agricultural Production

With Dr. Martin Entz,  
Natural Systems Agriculture Lab, U of M

## Webinar

July 14th, 2023  
9:00am-10:00am CST

 CANADIAN  
AGRICULTURAL  
PARTNERSHIP



 Sask  
Organics  
Organically Grown in Saskatchewan

 Canada



- Investment platform established to develop organic agriculture and marketing in the Canadian Prairies
- Builds resilience in the sector by investing in
  - organic provincial associations (Capacity Fund); and
  - high impact programs (Innovation Fund) related to marketing, research, policy, education and capacity development that have broad public benefit to the organic sector.



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The Canadian Organic Ingredient Strategy is funded by



[www.organicdevelopmentfund.org](http://www.organicdevelopmentfund.org)

# Martin Entz, PhD

Professor of Cropping Systems, Natural Systems Agriculture Lab, University of Manitoba

Martin Entz is professor in the University of Manitoba's Plant Science department where he leads the Natural Systems Agriculture lab. He received his PhD from the University of Saskatchewan in 1988 and worked as a farm manager and research agronomist before embarking on his academic career.

"The goal of my program is to discover new ways of farming ecologically; to empower farmers with knowledge to design organic and ecological farming systems adapted to where they live; and to engage students in this exciting process". He leads the Glenlea study – Canada's oldest organic-conventional farming systems comparison study, which is in its 32nd season.

In 2011, Martin started Canada's first farmer participatory wheat and oat breeding program focussed on organic production. "Farmer involvement is an important part of my research program."

Martin teaches courses in crop production and often hosts field-based "Summer Institutes" on sustainable agriculture.

Martin has led agricultural projects in Central America and Zimbabwe, and his lab is currently engaged in "Nature-positive agriculture" in East Africa.



# A systems approach to organic agricultural production

**Martin Entz, PhD, Natural Systems Agriculture Lab  
Department of Plant Science, University of Manitoba**



**University  
of Manitoba**

Agriculture has evolved to become more fossil fuel intensive, less efficient in output per unit energy input, and more global in their markets.

Yet, there is a more profound change taking place mostly at the grass roots – a recognition that the resilience and sustainability of ecology and natural system have much to teach modern agriculture. Organic farming systems are one manifestations of this new awareness.”

Charles Francis, Professor, University of Nebraska.

### Kg Oil Equivalent Used Per \$1000 GDP PPP

Country	Proxy	2004	% of US
China, Hong Kong	EWH	85	39.2%
Ireland	IRL	113	52.1%
Switzerland	EWL	117	53.9%
Italy	EWI	124	57.1%
United Kingdom	EWU	134	61.8%
Austria	EWO	137	63.1%
Israel	EIS	137	63.1%
Spain	EWP	140	64.5%
Brazil	EWZ	148	68.2%
Japan	EWJ	154	71.0%
Germany	EWG	163	75.1%
Turkey	TUR	163	75.1%
France	EWQ	169	77.9%
Chile	ECH	171	78.8%
Mexico	EWV	173	79.7%
Netherlands	EWN	175	80.6%
India	INP	186	85.7%
Belgium	EWK	195	89.9%
Thailand	THD	204	94.0%
Australia	EWA	207	95.4%
Sweden	EWD	212	97.7%
<b>United States</b>	<b>VTI</b>	<b>217</b>	<b>100.0%</b>
China	FXI	226	104.1%
Korea, Republic of	EWY	234	107.8%
Singapore	EWS	237	109.2%
Malaysia	EWM	243	112.0%
Indonesia	IF	244	112.4%
Canada	EWC	289	133.2%
South Africa	EZA	295	135.9%
Saudi Arabia	n/a	438	201.8%
United Arab Emirates	n/a	462	212.9%
Russian Federation	RSX	494	227.6%

source: United Nations www.QVMgroup.com

## Energy use per unit of GDP

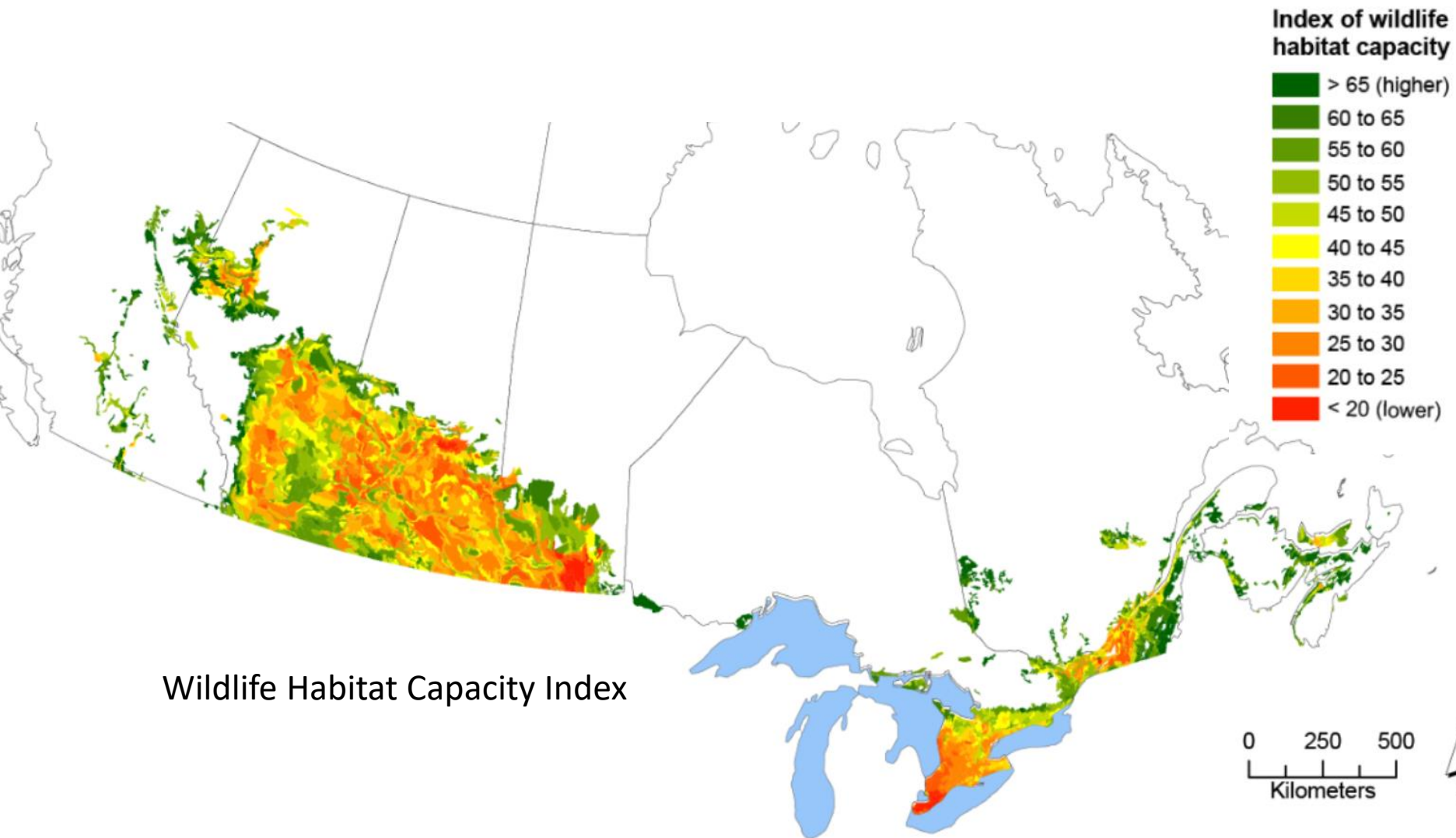


<b>Production system</b>	<b>Energy out/energy in</b>
<b>Mexican village corn</b>	<b>10.7:1</b>
<b>*Pre-industrial Wiltshire</b>	<b>40:1</b>
<b>Corn (US)</b>	<b>3.8:1</b>
<b>Soybean (US)</b>	<b>3.2:1</b>
<b>Potato (US)</b>	<b>1.3:1</b>
<b>Apples (US)</b>	<b>0.6:1</b>
<b>Tomato (US)</b>	<b>0.3:1</b>
<b>**Manitoba grain farm</b>	<b>8:1</b>
<b>**Manitoba organic farming</b>	<b>12:1</b>

**Pimental and Pimental 2008. Food, energy and society. CRC Press**

**\*Bayliss-Smith, T.P. 1982. The ecology of agricultural systems. Cambridge University Press**

**\*\*Hoeppner, J.W., M.H. Entz, B. McConkey, B. Zentner and C. Nagy. 2005. Renewable Agric. and Food Systems. 19:1-8.**

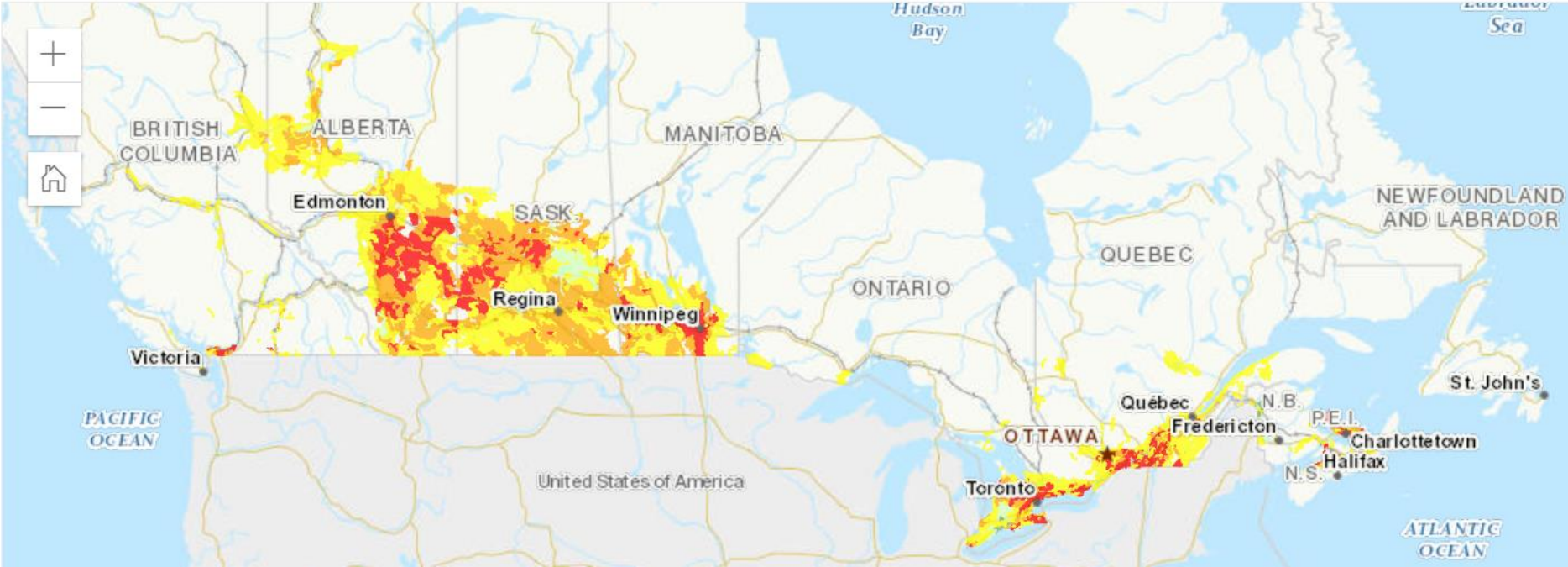


Wildlife Habitat Capacity Index

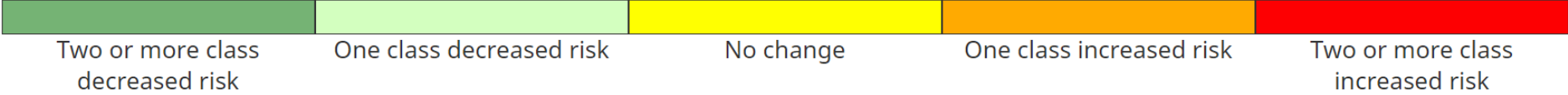
<https://www.canada.ca/en/environment-climate-change/services/environmental-indicators/wildlife-habitat-capacity-agricultural-land.html>

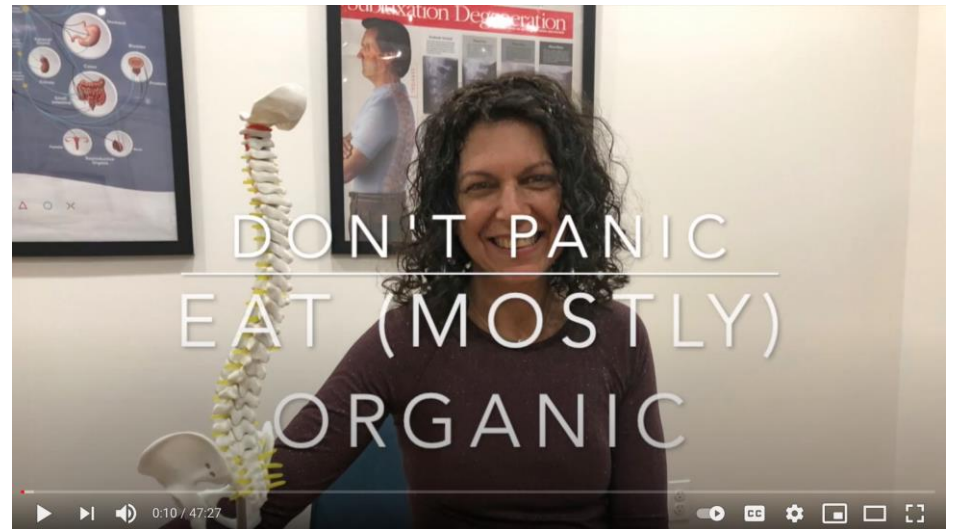


**Figure 2: Change in pesticide risk, 1981 to 2011**



**Legend:**



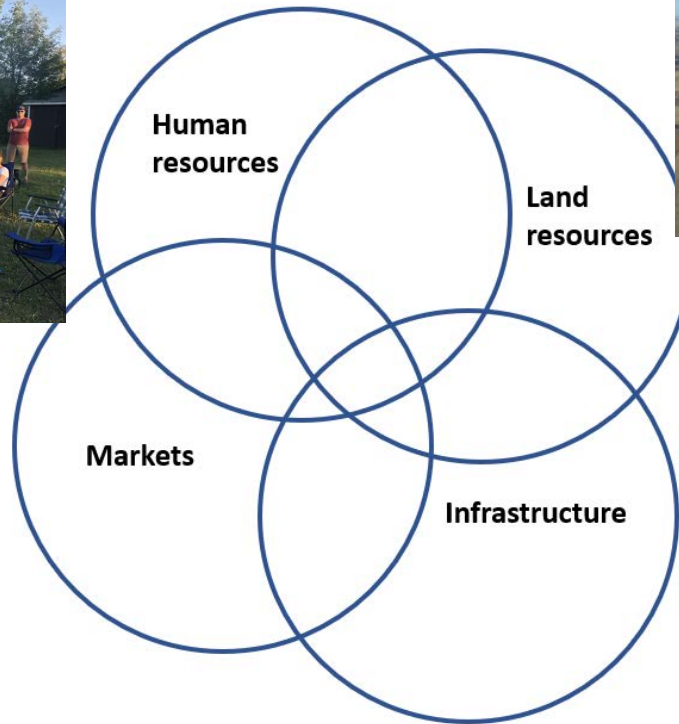
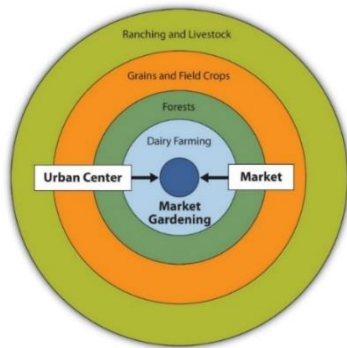


Canadian Agriculture  
6% organic in 2040

## Part 1. Farm resources to optimize organic production



Family



Soil, landscape,  
water



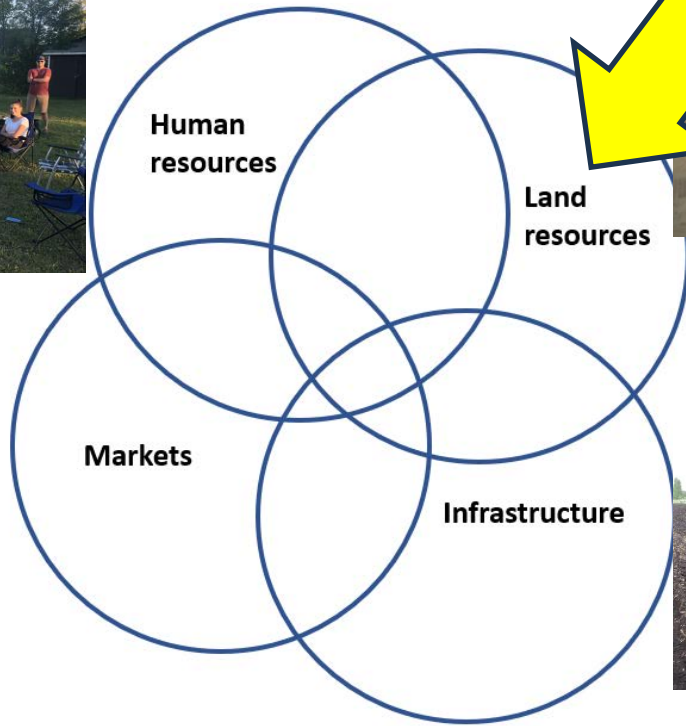
Machinery

**ORGANIC PRICING LIMITED AS TRADE WAITS  
ON NEW CROP**

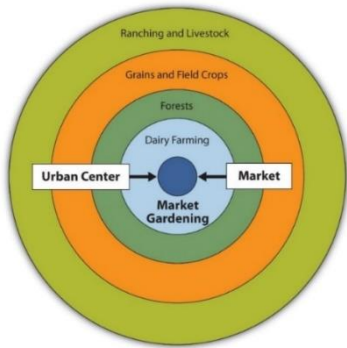
# Farm resources to optimize organic production



Family



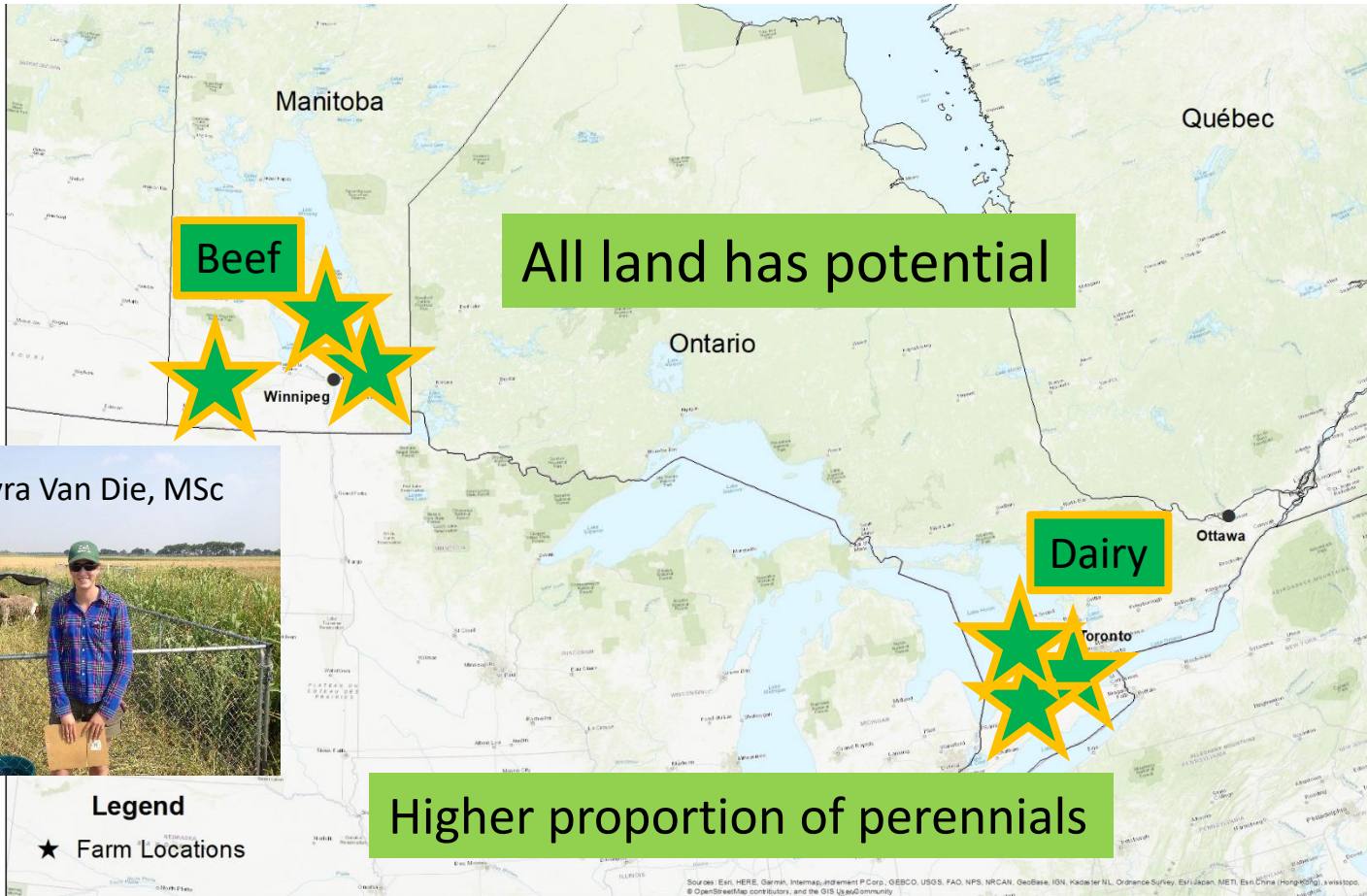
Soil, landscape, water



Machinery

**ORGANIC PRICING LIMITED AS TRADE WAITS ON NEW CROP**

# Grass-fed, organic livestock production

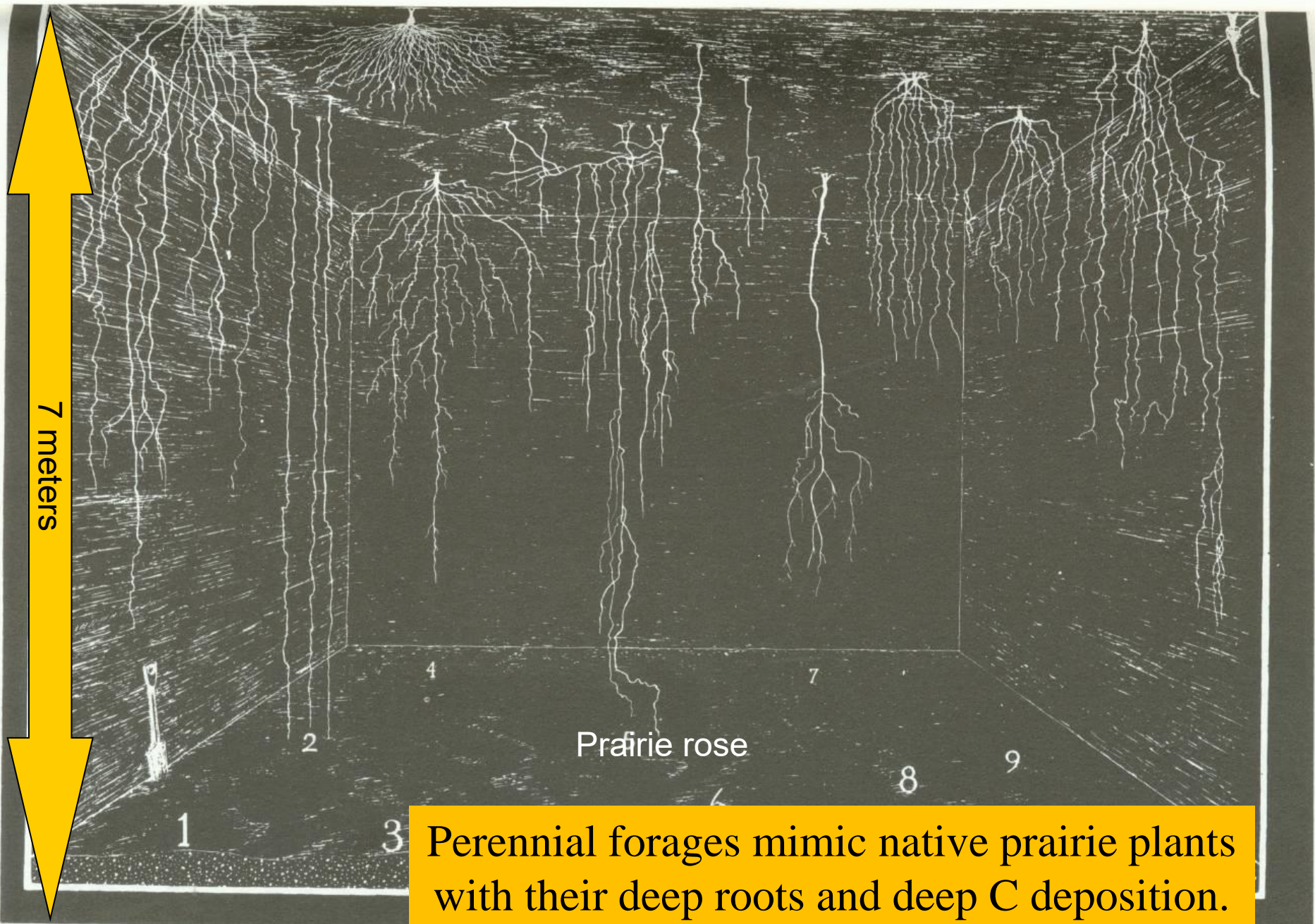


Myra Van Die, MSc



## Legend

★ Farm Locations



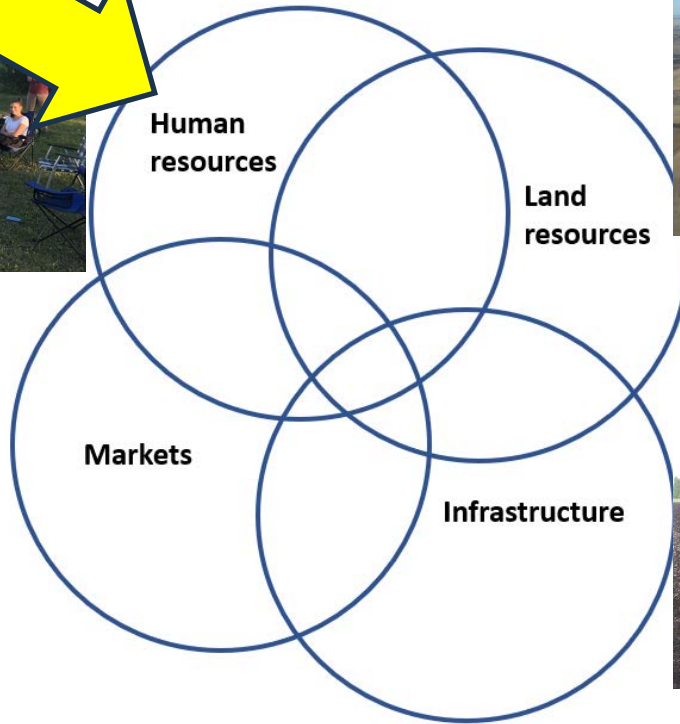
Perennial forages mimic native prairie plants with their deep roots and deep C deposition.

Weaver, 1919

# Farm resources to optimize organic production



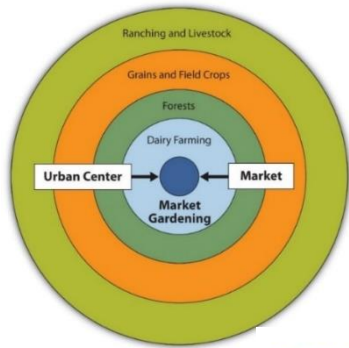
Family



Soil, landscape, water



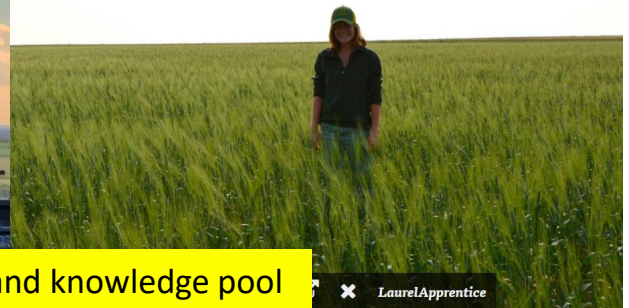
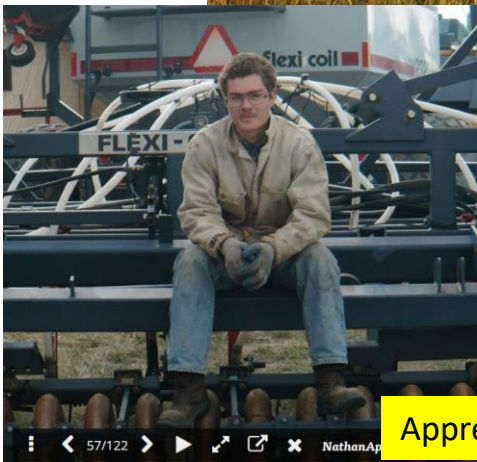
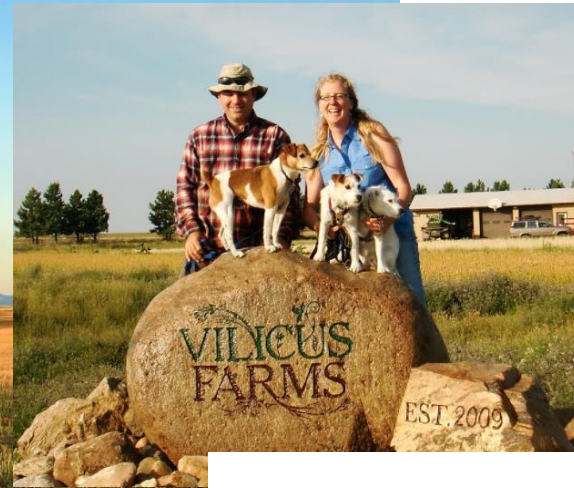
Machinery



**ORGANIC PRICING LIMITED AS TRADE WAITS ON NEW CROP**

Vilicus Farms, Montana  
Building a Farmily

<https://vilicusfarms.com/>



Apprentices on organic farms adds to labour and knowledge pool

Nathan Ap

Laurel Apprentice





# How to combat the sexism faced by women farmers

Published: August 19, 2020 3.28pm EDT

Women farmers say they face sexism and dismissiveness, and are expected to juggle farm work with caregiving. (Piqsels)

<https://theconversation.com/how-to-combat-the-sexism-faced-by-women-farmers-143666#:~:text=Finally%2C%20we%20recommend%20training%2C%20networking,food%20%E2%80%94%20and%20that%20benefits%20everyone.>

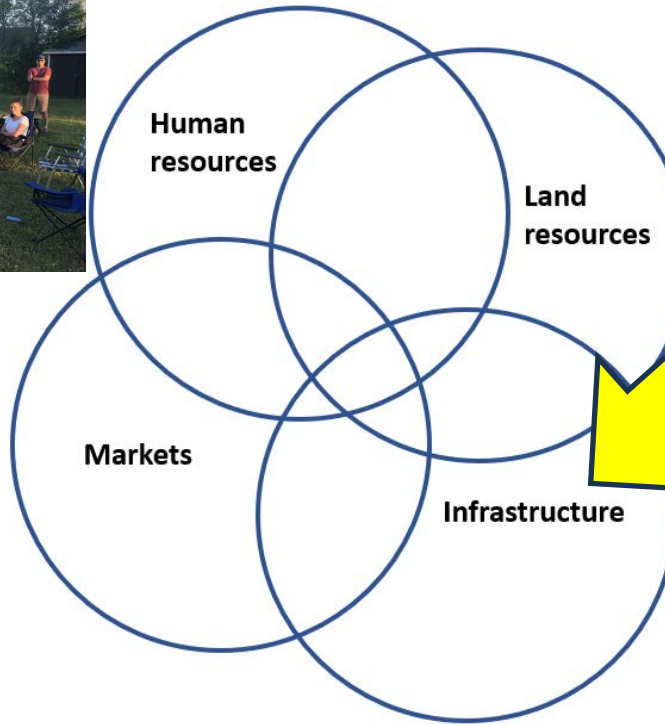
# Farm resources to optimize organic production



Family



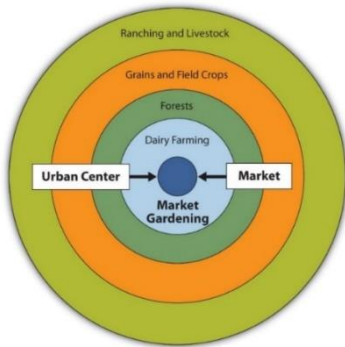
Land resources



Soil, landscape, water



Machinery



**ORGANIC PRICING LIMITED AS TRADE WAITS ON NEW CROP**

# Infrastructure and Enterprises

- what should come?
- what should go?



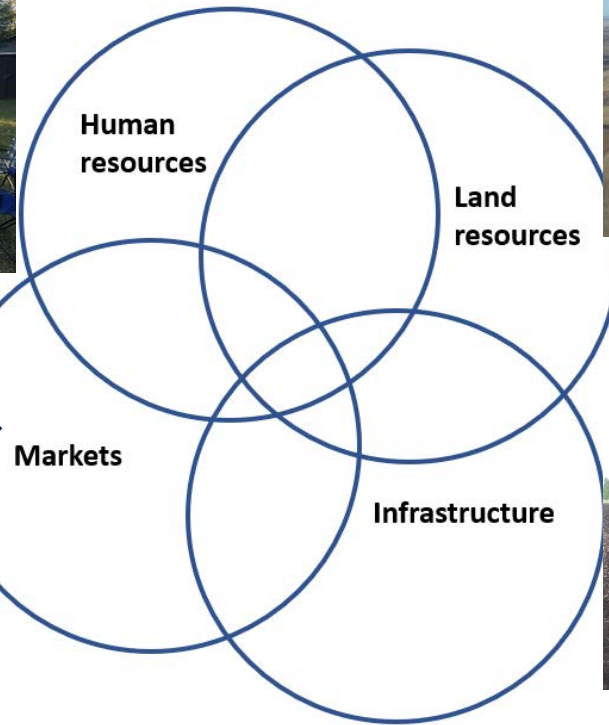
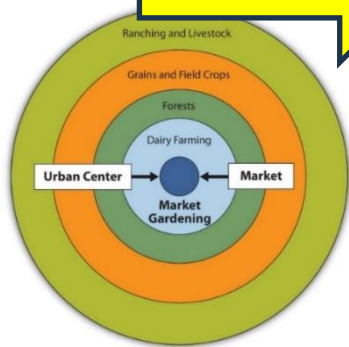
# Farm resources to optimize organic production



Family



Soil, landscape, water



Machinery

**ORGANIC PRICING LIMITED AS TRADE WAITS ON NEW CROP**



**3Gen Organics**

Family Farm Fresh



<https://www.youtube.com/watch?v=clDs9xp3OHw>

<https://www.3genorganics.ca/>

## Flax, pulses could reduce health care costs: researcher

**MARKETS** | Canada's health care costs keep rising, but better health could reduce that trend

By **Geralyn Wichers**  
CO-OPERATOR STAFF

**D**iets supplemented with flaxseed and pulses can reduce risk of certain diseases and thus curtail Canada's health care spending.

That was the message presented to attendees of the Manitoba Sustainable Protein Research Symposium in Winnipeg June 21.

The speaker was Luc Clair, a health economist and principal investigator with the Canadian Centre for Agri-Food Research in Health and Medicine. He studies potential health care savings of food-based health interventions. The centre is a federal research group based in Winnipeg.

"If we can make people healthier, then we can reduce the demand for health care services," said Clair.

### ■ WHY IT MATTERS

Canada was on track to spend about \$331 billion on health care last year, according to a November 2022 report from the Canadian Institute for Health Information.

Canada's health care spending is rising year over year, Clair said. The number of people with chronic diseases like diabetes, hypertension (high blood pressure) and heart disease is also rising, partly because of higher disease rates and partly due to a growing population. That population is also aging.

Canada's health spending reached 130 per cent of the country's GDP in 2020, during the first year of the pandemic, according to data from the Canadian Institute for Health Information. Even before that, however, the nation spent an average 11.45 per cent of its GDP between 2010-19. That compares to an average 9.1 per cent of GDP from 1990-99.

Statistics Canada reports that the average age of Canadians had risen to 47 years as of 2022, 3.9 years older than in 2002. Additionally, about one in five Canadians was 65 years old or older.

If governments want to reduce health care spending, reducing demand is one way to do it, Clair said.

Functional foods like pulses or flaxseed could be used as supplementary treatments along with pharmacological options.

Incorporating pulses into a diet has been shown as an effective strategy to reduce cardiovascular disease, according to Clair. He pointed to one study that showed pulses could slow the progress of peripheral artery disease or begin to reverse it.

Using that study and provincial data, Clair said he did a "cost of illness" analysis where he estimated the cost of peripheral artery disease to Manitoba and the potential savings if people with the disease ate half a cup of pulses per day.

He estimated this would reduce public costs by nearly \$666,000 per year.

"Not huge, but certainly helpful," he said.

Clair cited other research that estimated eating 100 grams of pulses per day could result in \$6.2 million in annual savings for Canada for expenses related to type 2 diabetes.

Another study, published in 2015 by Frontiers in Pharmacology, showed that an increase of one gram of dietary fibre per day could reduce costs in Canada related to type 2 diabetes by up to \$51 million and costs related to cardiovascular disease by up to \$93 million.

Clair also did a cost of illness study that examined savings across Canada if those diagnosed with hypertension adopted a flax-based treatment.

According to Health Canada, 40 grams of ground, whole flaxseed per day has been shown to reduce cholesterol, Clair's analysis suggested such a flax-based treatment in those with hypertension could save up to \$281 million annually in health care costs.

"Incorporating healthful plant-based foods into your diet can help reduce the risk of chronic disease, which then reduces the demand for health care services, which then reduces health care costs," the researcher said.

Gewchers@armmedia.com @geralynwichers

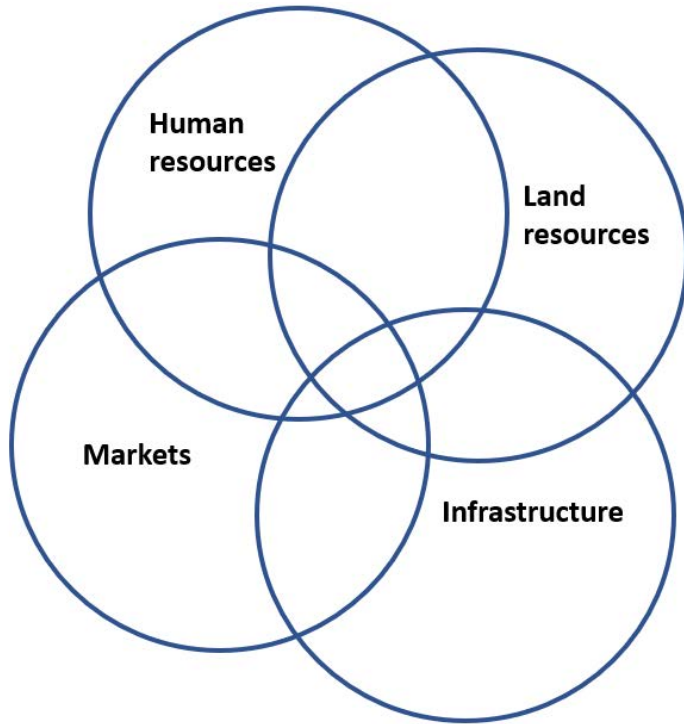


Health economist Luc Clair speaks at the Manitoba Sustainable Protein Research Symposium in Winnipeg June 21. PHOTO: GERALYNE WICHERS

**■ If we can make people healthier, then we can reduce the demand for health care services.**

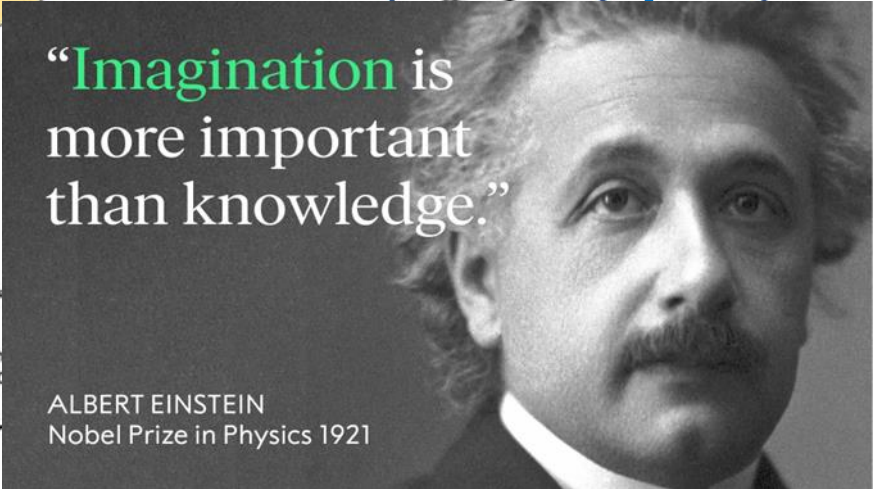
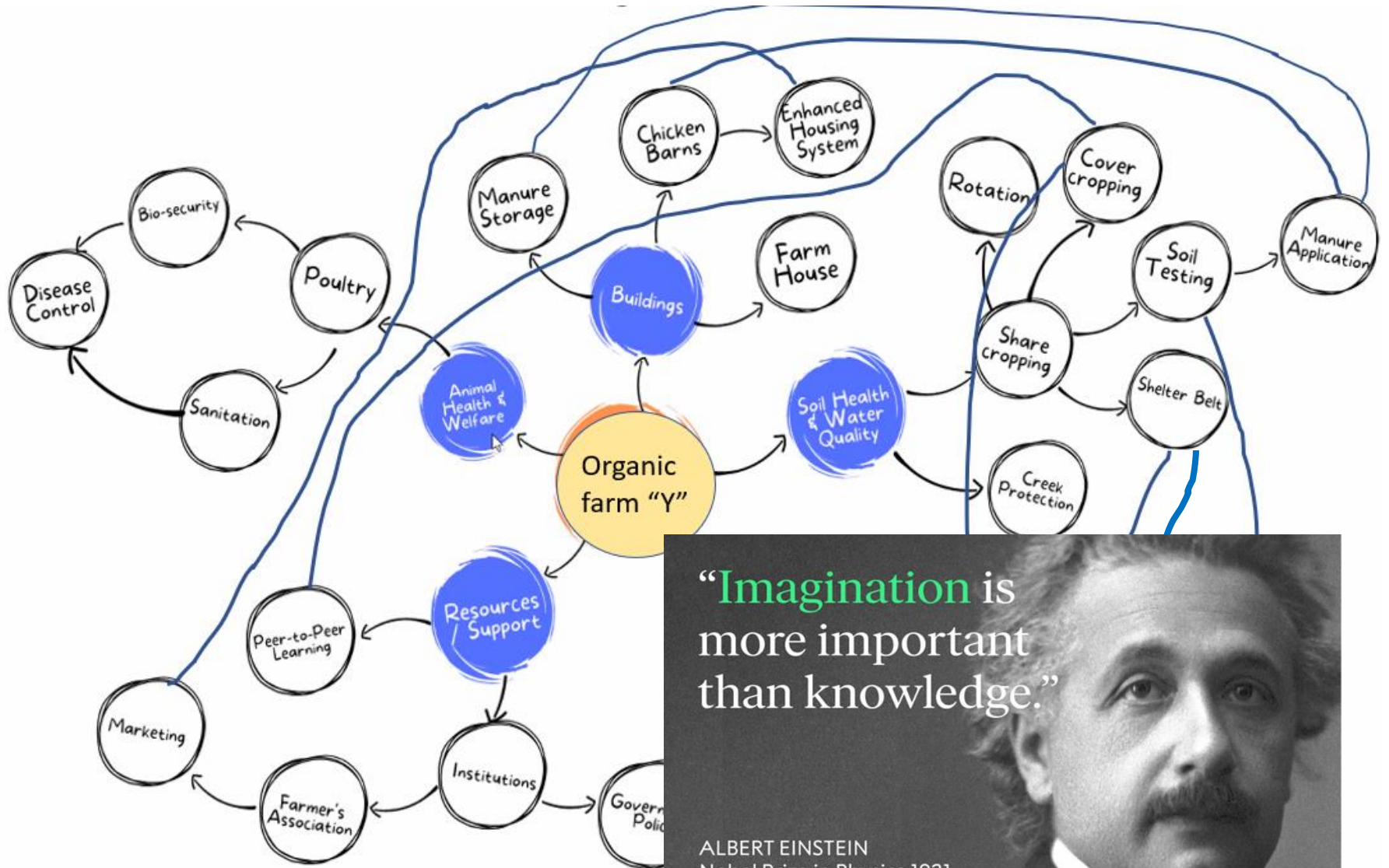
Luc Clair  
CANADIAN CENTRE FOR AGRI-FOOD RESEARCH IN HEALTH AND MEDICINE

# How do I see this system?



## Mind Map Chart

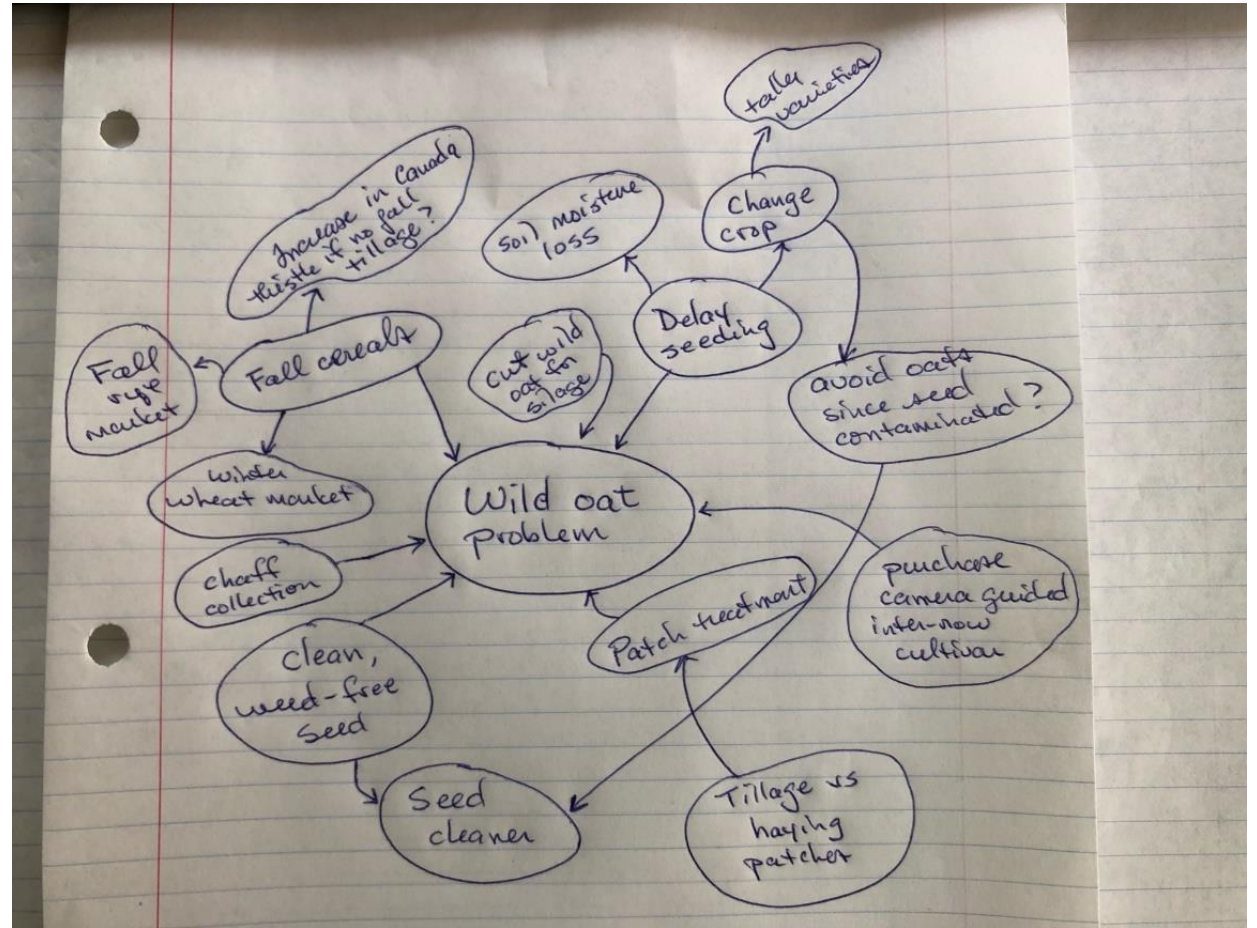




“Imagination is more important than knowledge.”

ALBERT EINSTEIN  
Nobel Prize in Physics 1921

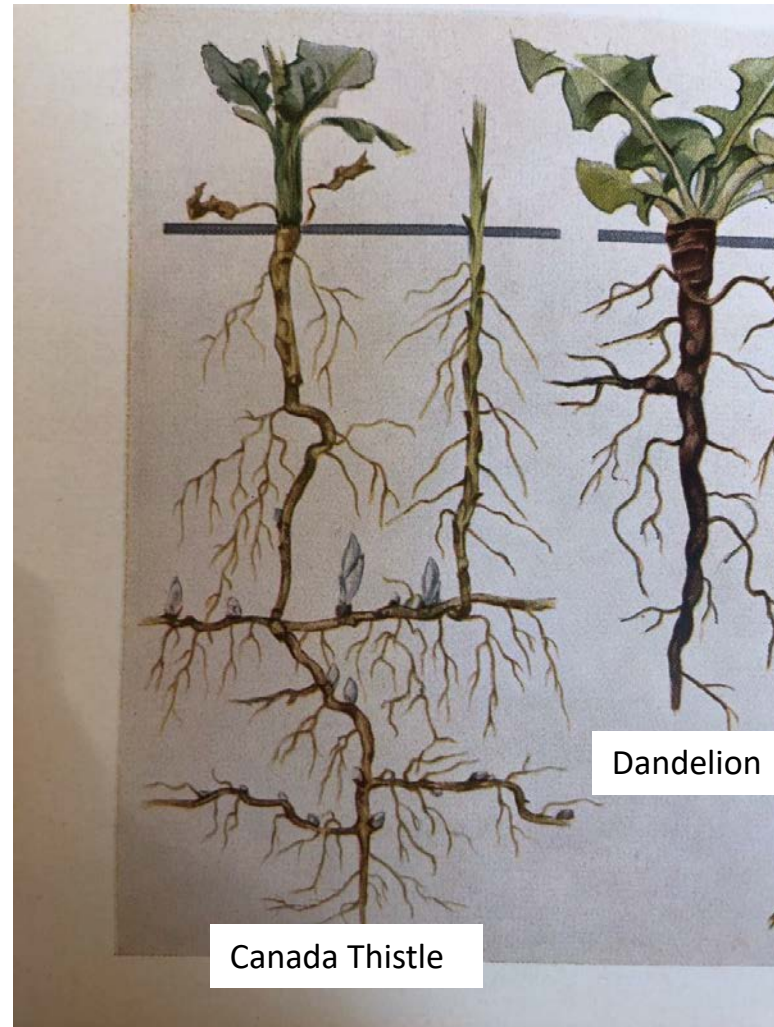
# Wild oat mind map





Draw a mind map for management of:

Canada Thistle  
vs  
Dandelion



## Part 2. Planning processes

“We don’t plan to fail, but sometimes we fail to plan”

- Agronomic planning
  - Rotation
  - Landscape
  - Data/record-keeping
- Business planning
- Optimum farm size?
- Threats
  - Rising land costs

## Part 2. Planning processes

“We don’t plan to fail, but sometimes we fail to plan”

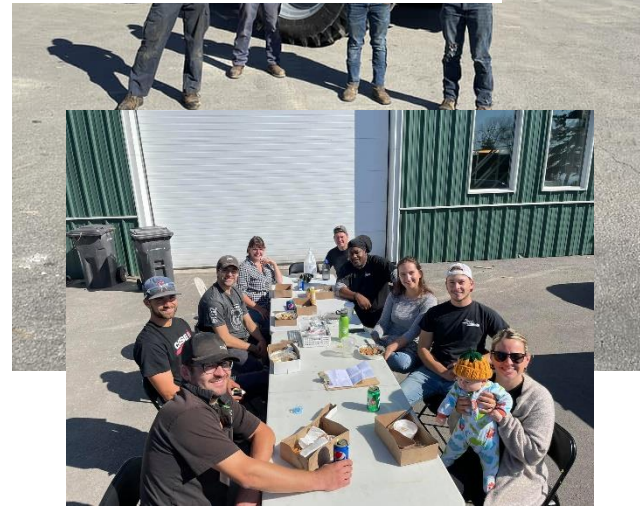
- Agronomic planning
  - Rotation
  - Landscape
  - Data/record-keeping
- Business planning
- Optimum farm size?
- Threats
  - Rising land costs



Let me share an example....



Les Fermes Longprés (2009) Ltée.  
Thanks to Matthew Dewavrin, agr. for this presentation





## Objectives, values, mission

### Self-sufficiency

- Inputs
- Machinery design/maintenance
- Marketing
- Infrastructure



## Objectives, values, mission

### Soil Conservation

- Ridge Till (~~mouldboard plowing~~)
- Green manure/ Cover Crops
- Limited use of manure
- Light equipment
- Traffic control



## Objectives, values, mission

### Biodiversity

- Organic certification
- Shelterbelts
- Strip Cropping
- Habitat preservation and enrichment



Objectives, values,  
mission

## Vertical integration

- Revenue stability
- Marketing based on traceability, transparency and environmental preservation
- Greater-Montreal Area and Vermont





# **Planning Trade-offs**



**Planning  
Trade-offs**

## Rotation excellence vs. finances



Oats where inadequate legumes in rotation



Oats where adequate legume green manures in rotation



Several weeks later.....

# System rehabilitation

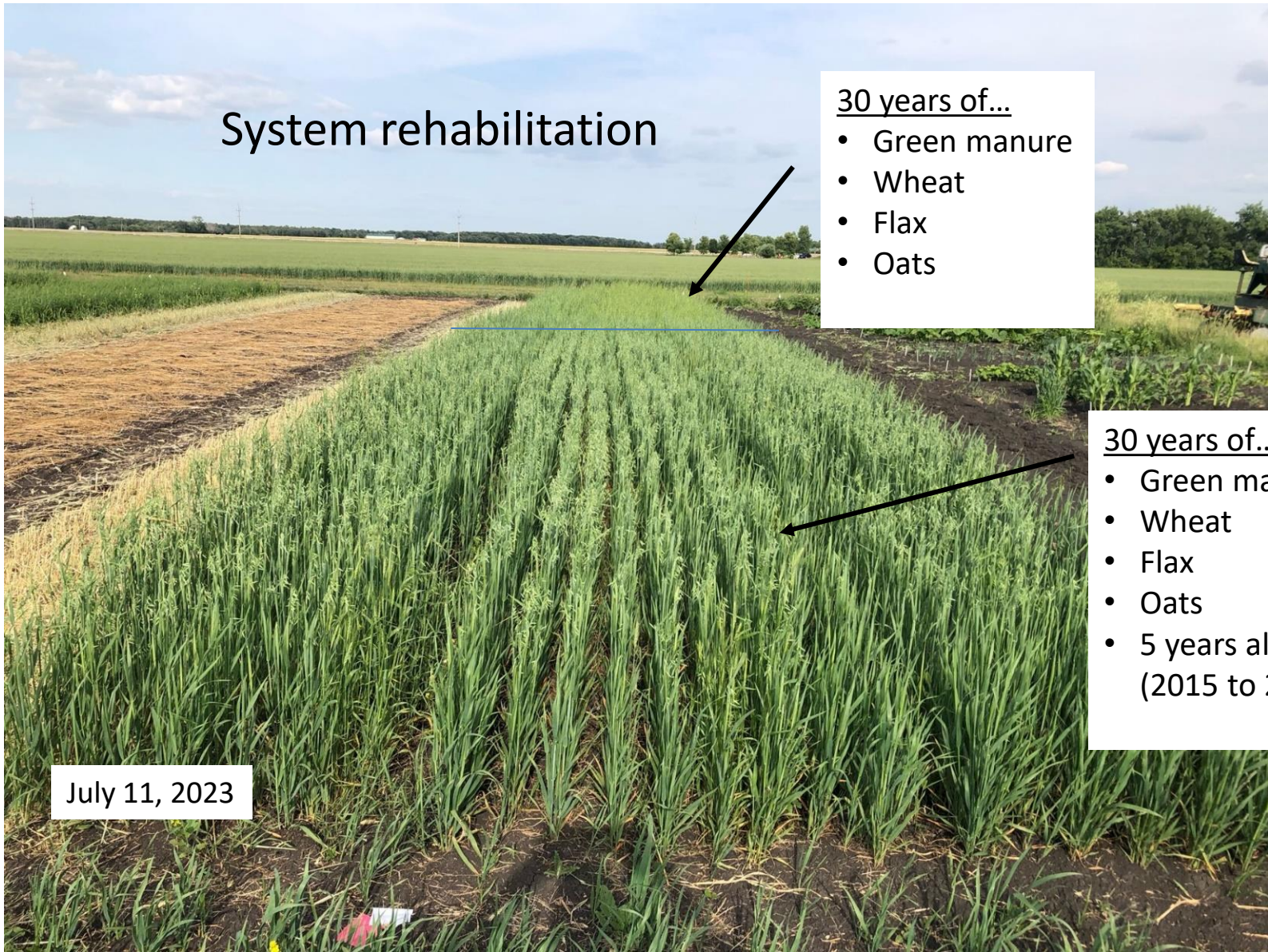
## 30 years of...

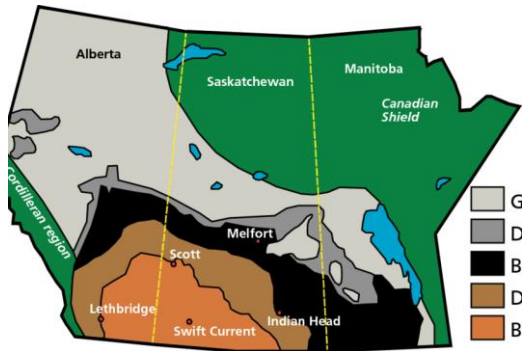
- Green manure
- Wheat
- Flax
- Oats

## 30 years of...

- Green manure
- Wheat
- Flax
- Oats
- 5 years alfalfa (2015 to 2020)

July 11, 2023

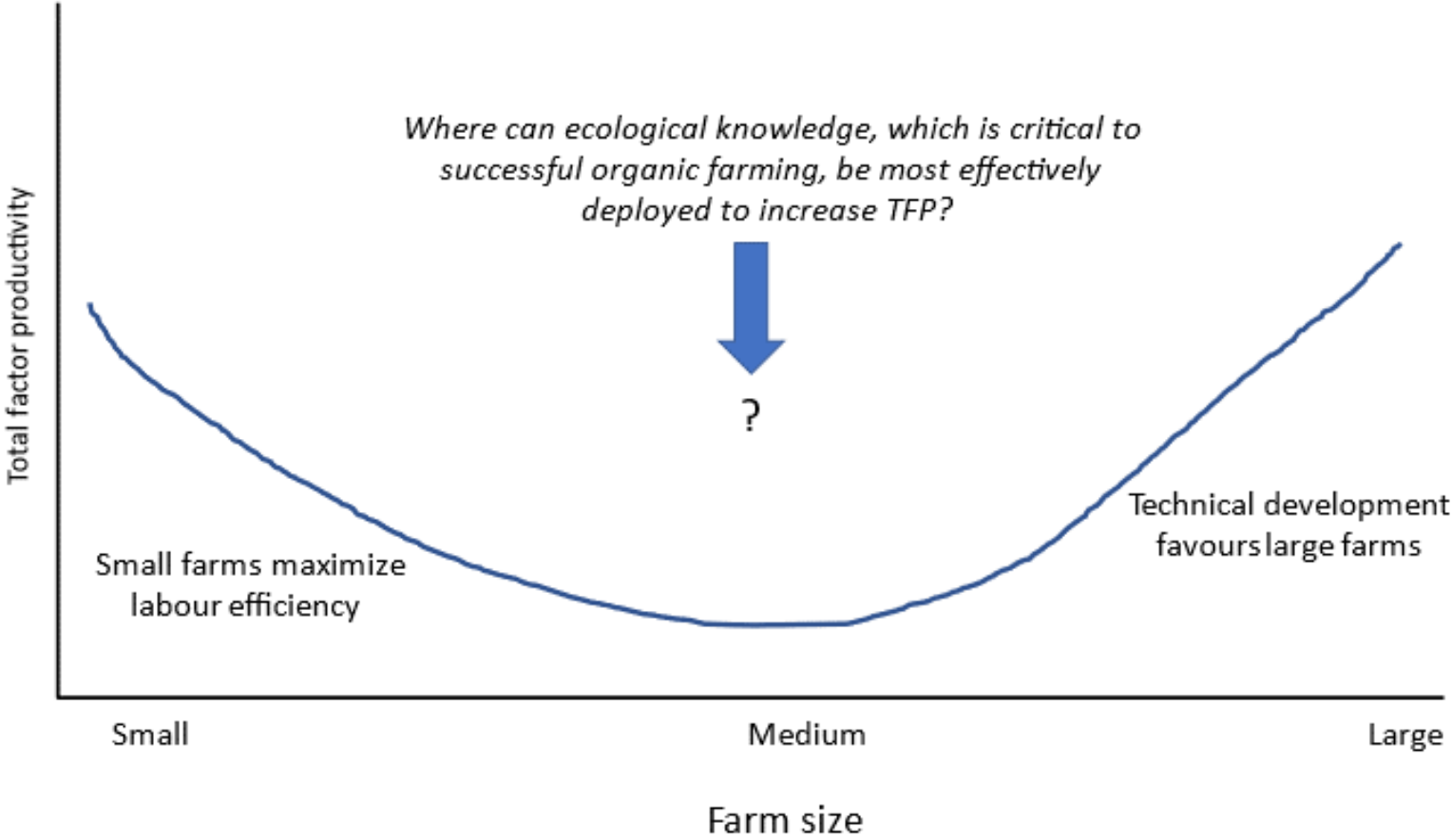




- Visit farms when you have the opportunity.
- Find out why they use a specific rotation.

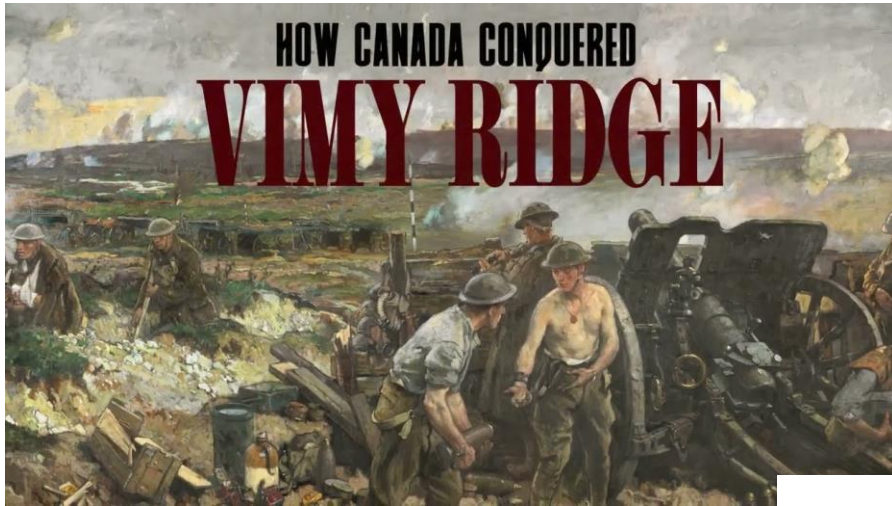
SE Saskatchewan	Alberta	Manitoba	PEI	Ontario	Quebec
Alfalfa seed 3 years	Green manure (cereal/pulse)	Green manure (grazed)	Red clover green manure	3 years legume/grass forage	Soybean
Hemp	Fall rye	Wheat or flax	Spring wheat	Winter canola	Winter wheat/pea or clover cover crop
Flax (underseeded to alfalfa)	Food grade pea/oat intercrop	Lentil or pea	Soybeans	Spelt	Corn (ryegrass cover crop interseeded)
or	Green manure (cereal/pulse)	Alfalfa hay (2 years)	Pea/barley intercrop	Soybean	
Green manure (year 1)	Spring wheat	Wheat or flax	Oats underseeded to red clover	Oat/pea grain	
Spring wheat (year 2)	Pea/barley intercrop (feed)	Oats			
<i>Two different rotations depend on soils</i>	<i>Green manure every 3<sup>rd</sup> year</i>	<i>High diversity. Livestock integration</i>	<i>Diversity of legume species</i>	<i>Winter and spring seeded grains</i>	<i>Manure used to supply some N</i>

# Optimum Farm Size?



# Part 3. Learning Systems

All farms need a Learning Plan



All members of the Family need to learn – and to know the learning goal.



## All farms need a Learning Plan

**Effortful learning.** It's analogous to weight training. Lifting heavier weights which require more effort will build more muscle in much the same way investing more effort in grappling with new information builds stronger, deeper knowledge.





What are your learning goals?



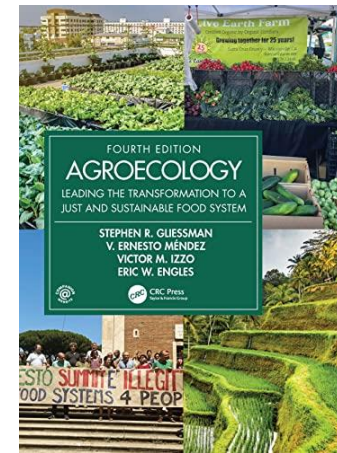
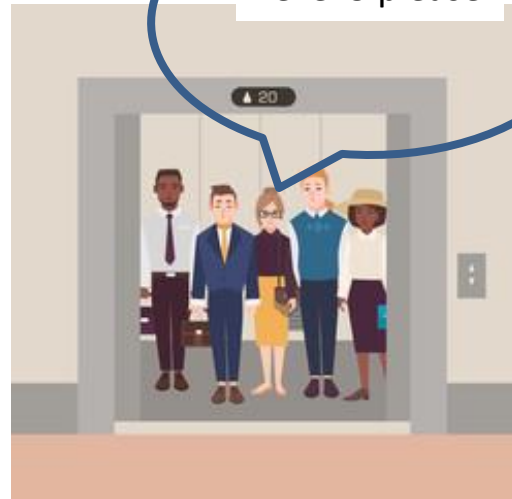
Level 1. Increase efficiency of conventional practices

Level 2. Substitute conventional practices with alternative practices

Level 3. Redesign the system so that it functions on basis of a new set of ecological relationships

Level 4. Re-establish more direct relationship between people who produce and eat food.

Level 3 please



Stephen Gliessman, Ivette Perfecto and others

# Ecological knowledge

Knowledge of species of both animals and plants, and biophysical characteristics of the environment through space and time. Example is a rancher who tracks the pasture and rangeland condition alongside the health of the grazing animals.



An **ecosystem** is all the biotic (living) and abiotic (non-living) components that interact within an area at once. Think of a farm, or even a farm field, as an ecosystem. Use a mind map to show the parts and the connections within that farm ecosystem.



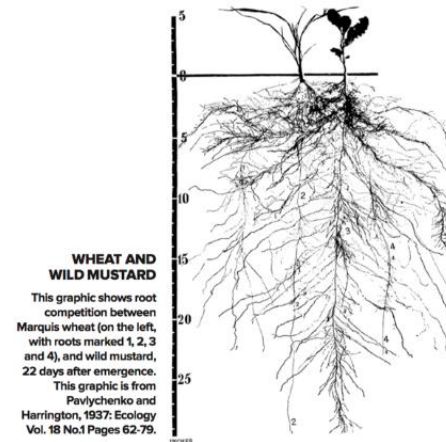
**Biodiversity** is the variation of species in an ecosystem. How many plant species are growing in a pasture?



**Competition** is a mutually detrimental interaction between species which share limited resources.



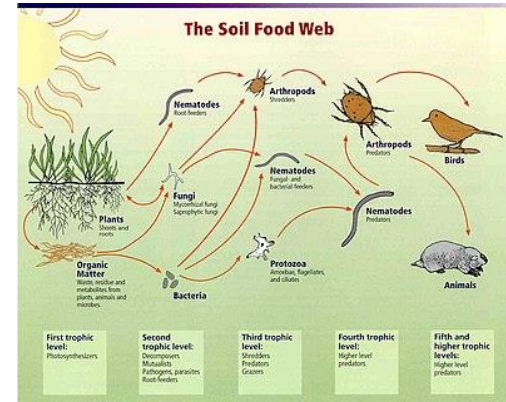
**Interspecific competition** is between individuals of different species. For example, wild oats and wheat.



**Intraspecific competition** is among individuals of the same species. For example, oat plants seeded at a very high seeding rate will compete with each other.

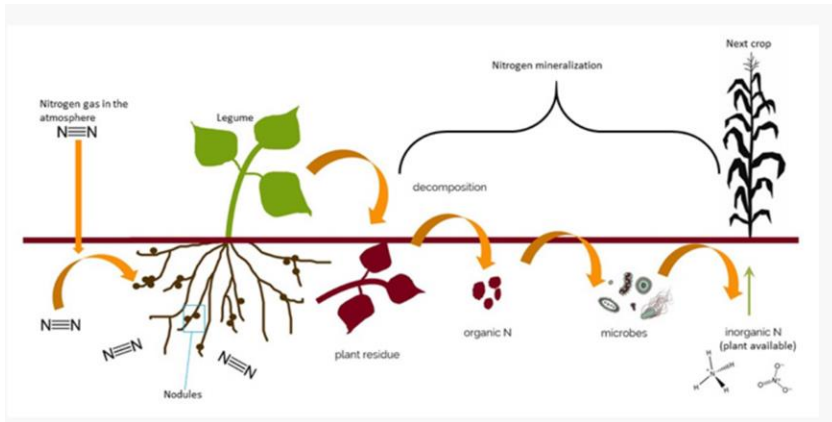


A **foodweb** is an interlocking pattern formed by a series of inter-connecting food chains. The foodweb can include beneficial (eg. crop harvest) and non-beneficial (eg. insect pest) organisms.



Relationships between soil food web, plants, organic matter, and birds and mammals  
Image courtesy of USDA Natural Resources Conservation Service  
[http://soils.usda.gov/sqi/soil\\_quality/soil\\_biology/soil\\_food\\_web.html](http://soils.usda.gov/sqi/soil_quality/soil_biology/soil_food_web.html)

**Decomposers** break down decaying or dead organisms. Some agronomists have buried underwear to study how quickly soil decomposers break down the cotton cloth.



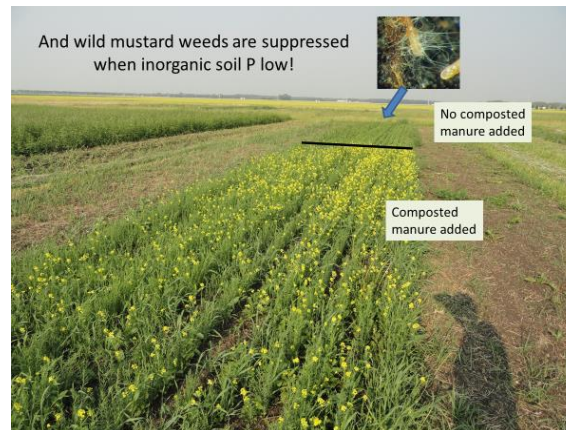
Nitrogen cycling with a legume green manure. Figure modified slightly from that kindly provided by Dr. Julie Grossman and Sharon Perrone, University of Minnesota.



A **generalist species** can thrive under many environmental conditions and make use of a variety of different resources. Grasshoppers is an example, though the grasshopper population will build up in hot, dry cycles.



The **niche** is the role that an organism plays in an ecosystem including both the environmental conditions it needs and its interactions with other organisms. Wild mustard and redroot pigweed are non-mycorrhizal plants so their niche is soils with high levels of available phosphorous (because mycorrhizal fungi help plants access soil P).



**Disturbance** can be physical (tillage, grazing) or chemical (spraying a herbicide).



Tillage is not the only disturbance...



# Development of Ecological Knowledge

## Depletion crisis model

- Experience of limited resources
- Most easily discovered if living on an island
  - Eg. deplete fishery
- Crisis allows societies to learn though this is not always successful (eg. Easter Island)

## Ecological understanding model

- Cultural
- Community based
- Indigenous examples
  - Net fishery
  - Beavers and water mgt.
  - Fire culture for blueberry production

# Using ecological knowledge to adapt to new circumstances



## Blade roller – from the Tropics

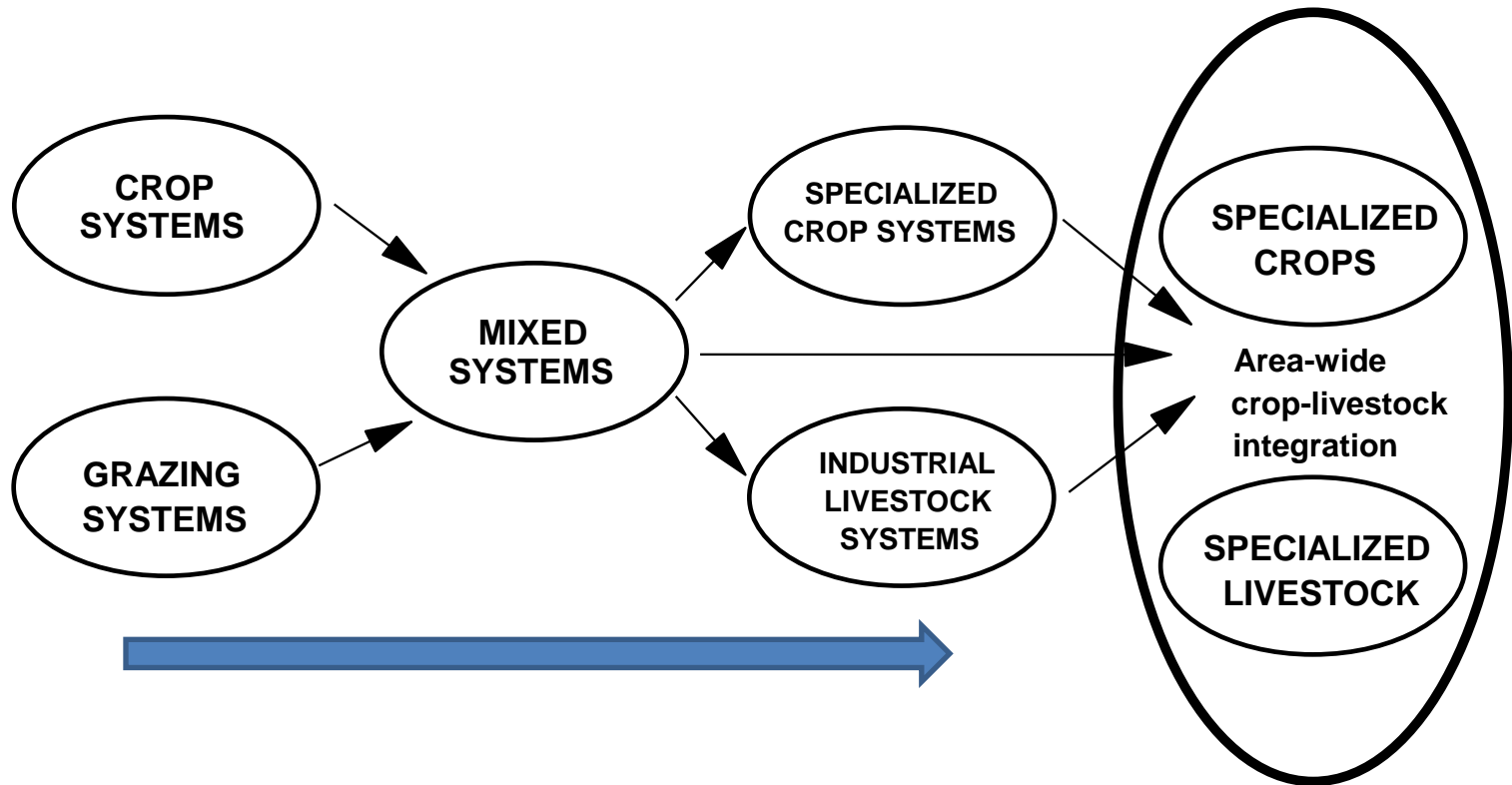


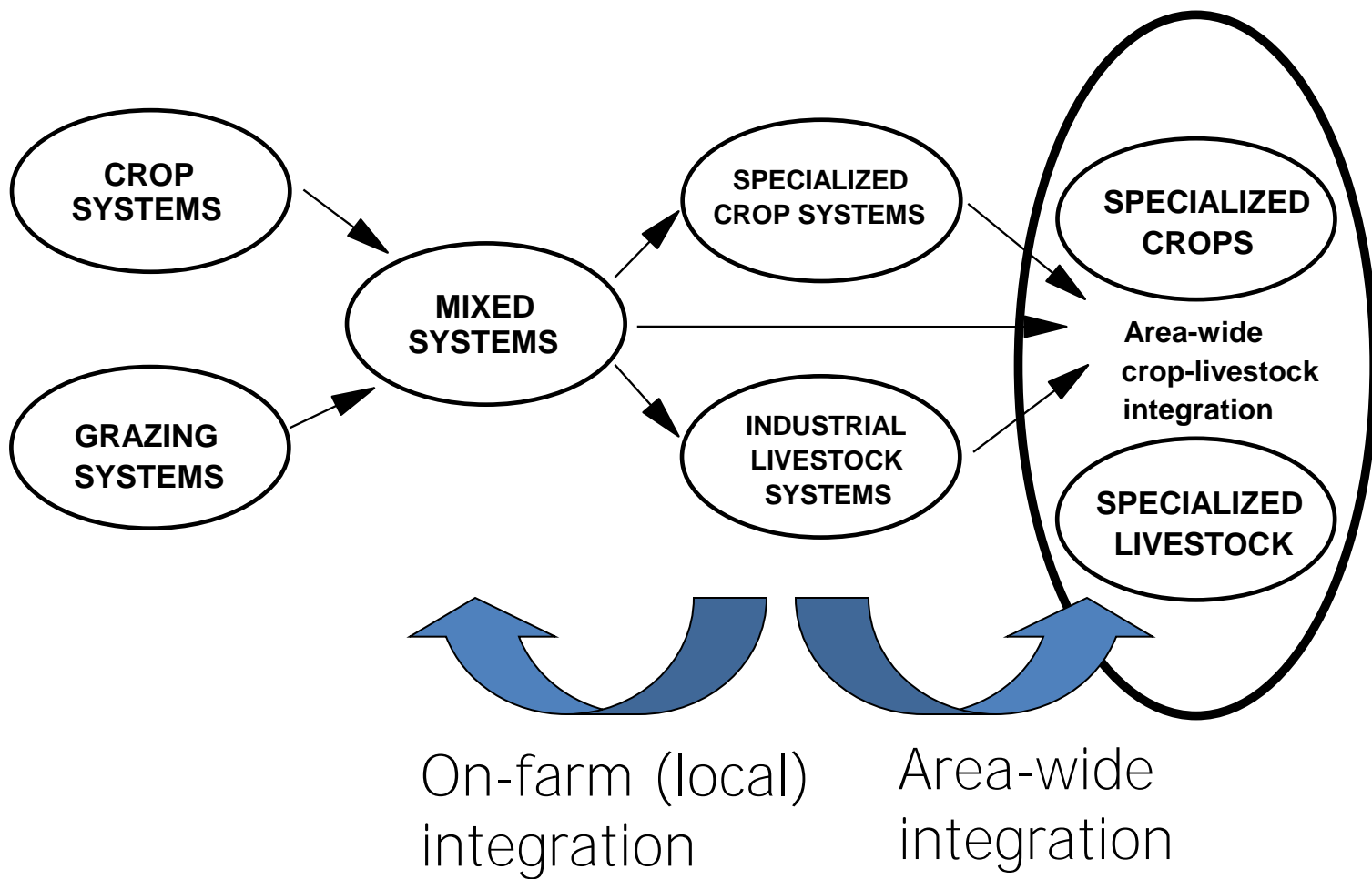


Adapt the roller to new situations

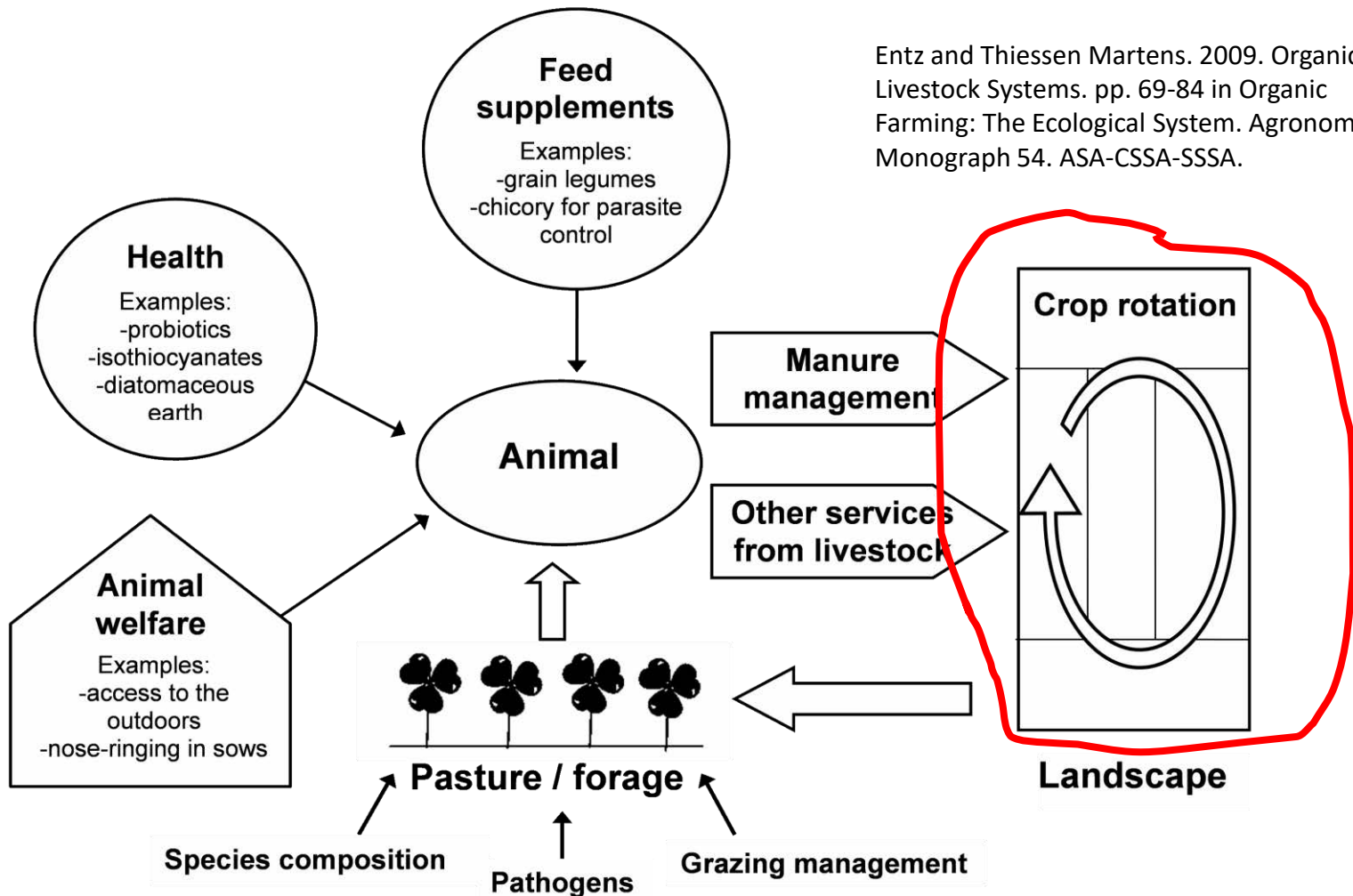


## Part 4. Crop-livestock integration

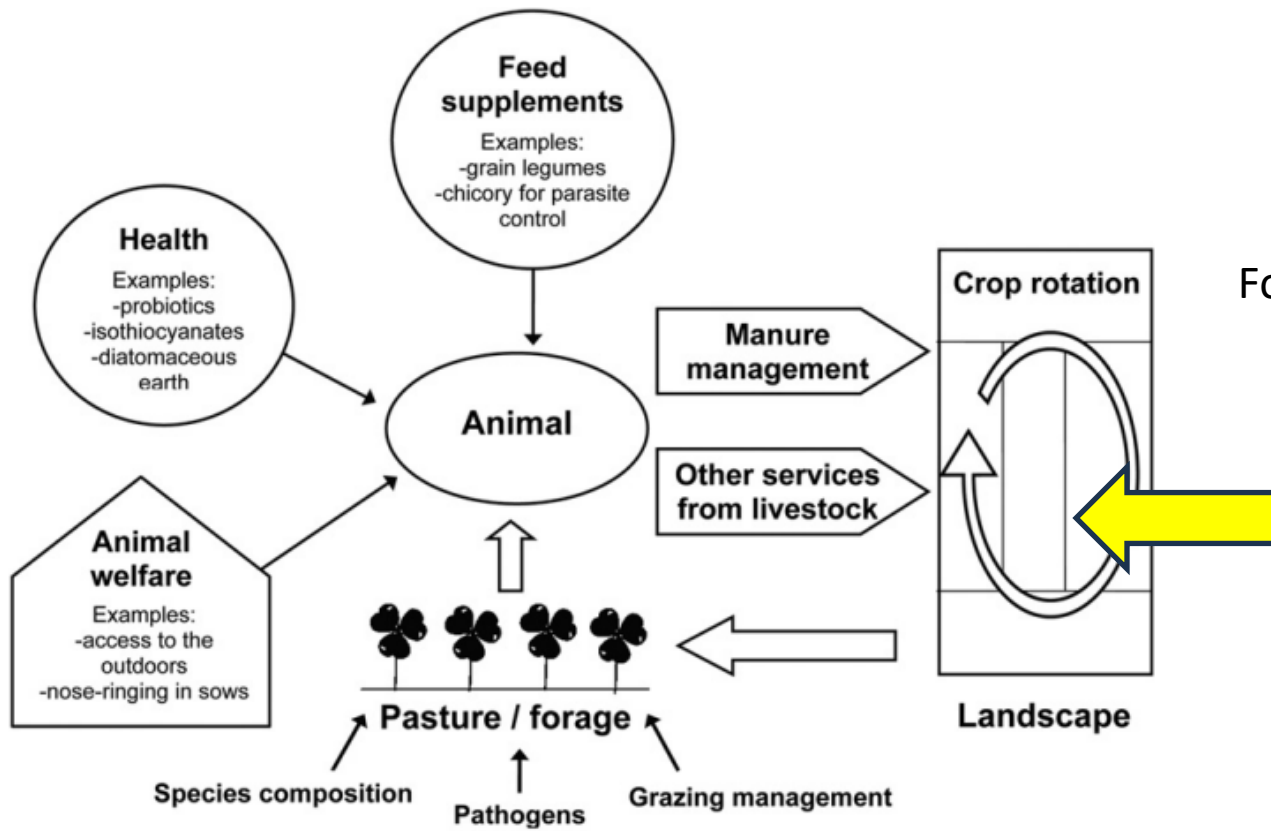




# Major Components of Organic Crop-Livestock Systems...



Entz and Thiessen Martens. 2009. Organic Crop-Livestock Systems. pp. 69-84 in Organic Farming: The Ecological System. Agronomy Monograph 54. ASA-CSSA-SSSA.



Forage legumes in rotation



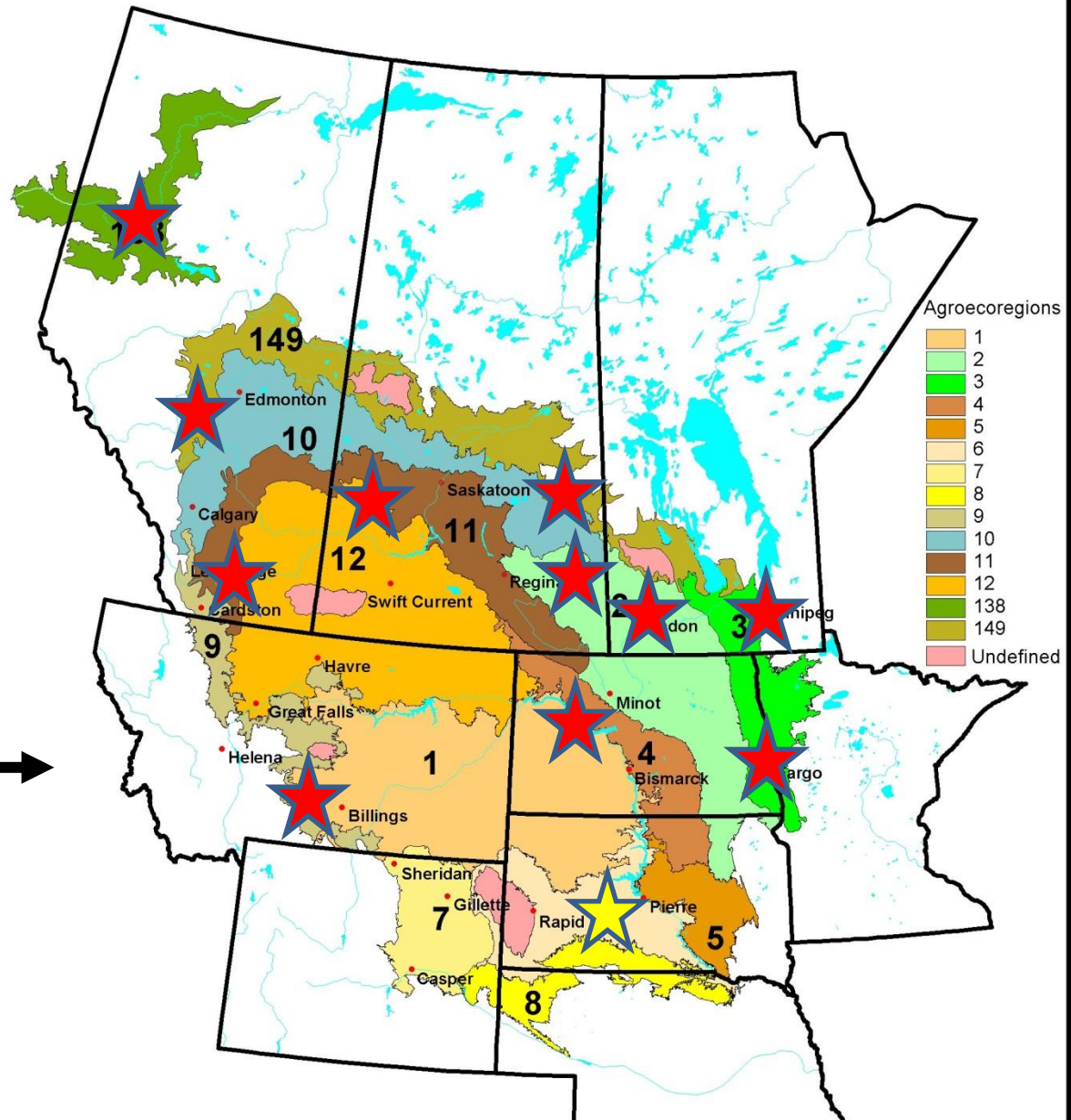


# Agronomic benefits of perennial hay phases in grain-based cropping systems

Canada



USA

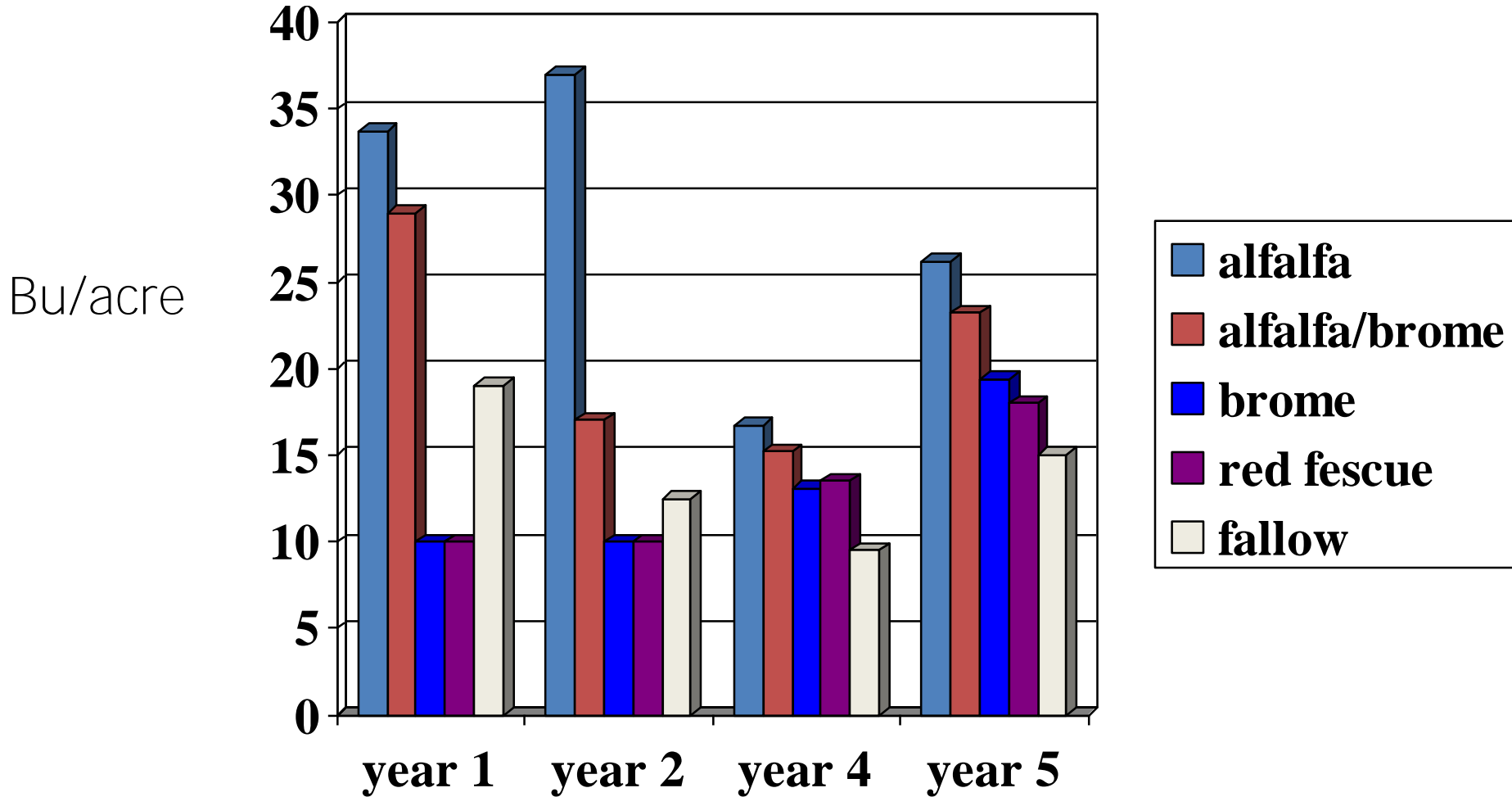


# Yields of wheat grown successively after fallow-wheat or forages Gray Luvisol soil, McLennan, Alberta

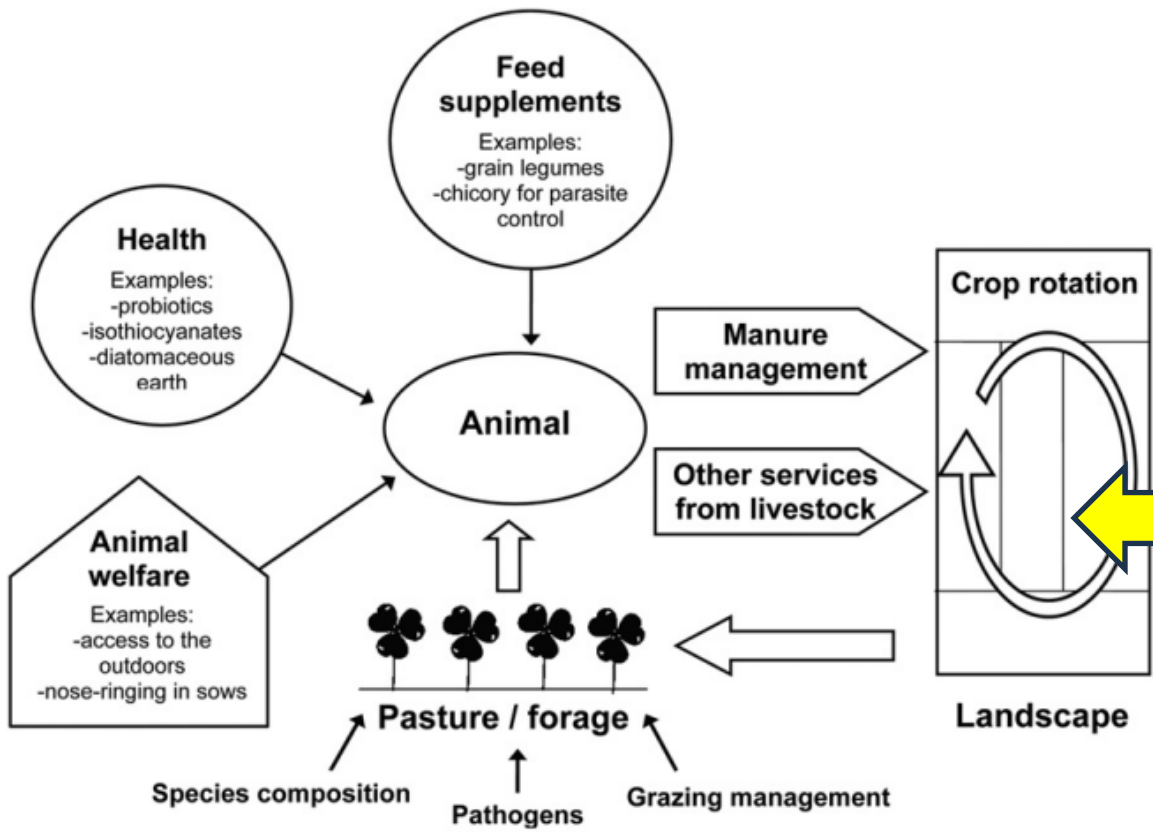


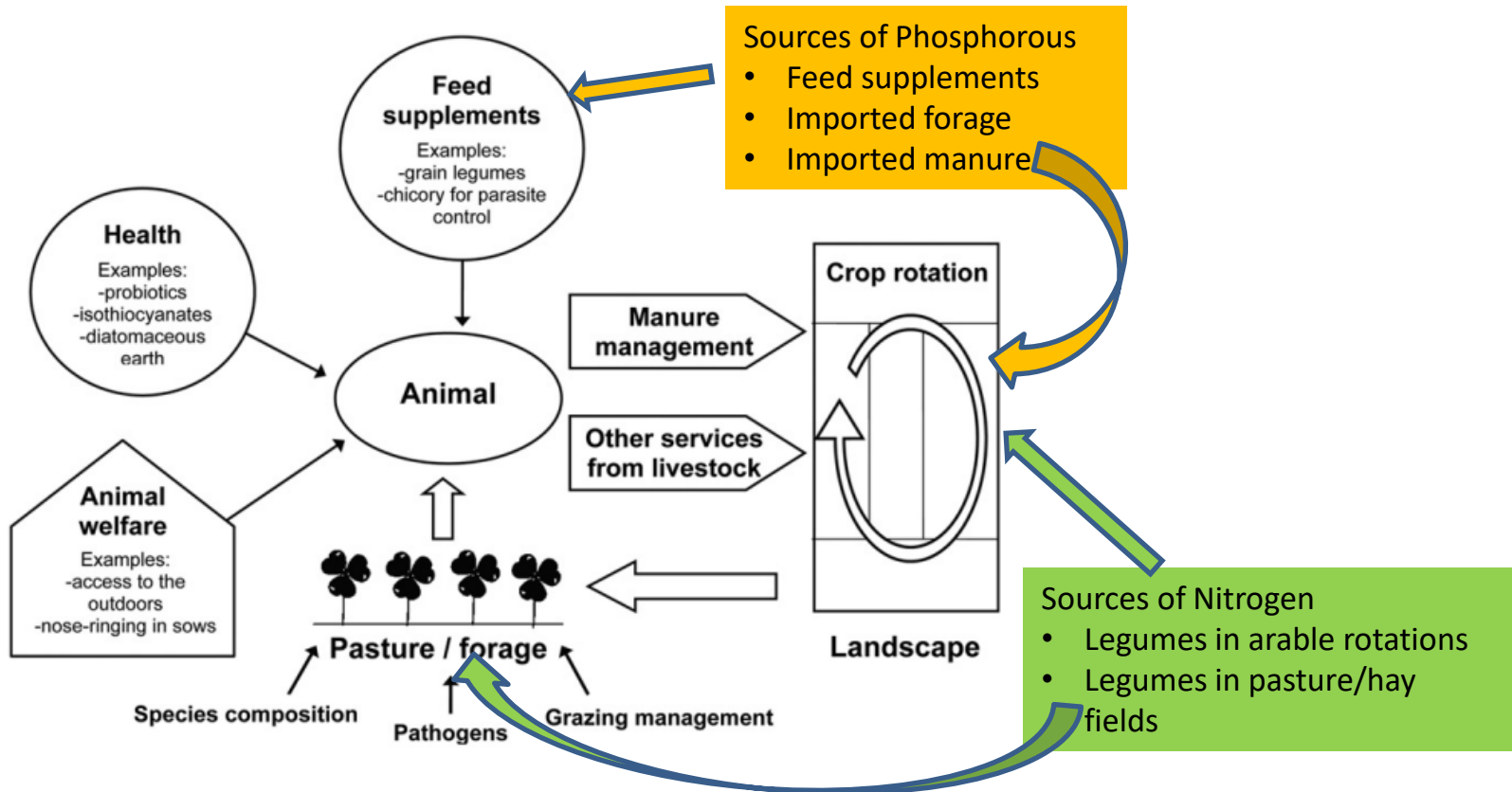
Agriculture and Agri-Food Canada

Agriculture et Agroalimentaire Canada



Connecting crops and livestock grazing green manure and cover crops





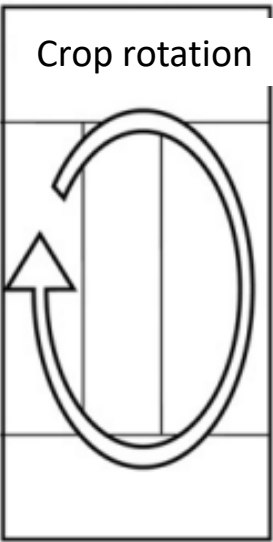
**Sources of Phosphorous**

- Feed supplements
- Imported forage
- Imported manure

**Sources of Nitrogen**

- Legumes in arable rotations
- Legumes in pasture/hay fields

Soil test to establish nutrient content

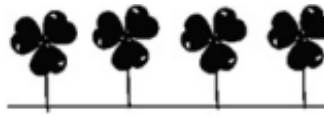


Analyze manure nutrient content



Nutrient content in feed dictates nutrient content in manure

Analyze plant nutrient content



Thistle in  
alfalfa spindly  
and investing  
energy into  
growing taller  
– to capture  
light



Cutting height



# Thanks for your attention!!

## Natural Systems Agriculture Tour

**SAVE THE DATE!**

**Tuesday, August 1, 2023**

**9 AM to 2 PM - Tour begins 9:30 sharp**

Join us for an exploration of organic and regenerative crop and soil management; and crop-livestock integration.

### Participation options

- **In person** or
- **Online.** Video tour accessed through Youtube and Zoom link to lunchtime guest speaker. Links emailed to you on July 28, but you must register.

Lunch \$20.00 **Cash only** payment at Farm and Food Discovery Centre.

Lunchtime guest speaker via Zoom is **Dr. Andreas Gattinger**, Professor of Organic Agriculture, Specialization sustainable soil management, Justus-Liebig-Universität Gießen, Germany



**REGISTRATION REQUIRED**  
please scan QR code



SCAN ME





- Investment platform established to develop organic agriculture and marketing in the Canadian Prairies
- Builds resilience in the sector by investing in
  - organic provincial associations (Capacity Fund); and
  - high impact programs (Innovation Fund) related to marketing, research, policy, education and capacity development that have broad public benefit to the organic sector.



#### Platinum Sponsors



GRAIN MILLERS



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