Welcome to this week's presentation & conversation hosted by the **Canadian Association for the Club of Rome**, a Club dedicated to intelligent debate & action on global issues.

The views and opinions expressed in this presentation are those of the speaker & do not necessarily reflect the views or positions of CACOR.

Agriculture, Climate, and Health: How Regenerative Agriculture and Plant-Rich Diets Could Reverse Climate Change and Improve Human Health.

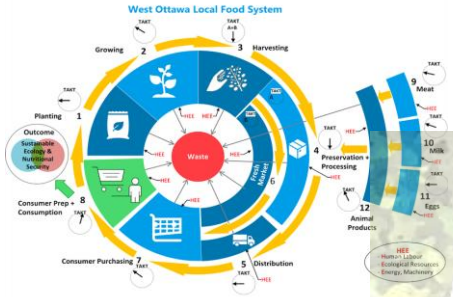
Rosemary Kralik was born in Egypt, moved to the UK when she was four years old, then immigrated to Canada with her mother. Her experience is in graphic art, architectural drafting, and systems design in management consulting. Inspired by Allan Nation and Joel Salatin's ideas about regenerative agriculture, she purchased a 73-acre farm in Hemmingford, then a 722-acre farm in the Lanark Highlands, which she manages by herself.

Barry Bruce grew up on a farm in Guelph, Ontario, and practiced family medicine in Carp for 48 years with a special interest in primary prevention. He started ExerFarm in 2018 to provide a venue for patients to get exercise and improve their nutrition. He also became involved with Deep Roots Food Hub, a NFP corporation with a mandate of food security and the construction of an above-ground, off-grid root cellar in 2018. The vision is "Sustainable Local Food Systems Everywhere."

The presentation will be followed by a conversation, questions, & observations from the participants.

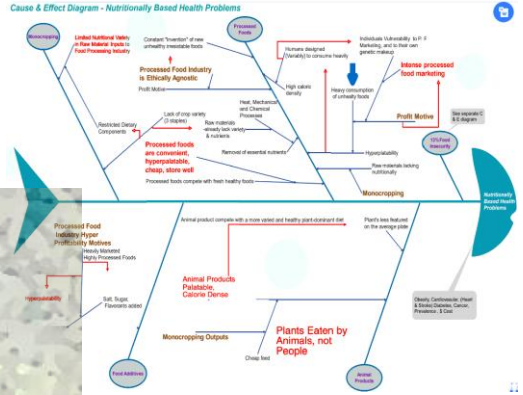
CACOR acknowledges that we all benefit from sharing the traditional territories of local Indigenous peoples (First Nations, Métis, & Inuit in Canada) and their descendants.

Website: canadiancor.com
Twitter: @cacor1968
YouTube: Canadian Association for the Club of Rome
2024 Jul 03 Zoom #204



Dr. Barry Bruce

1team4health@gmail.com

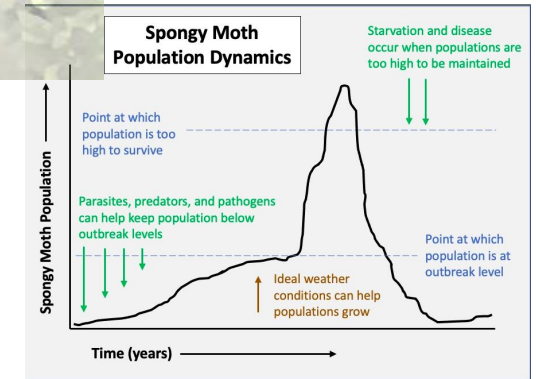


Sustainable Local Food Systems, Everywhere!

How Regenerative Agriculture and Plant-Rich diets Could Reverse Climate Change and Improve Human Health

Rosemary Kralik and Barry Bruce

CACOR **July 3, 2024**

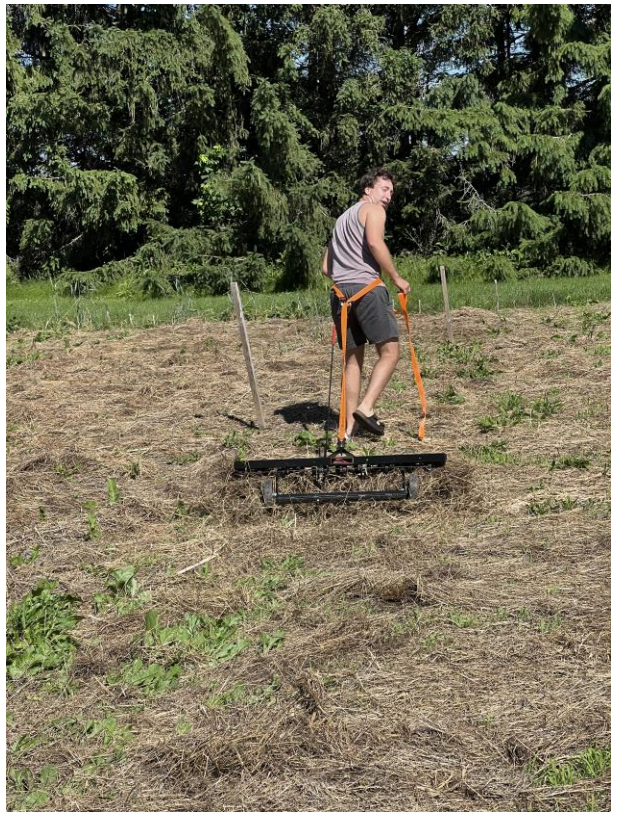


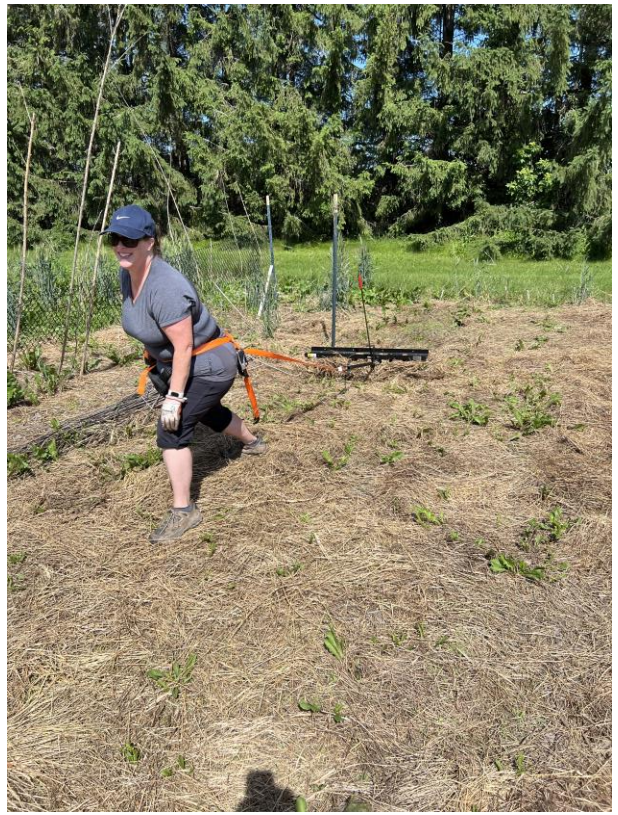
Current AgriFood System – Global performance Score = F minus and *Unsustainable!!*

- Most of crops globally feed livestock, not people
- 800 million starving
- 2+ billion food insecure
- 2+ billion “dys-nourished”, heavy meat eaters, rampant “normalized” Cardiovascular and metabolic disease
- 31 % of GHGs globally
- 75 % + of global soils degrading
  - Tilling – destroys mycorrhizal web, releases 75 % of carbon to atmospherre
  - Inorganic Fertilizers – starves soil organisms, majority washes into waterways
  - “’cides” - glyphosate and pesticides kill indiscriminately, GMOs needed to protect crops
  - Monocropping - vulnerable to pests
  - Land use has peaked, maintained by destroying forests and jungles
  - Feedlots, industrial meat – animals crowded together, disease, stress, anitbiotics
  - Food Miles ++ - especially in Canada during the winter – but commodity crops travel well…
  - Cities vulnerable to supply chain interruptions, only have 3 days of food at any one time
- Fresh water and Oceans degraded
- 30 – 50 % of food is wasted

A More Ideal Global Food System

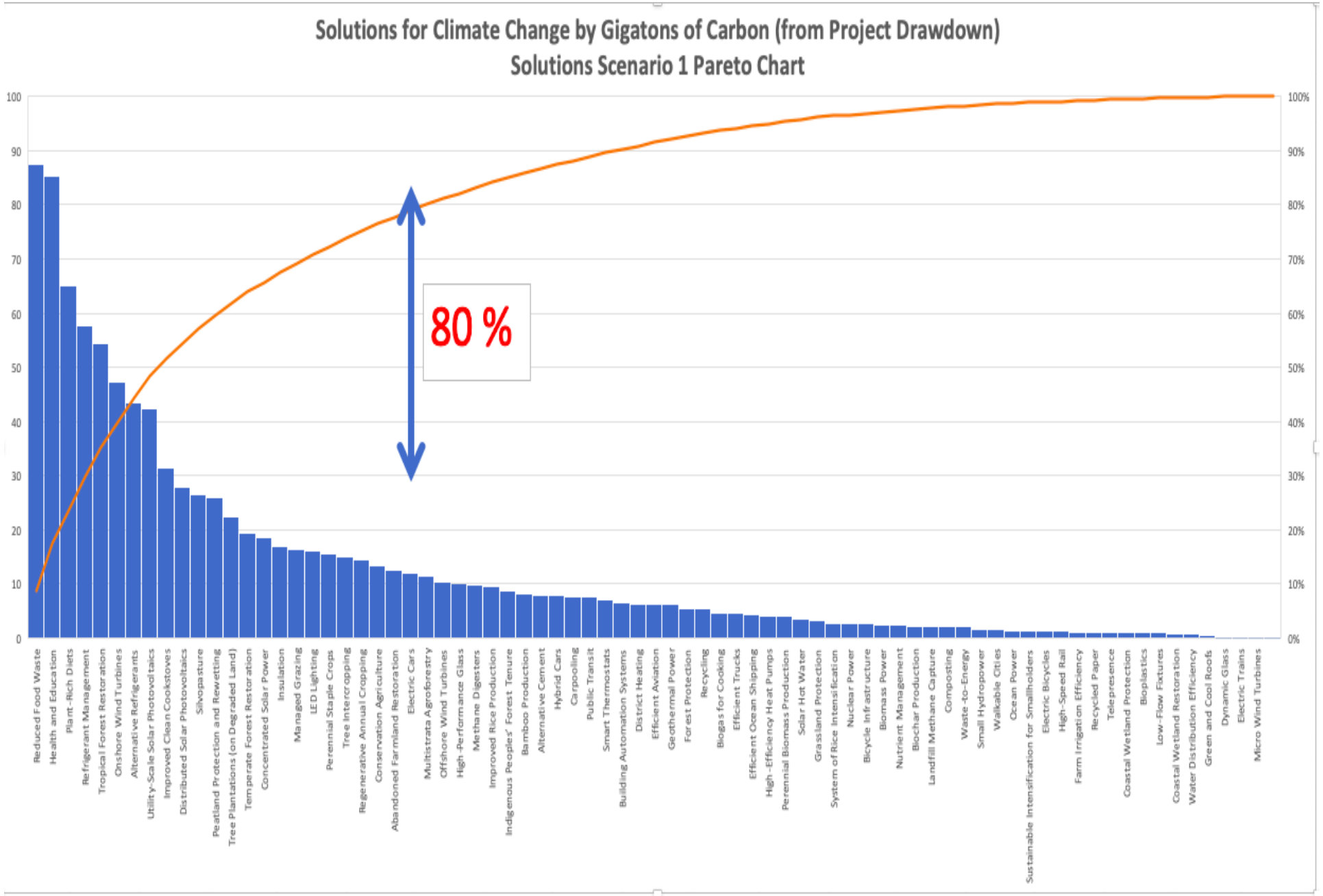
- Everyone On Planet Earth is well nourished
- GHGs massively sequestered in soils full of life forms on a global scale
- Food Production requires no tilling, herbicides, pesticides, or inorganic fertilizers
- Input costs for food production are reasonable, including materials and labor
- No food is grown as animal feed except perhaps hay for cold climates
- Plant-rich diets are the norm, and vegan diets are common
- Human Health improves due to dietary changes
- Land area needed for food production is under 2 billion acres
- Local food systems predominate on Earth
- Waterways and Oceans are not contaminated with agricultural runoff
- 8-9 billion acres are re-naturalized
- Non-human life forms have rebounded and are stable





ExerFarm - Removing Mulch in order to Plant

My 5 Year Old Granddaughter – Let's Design A Food System So That She and All other grandkids could be Healthy 104 Year olds.

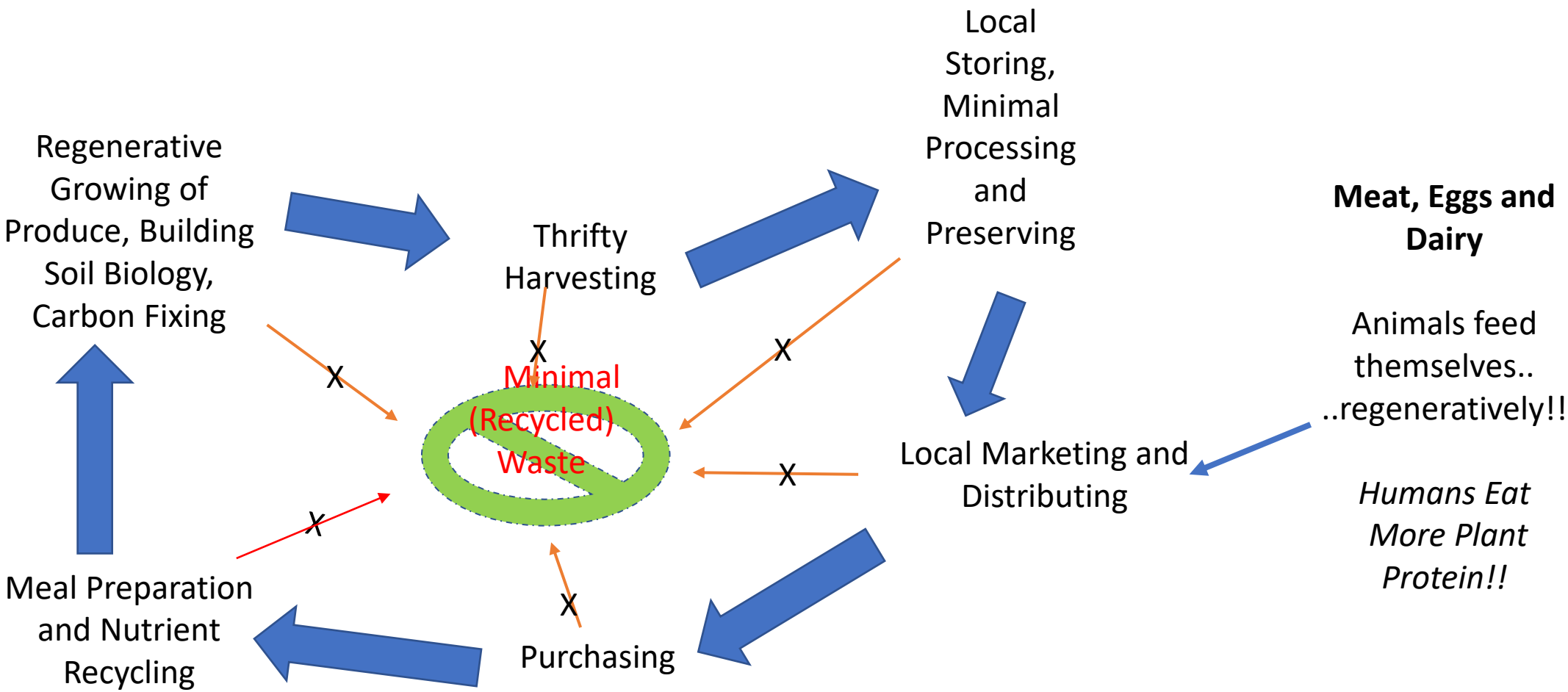


How Important are Food, Agriculture, Land Use and Land Sinks in the Big Picture??

Drawdown 25 SOLUTIONS in order of Sector to Save (80 %)	SECTOR(S)	SCENARIO 1 *
Reduced Food Waste	Food, Agriculture, and Land Use / Land Sinl	87.45
Plant-Rich Diets	Food, Agriculture, and Land Use / Land Sinl	65.01
Tropical Forest Restoration	Land Sinks	54.45
Silvopasture	Land Sinks	26.58
Peatland Protection and Rewetting	Food, Agriculture, and Land Use / Land Sinl	26.03
Tree Plantations (on Degraded Land)	Land Sinks	22.24
Temperate Forest Restoration	Land Sinks	19.42
Managed Grazing	Land Sinks	16.42
Perennial Staple Crops	Land Sinks	15.45
Tree Intercropping	Land Sinks	15.03
Regenerative Annual Cropping	Food, Agriculture, and Land Use / Land Sinl	14.52
Conservation Agriculture	Food, Agriculture, and Land Use / Land Sinl	13.4
Abandoned Farmland Restoration	Land Sinks	12.48
	Total	***388.48***
Refrigerant Management	Industry / Buildings	57.75
Onshore Wind Turbines	Electricity	47.21
Alternative Refrigerants	Industry / Buildings	43.53
Utility-Scale Solar Photovoltaics	Electricity	42.32
Improved Clean Cookstoves	Buildings	31.34
Distributed Solar Photovoltaics	Electricity	27.98
Concentrated Solar Power	Electricity	18.6
Insulation	Electricity / Buildings	16.97
LED Lighting	Electricity	16.07
Health and Education	Health and Education	85.42
Electric Cars	Transportation	11.87
	Total	***399.06***

Food, Agriculture, Land Use, and Land Sinks = About Half of the 80 %

Generic Elements of a Sustainable Local Food System



Barry Bruce MD, FCFP
Deep Roots Food Hub
https://www.deeprootsfoodhub.ca/

XRFRM: I DIG CARROTS 2023

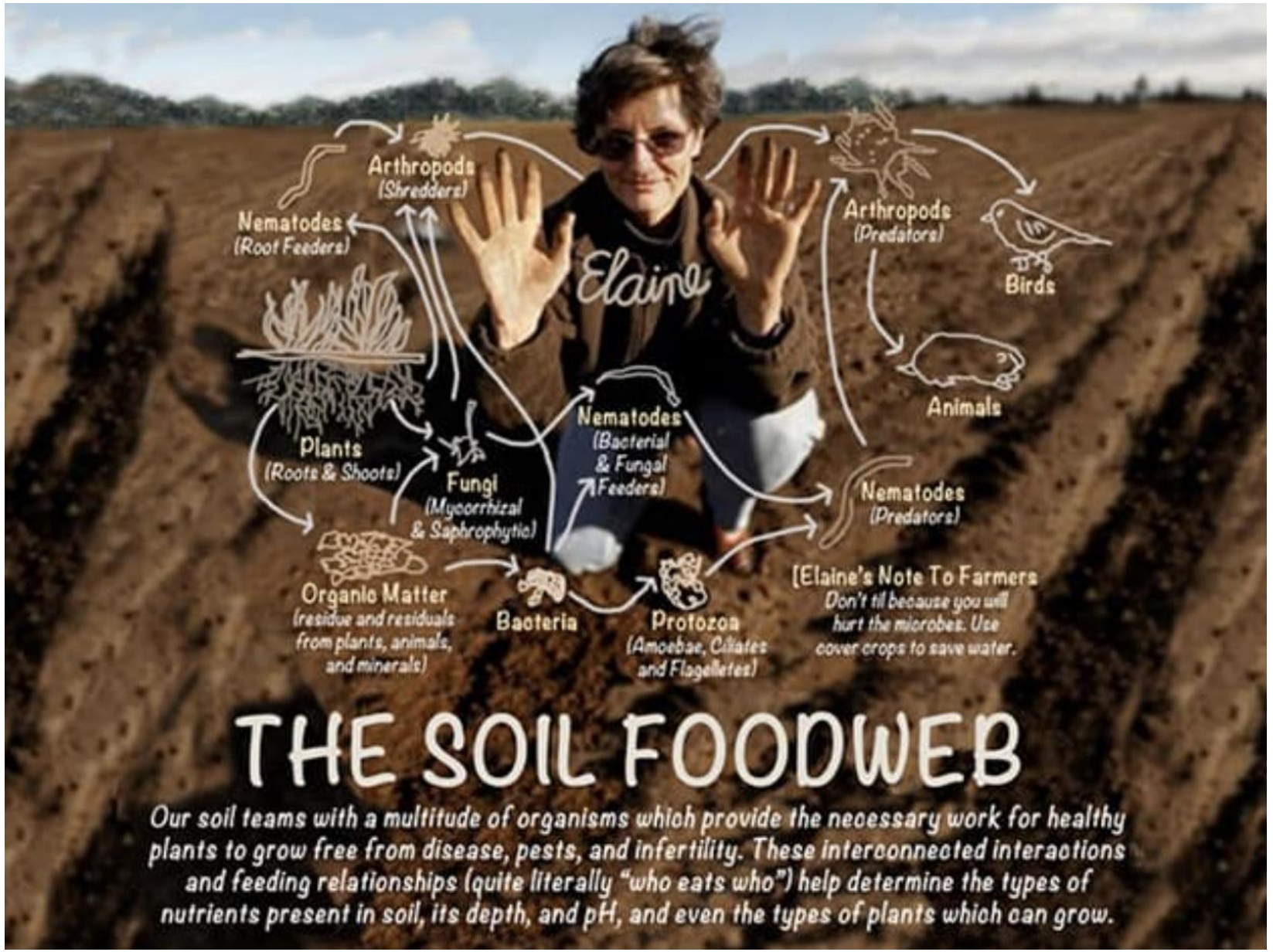
September 29 2023
ExerFarm Carrots Grown
Regeneratively

- No Tilling
- No Fertilizer
- No Insecticides, Herbicides
- No Irrigation

About 11 hours per week of volunteer labor, ¼ acre

Weeded with lawnmower, scythe, string trimmer

Some fungal amendments in 2022 (local Johnson-Su Reactor)



https://www.soilfoodweb.com/resources/animations-videos/?vID=372478833&h=7c10d53c26

Dr. Elaine Ingham's "Soil Food Web"… fungal mycorrhizae, bacteria, nematodes, protozoa, worms, arthropods, work with plant roots which provide energy for the whole system of ***carbon-based life forms.***

The Elephant In The Room Is Actually A Cow

Sustainability Hub Southeast Asia
122 followers

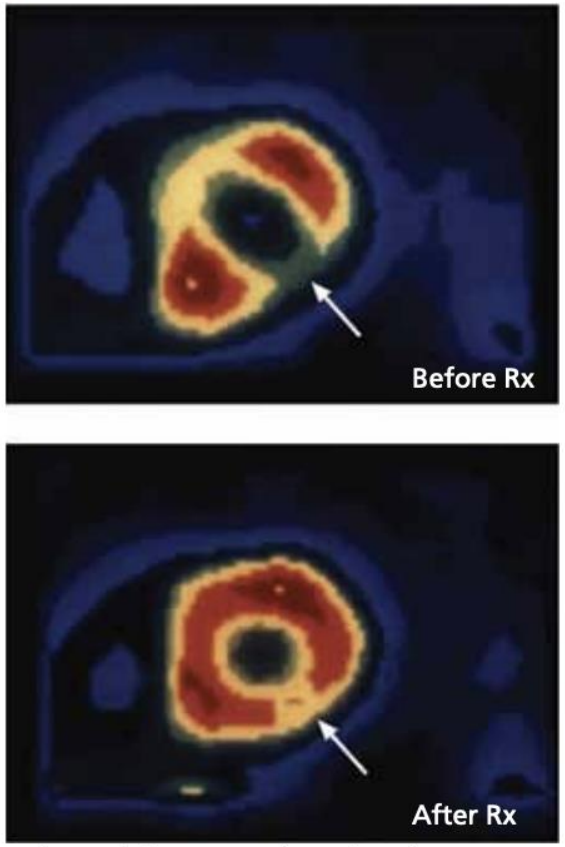
July 19, 2023

For Every 25 calories of food put into a cow, we get 1 calorie out plus a pile of methane, antibiotic resistant bacteria, and chronic human diseases


iStock
Credit: dhughes9
174479340

FIGURE 1

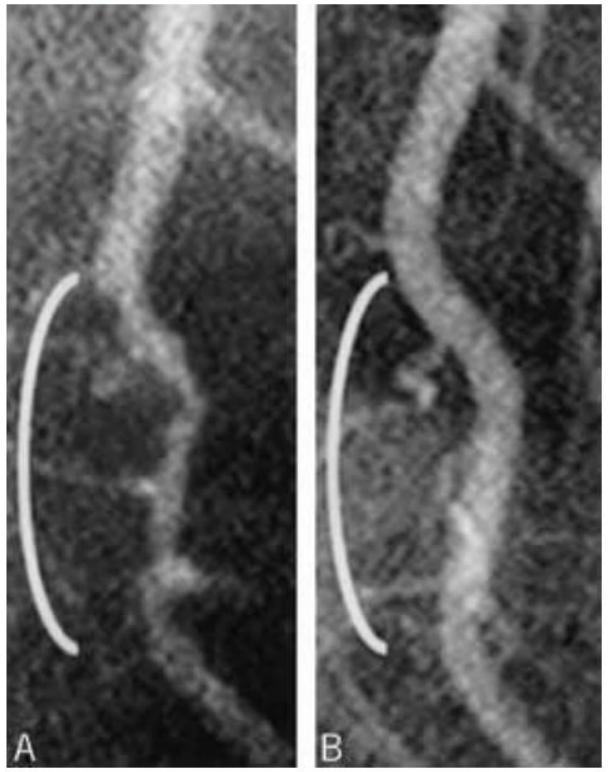
Restoration of myocardial perfusion[2]



Positron emission tomography performed on a patient with coronary artery disease shows an area of myocardium with insufficient blood flow (top). Following only 3 weeks of plant-based nutritional intervention, normal blood flow was restored (bottom).

FIGURE 2

Reversal of coronary artery disease[4]



Coronary angiography reveals a diseased distal left anterior descending artery (A). Following 32 months of a plant-based nutritional intervention without cholesterol-lowering medication, the artery regained its normal configuration (B).

"Proper nutrition, through a whole food, plant-based diet, & a balanced lifestyle is essential for health & can be the difference between healing an illness or treating its symptoms." - Dr Klaper

Dr. Esselstyne – 198 patients with established CVD treated with a **plant-based diet**. 177 adhered, 21 did not.

Of the 177, 1 stroke occurred

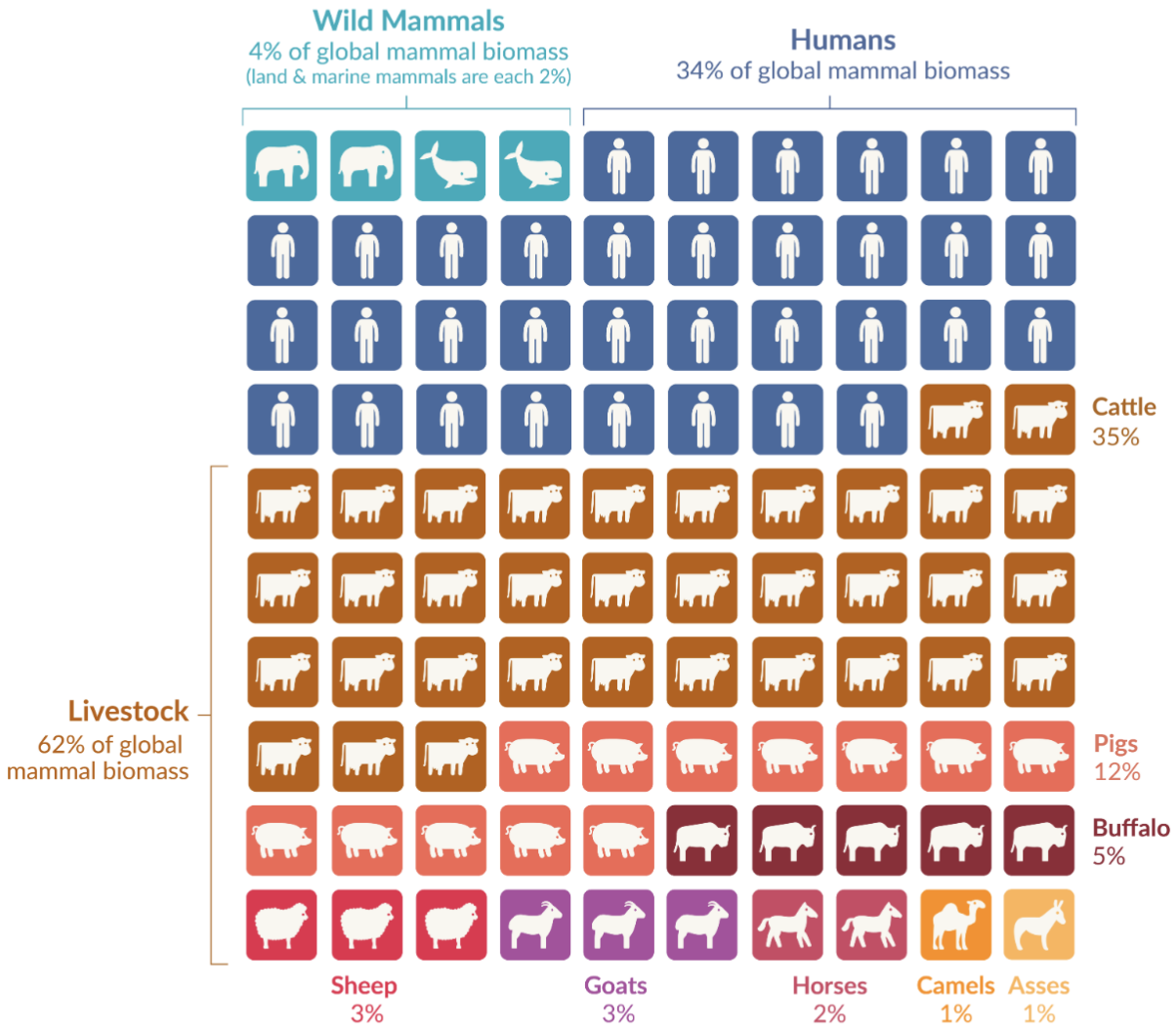
Of the 21, 16 had adverse outcomes (100 times the above event rate)

Figure 1 shows restoration of blood flow after 3 weeks of a plant-based diet.

Distribution of mammals on Earth

Our World in Data

Mammal biomass is measured in tonnes of carbon, and is shown for the year 2015. Each square corresponds to 1% of global mammal biomass.



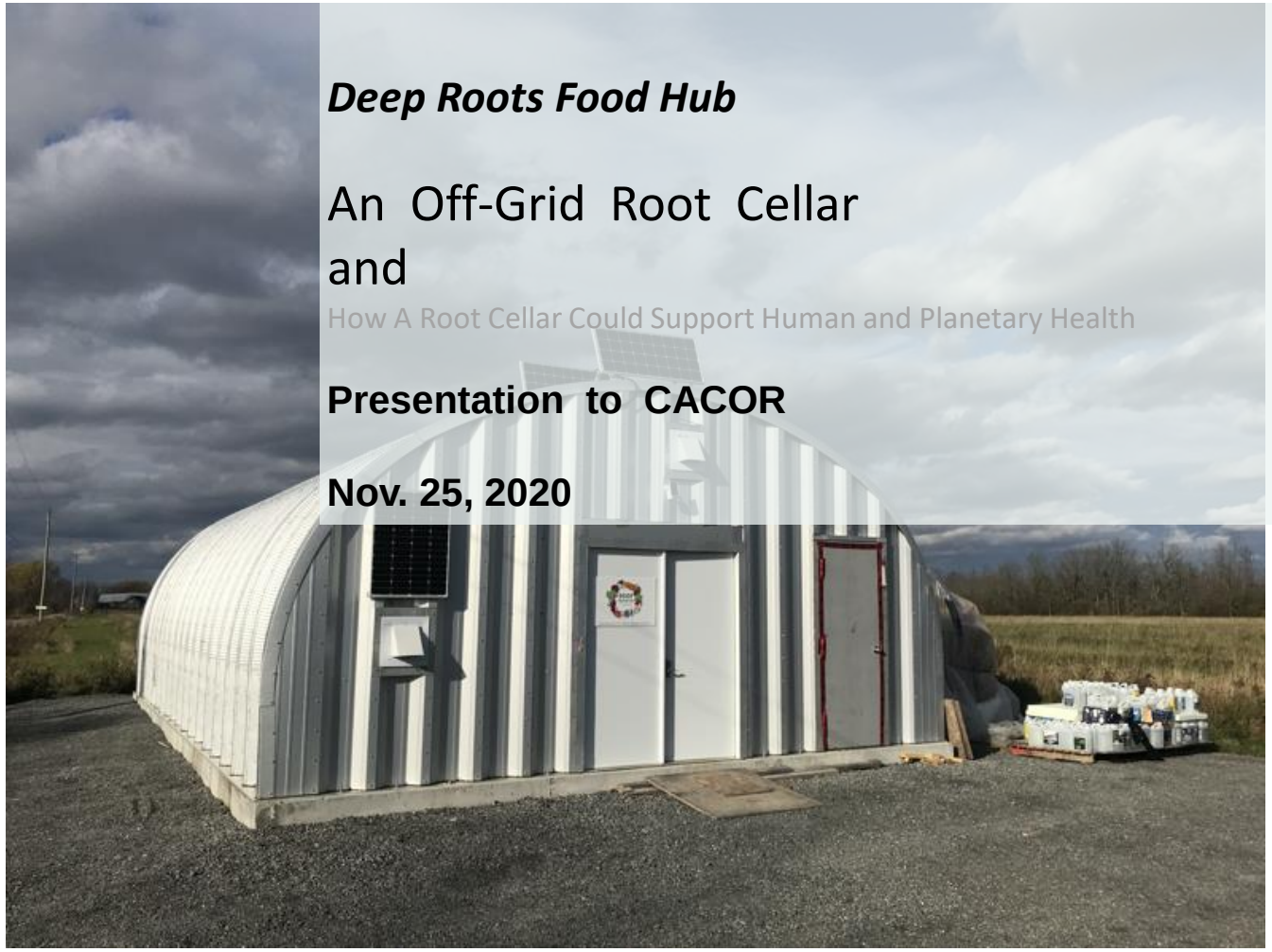
Note: An estimate for pets has been included in the total biomass figures, but is not shown on the visualization because it makes up less than 1% of the total.

Each icon is equivalent to around one million tonnes of carbon. This includes both land and marine wild mammals.

Wild mammals make up just 4% of the mammal kingdom.

The dominance of humans is clear. Alone, we account for around one-third of mammal biomass. Almost ten times greater than wild mammals.

Our livestock then accounts for almost two-thirds. Cattle weigh almost ten times as much as all wild mammals combined. The biomass of all of the world's wild mammals is about a third of our pigs alone.



Deep Roots Food Hub

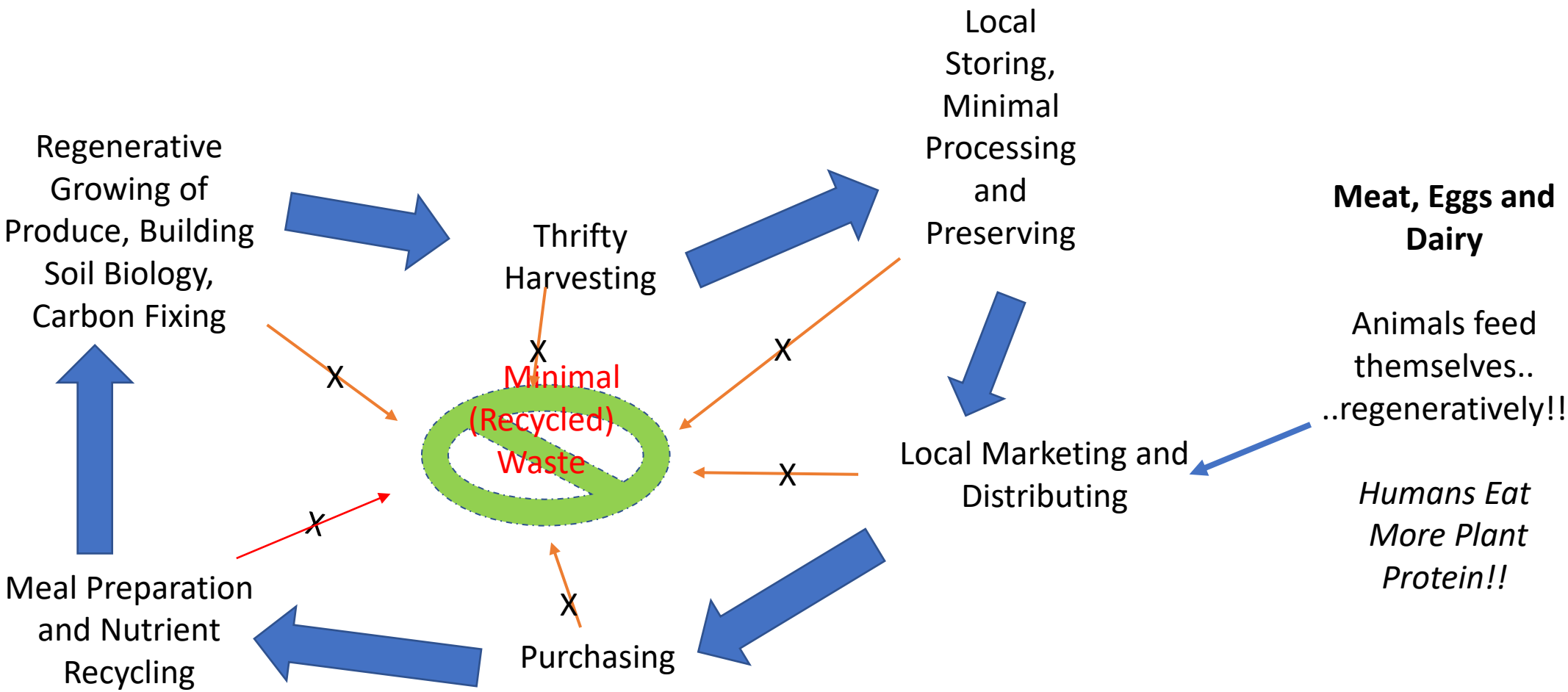
An Off-Grid Root Cellar
and
How A Root Cellar Could Support Human and Planetary Health

Presentation to CACOR

Nov. 25, 2020

ExerFarm Produce, Heading for the Root Cellar

Generic Elements of a Sustainable Local Food System

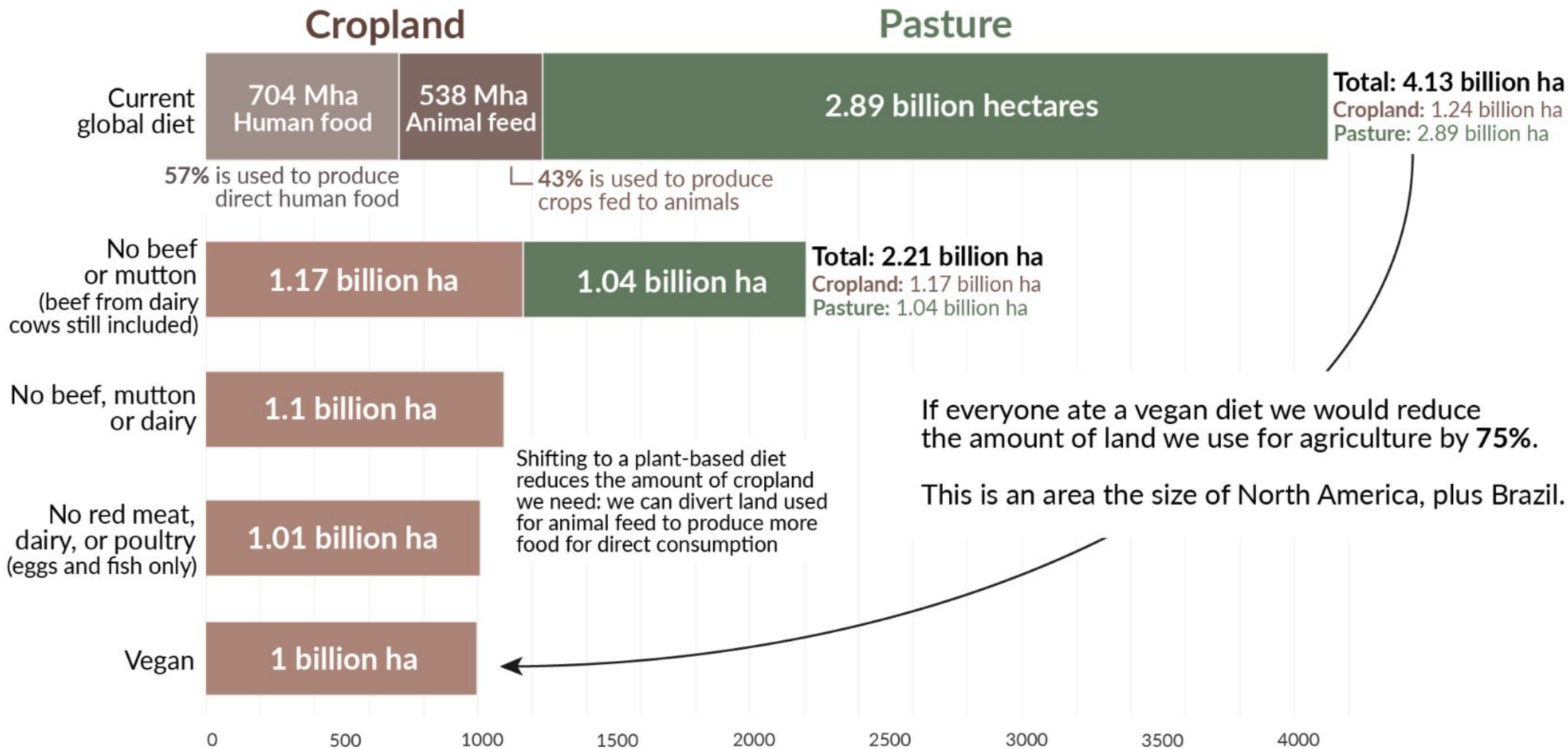


Barry Bruce MD, FCFP
Deep Roots Food Hub
https://www.deeprootsfoodhub.ca/

Global land use for agriculture across different diets

Our World in Data

Global agricultural land use is given for cropland and pasture for grazing livestock assuming everyone in the world adopted a given diet. This is based on reference diets that meet calorie and protein nutritional requirements.



Data Source: Joseph Poore & Thomas Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*.

OurWorldinData.org – Research and data to make progress against the world's largest problems.

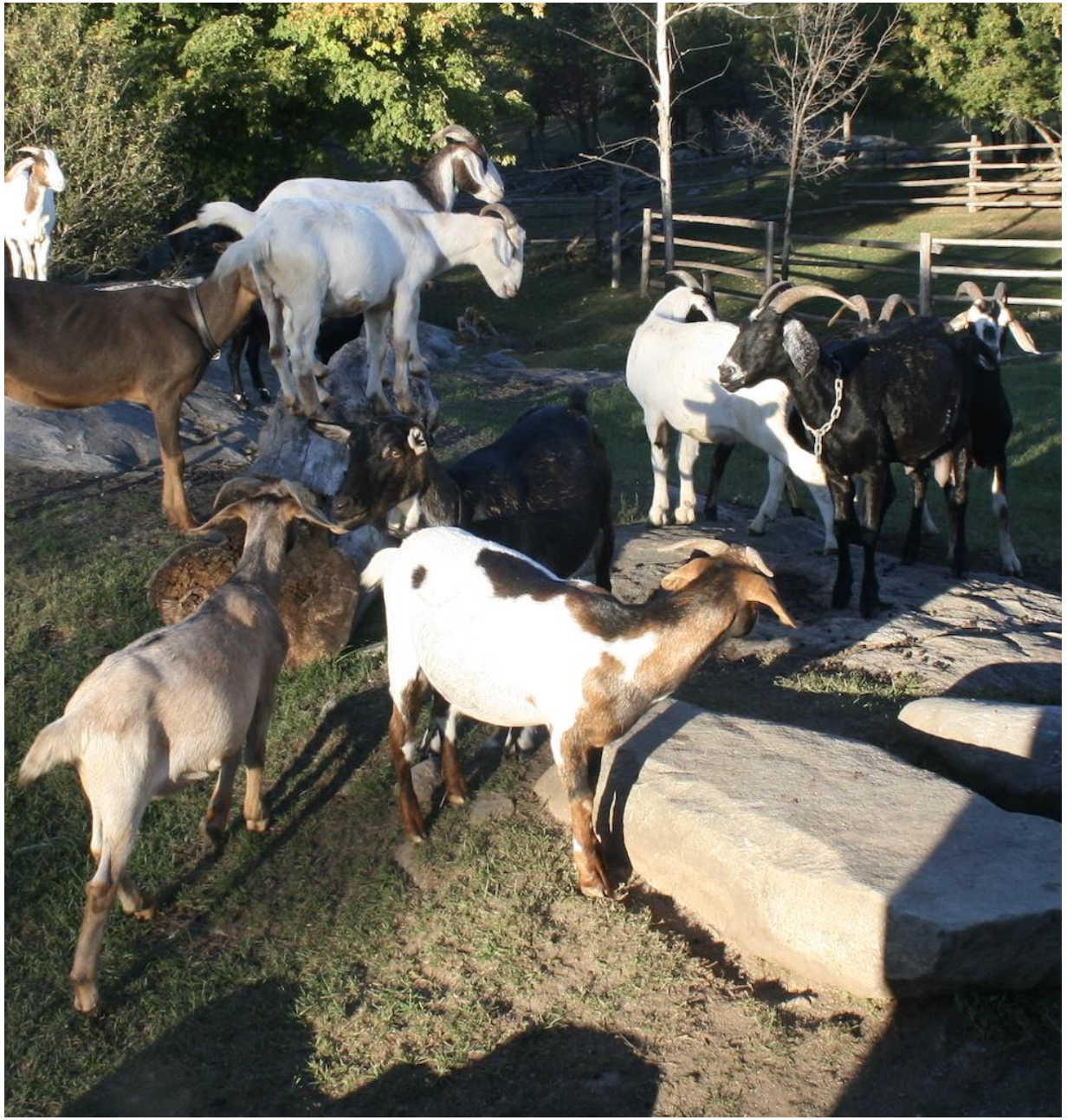
Rosemary's Bull Yak

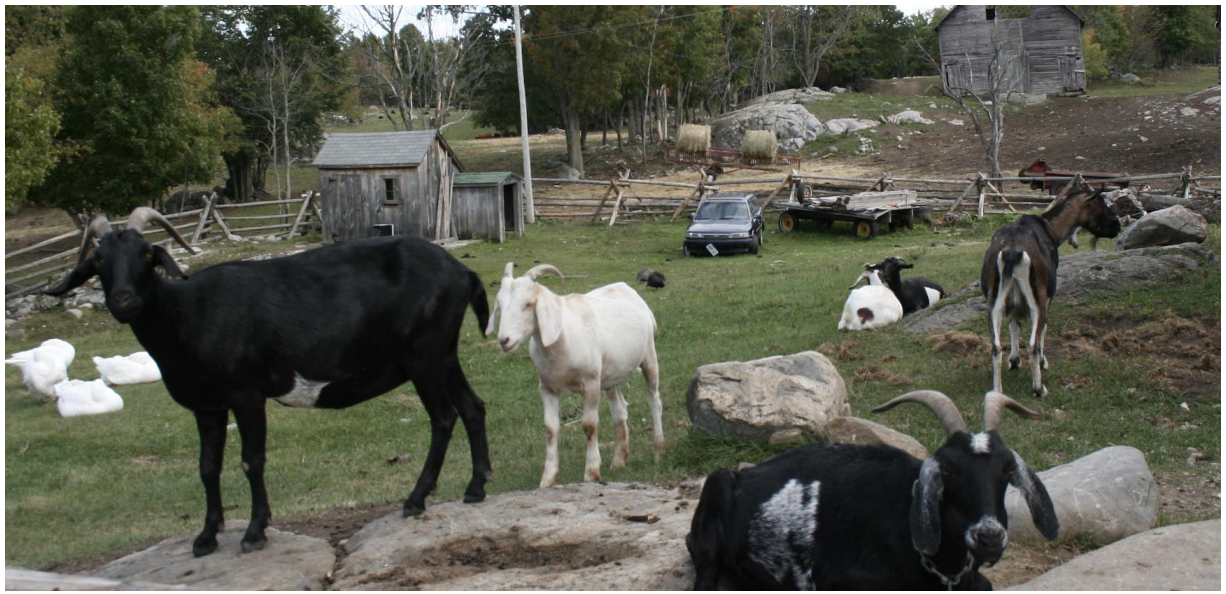
Jeannie and Bull

MORE BULL

Yet more bull

Declan & Rufous





Goats at Play

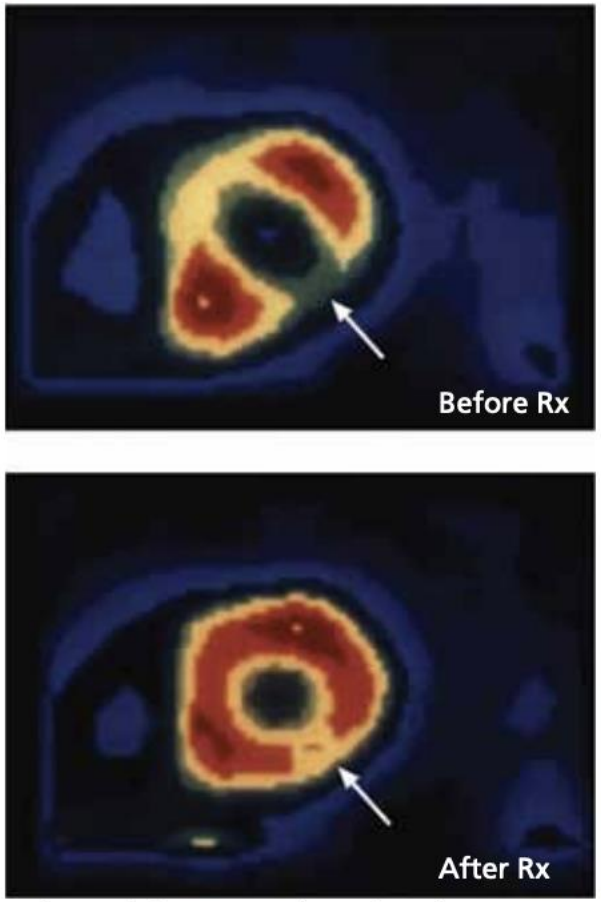

Highlands

Resting

William

FIGURE 1

Restoration of myocardial perfusion[2]



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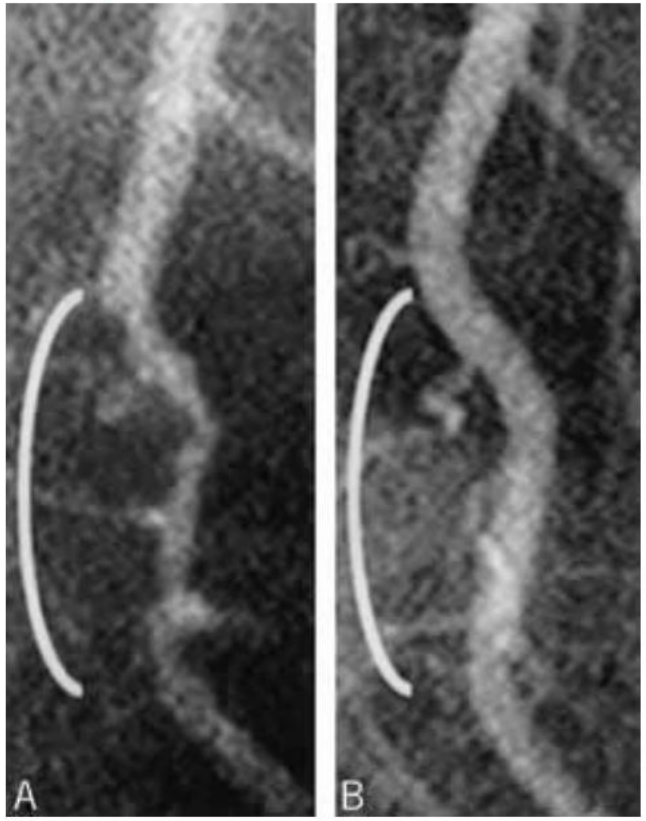

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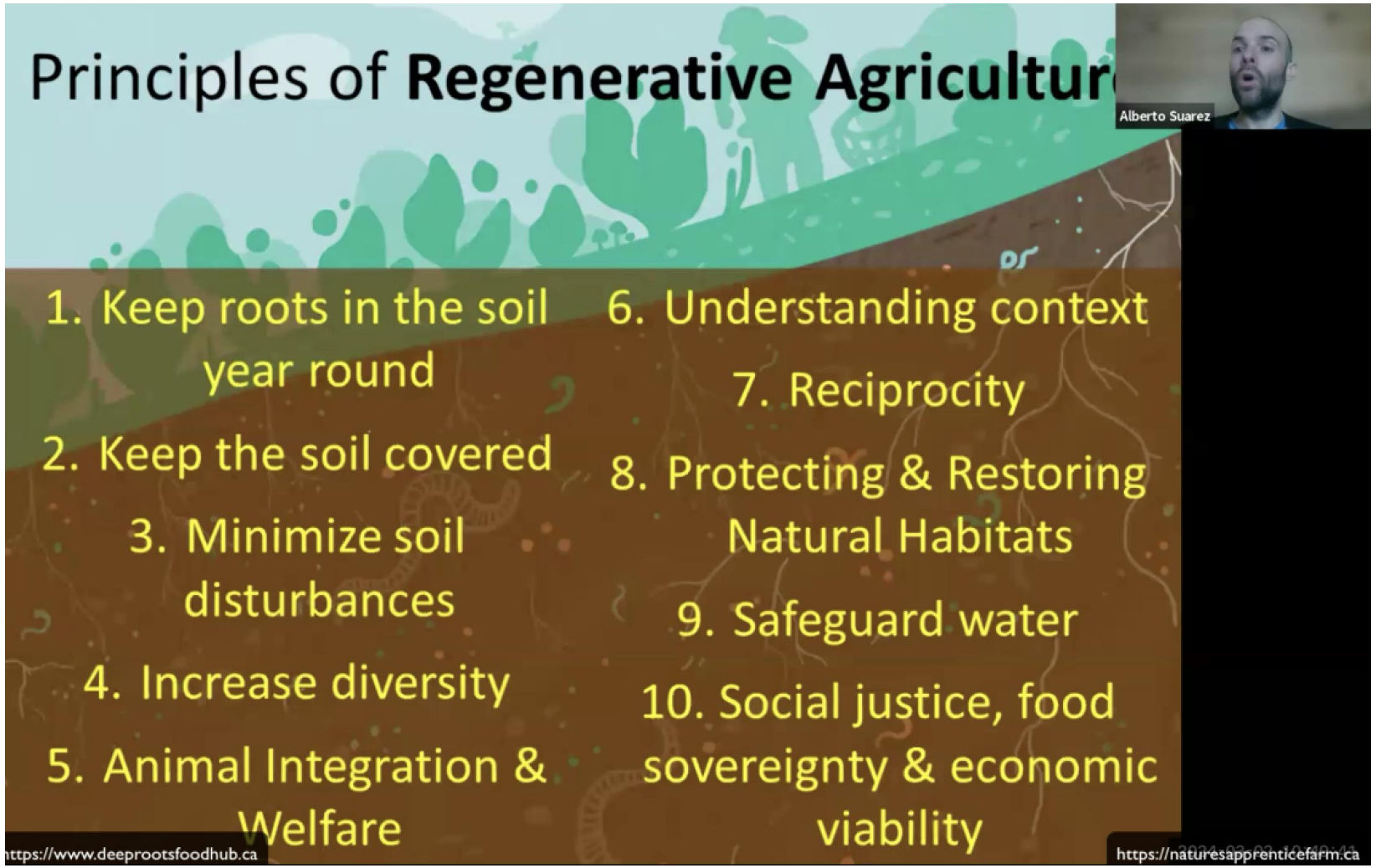
Figure 1 shows restoration of blood flow after 3 weeks of a plant-based diet.

“Sustainable Local Food System” would be designed:

- To maximize carbon sequestration through regenerative agriculture
- to foster the production of food varieties that are attuned to the local environment, as opposed to being able to travel for thousands of kilometers,
- to have economies, but not diseconomies, of scale
- to preserve locally as needed (eg considering the short Canadian growing season)
- to market and distribute as locally as possible
- to educate consumers and to provide them with tools for a plant-rich diet
- to ensure that no one suffers from food insecurity within the local food system
- To be an efficient, sufficient, and waste-free circular food economy
- To be replicated


DESIGN
FORTHE WORST
BELIEVING
WE ARENOT SEPARATE FROM ORABOVE NATURE
DESIGN FORTHE POWER DOUBLE DOUBLE
DESIGN YOUR OWN ECONOMY
SKETCH: HEY EVERYBODY LETSFAIL!
THINK LIKEYOU ARE LOSTIN THE FOREST
BE WHOLE BRAIN CREATIVE ITSATALENT ANDA SKILL
COMPETE WITH BEAUTY
DESIGN FOR ALLTHE SENSES
RISE ABOVE THE NOISE
DESIGN THE DIFFERENCE NOT THE OBJECT
DESIGN THE PLATFORM FOR CONSTANT DESIGN
SCALE FOR IMPACT
DESIGN THE INVISIBLE
DESIGN THENEW NORMAL
DESIGN WHAT YOUDO TOTELL YOUR STORY
NEW WICKED PROBLEMS DEMAND NEW WICKED TEAMS
THOSE WHODO TEACH GETOUT THERE ANDDO
WORK ON WHAT YOU LOVE

The End


Principles of Regenerative Agricultur
Alberto Suarez
1. Keep roots in the soil year round
2. Keep the soil covered
3. Minimize soil disturbances
4. Increase diversity
5. Animal Integration & Welfare
6. Understanding context
7. Reciprocity
8. Protecting & Restoring Natural Habitats
9. Safeguard water
10. Social justice, food sovereignty & economic viability
https://www.deeprootsfoodhub.ca
https://naturesapprenticefarm.ca


Principles of Soil Health (and Reg. Agriculture)
1. Keep it PLANTED
2. Keep it COVERED
3. MINIMIZE DISTURBANCES
4. Increase DIVERSITY
5. CHEMICAL FREE
6. ANIMAL INTEGRATION
7. Work with your CONTEXT
For more principles visit
regenerationcanada.org

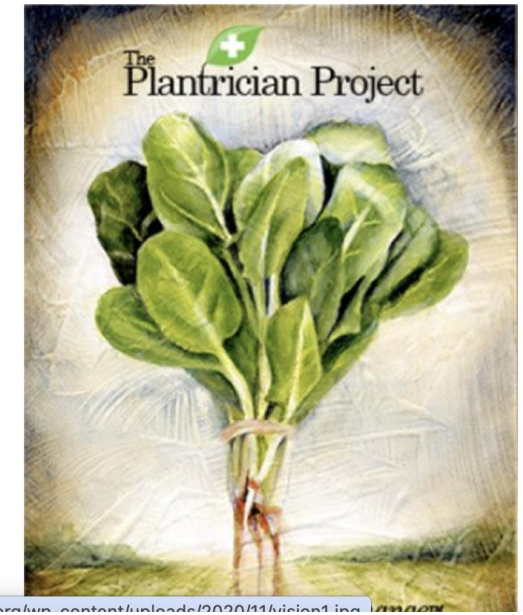
Where's My Crop??? ExerFarm - Beets and Carrots, trial for EFAO July 3 2024

Plantrician Project

Our Vision

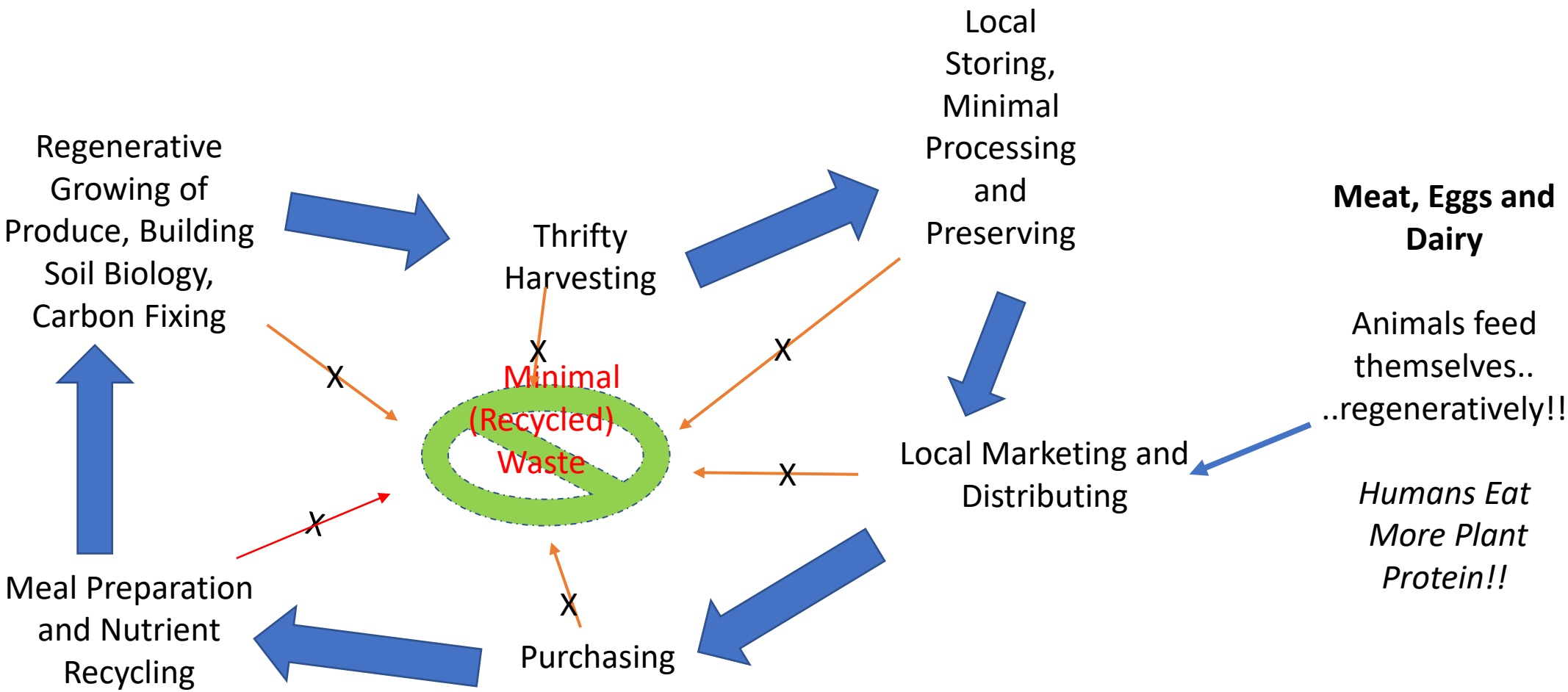
A nation—and a world—in which all physicians, healthcare providers and, health influencers have embraced the dietary paradigm shift to a whole food, plant-based diet; in turn, effectively promoting patient and client adoption of this health-protecting, disease-fighting way of living.

The result: the transformation and regeneration of human health, health care, and the food ecosystem.



https://plantricianproject.org/regenerative-health-institute

Generic Elements of a Sustainable Local Food System



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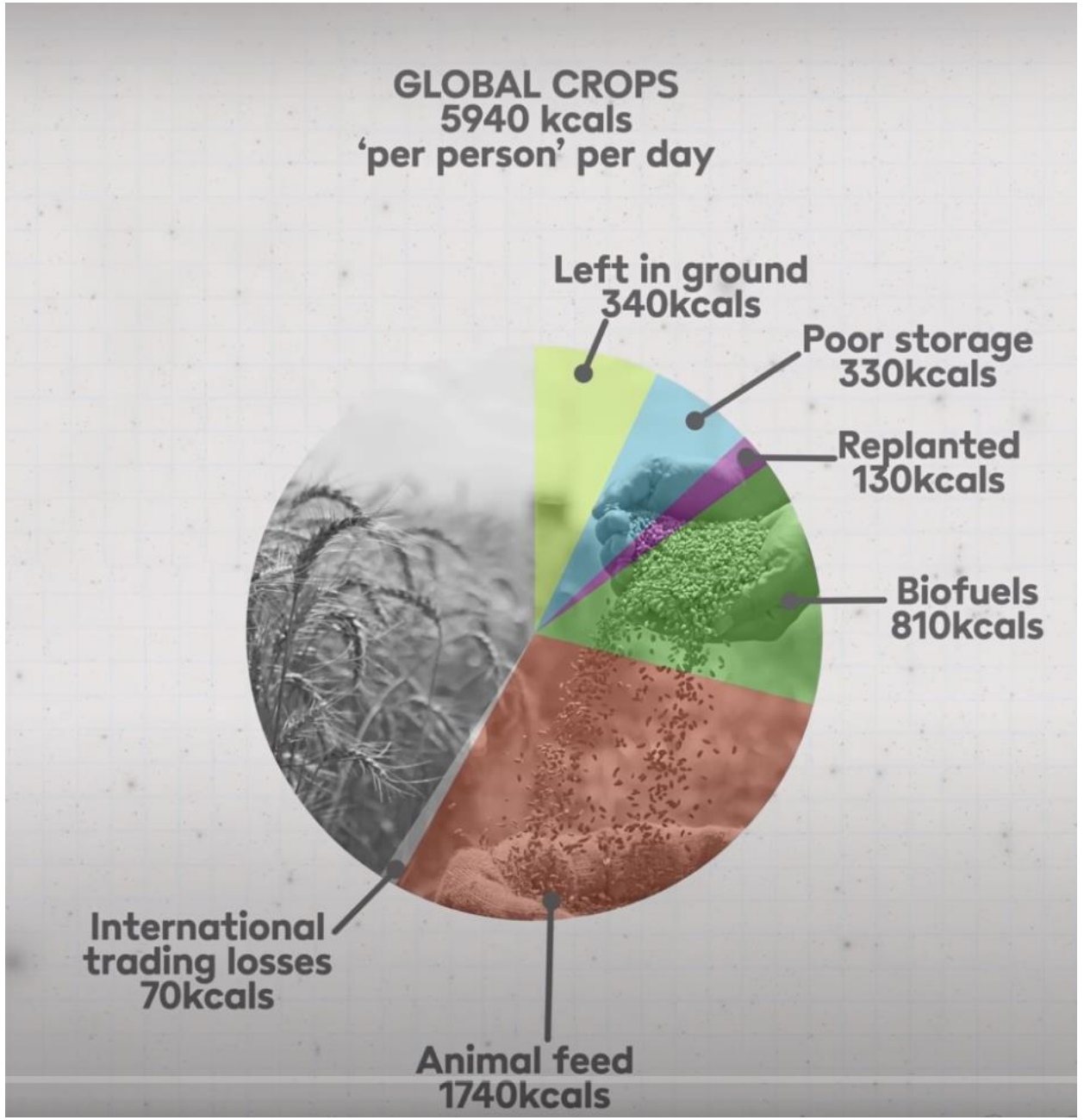
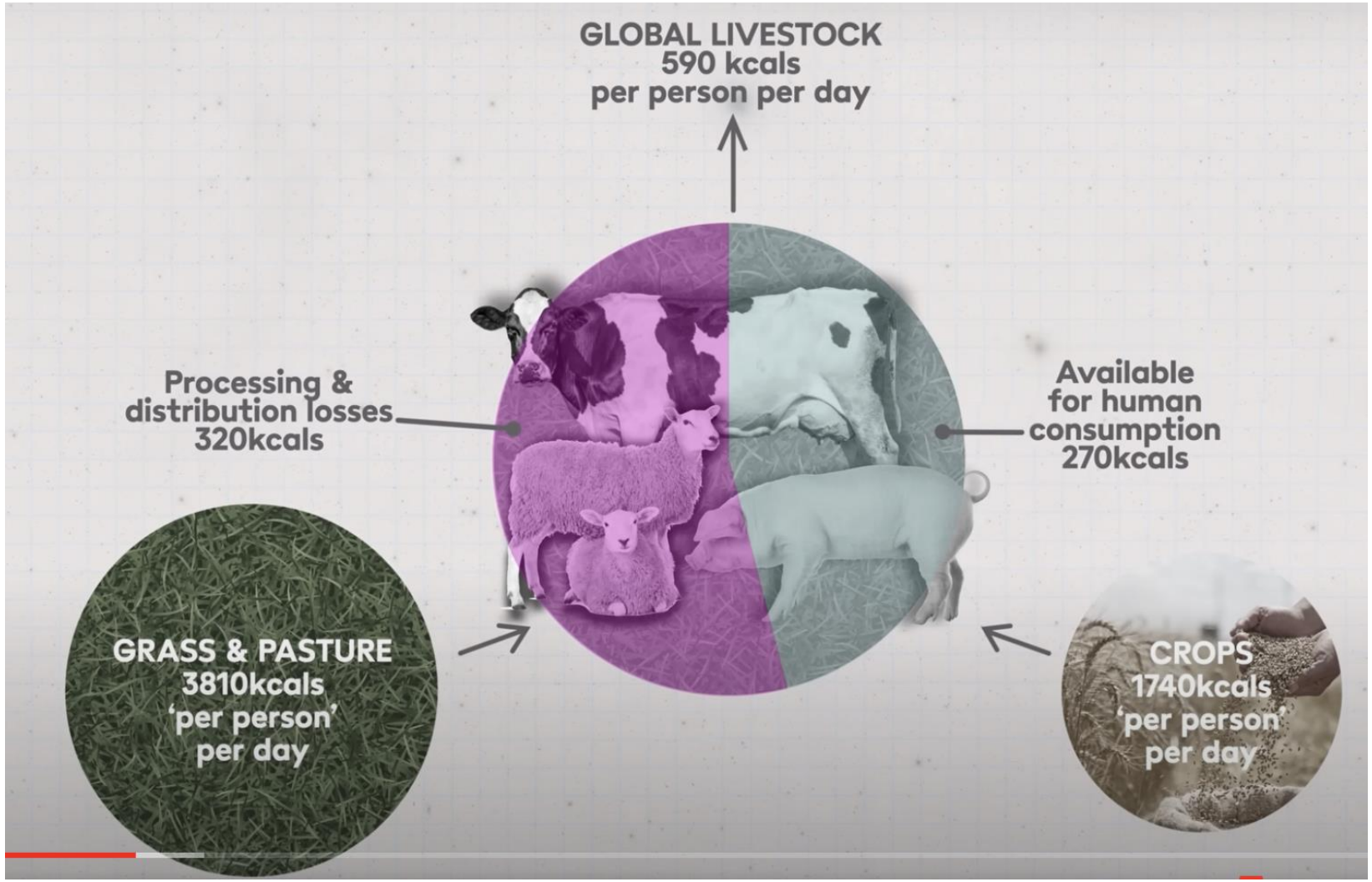
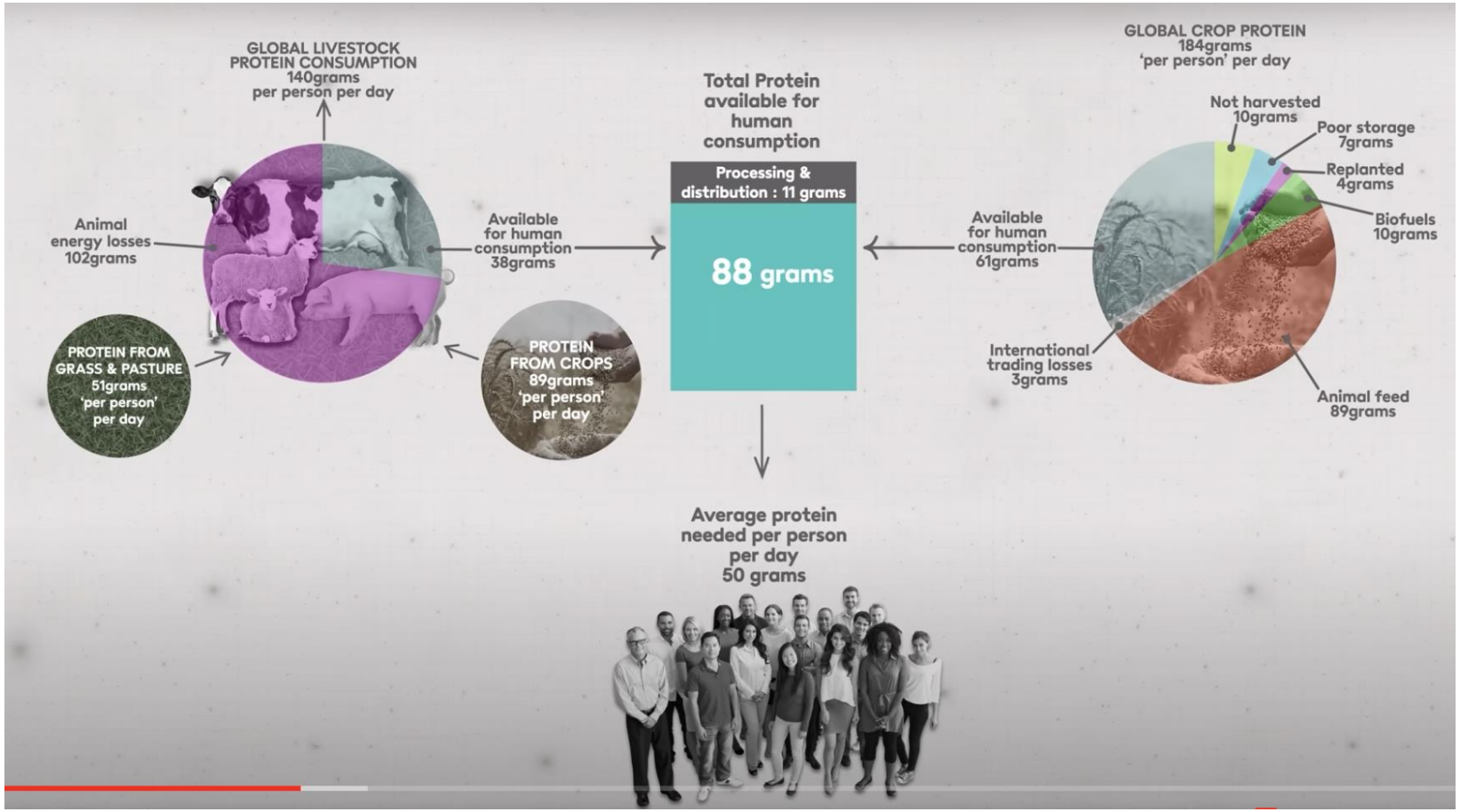
How *NOT* to Make the Great (Plant-Rich Diet) Leap!!

- Fail to design an alternative food system
- Fail to make a plant-rich diet sensually appealing
- Fail to make a plant-rich diet affordable
- Fail to make a plant-rich diet easily available
- Institute bans and restrictions
- Fail to involve the community
- Fail to decentralize food production


GLOBAL CROPS
5940 kcals
'per person' per day
Left in ground
340kcals
Poor storage
330kcals
Replanted
130kcals
Biofuels
810kcals
International
trading losses
70kcals
Animal feed
1740kcals


GLOBAL LIVESTOCK
590 kcals
per person per day
Processing &
distribution losses
320kcals
Available
for human
consumption
270kcals
GRASS & PASTURE
3810kcals
'per person'
per day
CROPS
1740kcals
'per person'
per day


GLOBAL LIVESTOCK PROTEIN CONSUMPTION 140grams per person per day
Animal energy losses 102grams
Available for human consumption 38grams
PROTEIN FROM GRASS & PASTURE 51grams 'per person' per day
PROTEIN FROM CROPS 89grams 'per person' per day
Total Protein available for human consumption
Processing & distribution : 11 grams
88 grams
Available for human consumption 61grams
GLOBAL CROP PROTEIN 184grams 'per person' per day
Not harvested 10grams
Poor storage 7grams
Replanted 4grams
Biofuels 10grams
International trading losses 3grams
Animal feed 89grams
Average protein needed per person per day 50 grams

https://gamechangersmovie.com/

The Elephant in the Room is Really a Cow!!!

https://link.springer.com/article/10.1007/s11625-022-01235-7

“Only 6 % of global soybean goes to feed humans, in spite of having all we need as humans….”
2/3 of global antibiotics go into animals. <<because those animals, not Rosemary’s, are unhealthy – crammed into unsanitary spaces, fed unnatural foods, shortened life – inevitably, organisms with antibiotic resistance cross over to humans>>

https://canadiancor.com/breaking-news/we-need-to-talk-about-your-starving-grandchildren/

Revised Overview June 21 2024

1. What we're going to tell you, from the point of view of a pessimist (the view we should be taking, with a probability lens and also, using the Precautionry Principle).
    1. Climate is deteriorating and time is running out and there's a growing urgency because ?? Nations set goals well into the future and then relax….
    2. Adding greenhouse gas is a problem
    3. Failure to remove greenhouse gas (especially CO2) is a problem
    4. Token, high-cost technological methods of carbon capture don't have much capacity, except as a climate tranquilizer.
    5. Burning fossil fuels only adds to the problem
    6. Our Agri-food system adds to the problem, but also, fails to use the vast carbon sink that only it can fill
    7. We'll show you how it's possible that the Agri-Food system could both reduce adding **and** increasing removal and sequestering carbon. To do this, we probably have to switch from being pessimistic to being optimistic.

https://climate.ec.europa.eu/system/files/2016-11/soil_and_climate_en.pdf Soil The Hidden Part of Climate Change

Overview

1. How Much Trouble are We In?
2. Causes and Contributors vs Cures – The relative importance of Drawdown Solutions
3. The principles of a planetary curative approach: Sufficiency, Sustainability and the Precautionary Principle as expressed by “Earth For All” – From Business as Usual to Too Little to Late to the Giant Leap
4. Why “Local Food Systems Everywhere” is a sufficient, sustainable Giant Leap – What each word means…Not Fighting the agricultural status quo….just making it obsolete.
5. Why the Giant Leap could be a lot of fun…but we have to make a lot of changes, quickly and profoundly

June 2024 stuff – refers to Eat Lancet but also a new study showing the degree of reduced mortality from eating a “planetary diet” - https://www.cbc.ca/news/climate/planetary-health-diet-mortality-1.7228831 Good

Title choices: June 19

- Do We All Have to become Vegans to Save Planetary Life?
- ……Plant-Rich isn’t Vegan
- **Agriculture, Climate and Health – How Regenerative Agriculture and Plant-Rich diets Could Reverse Climate Change and Improve Human Health**

What we're going to to say about regenerative agriculture is that it's possible that, if widely practiced, it could reduce atmospheric C02 to safe levels within 6 years. It's hypothetical, because we don't have a second earth that demonstrates this.
What isn't hypothetical is that, aside from burning a cubic mile of fossil fuels annually, the main cause of climate change is related to the agricultural and food system.
Also, it's a fact that ___% of serious disease and death result from our diet.
The precautionary principle says to me that we'd better try another agriculture and food system. BB

Approach to Rosemary's part – May 30, 2024

- We're still not primarily meat eaters
- We don't do well on a meat rich diet but
- Eating pasture-fed beef is an improvement on the standard type of beef that is fattened on grain and confined because;
  - It's leaner
  - The omega 3/6 ratios are healthier.
  - There's likely to be a carbon-sequestering microbiome beneath the pasture's surface
- On the other hand, as one of my colleagues says, "The Elephant in the Room is a Cow", given that with the bovine species, there's 25 or more calories consumed, in return for 1 calorie for us and a whole lot of methane for the atmosphere.
- Dr Klaper and Dr. Esselstine contend that there is a "Red Tide" that come from a meat or animal protein-based meal

https://eatforum.org/content/uploads/2019/07/EAT-Lancet_Commission_Summary_Report.pdf

I think the EAT Lancet approach is too conservative. (however, I'd have to review these to be sure that I got them all, and that these assertions are correct)

- Use existing land base
- No emphasis on local food – implies no effort to explore food production in regions that typically don't grow food.
- Use of 2050 as target
- No mention of ending factory farms.
- No mention of ending destructive farming practices.

AGRICULTURE

https://agriculture.canada.ca/en/environment/greenhouse-gases KEEP

Environmental impacts of animal agriculture: https://www.sej.org/publications/features/six-ways-cover-environmental-impacts-animal-agriculture KEEP

Water demands of agriculture: https://www.statista.com/chart/9483/how-thirsty-is-our-food/ ARCHIVE

Soil Health: Mayer, Int'l J. of Food Science & Nutrition, Vol 73, Issue 3, 2022 ARCHIVE

https://www.sciencedirect.com/science/article/abs/pii/B9780128180327000266 (soil health) ARCHIVE

Ontario Provincial Climate Change Impact Assessment Technical Rpt Jan/2023 chapter on the future of agriculture in Ontario and connection to other sectors. ARCHIVE

PLANT-BASED DIETS

A LOT OF GOOD RESOURCES HERE, HARD TO CHOOSE. I THINK FIRST AS MEDICAL PROFESSIONALS WE HAVE TO CITE EVIDENCE OF HEALTH BENEFITS AND THE BMJ SYSTEMATIC REVIEW DOES THAT. WOULD SUGGEST

1) BMJ ARTICLE

https://www.bmj.com/content/370/bmj.m2412 (Dietary intake of total, animal, and plant proteins and risk of all cause, cardiovascular, and cancer mortality: systematic review and dose-response meta-analysis of prospective cohort studies)

2) CANADA FOOD GUIDE "WHY" PAGE. https://food-guide.canada.ca/en/healthy-eating-recommendations/make-it-a-habit-to-eat-vegetables-fruit-whole-grains-and-protein-foods/#section-1

3) "PRACTICAL RESOURCES TO IMPLEMENT PLANT BASED EATING" AND INCLUDE THESE TWO- https://plantbasedhealthprofessionals.com/factsheets

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6164190/ this is a 2018 original article describing the rhizophagy cycle – what nutrients are exchanged were not known in 2018 - maybe they're known now? Should do search…

Do Agricultural Policies Work – Are They liable to be “The Great Leap Forward” or “Too Little Too Late” or even “Business as Usual”

https://ourworldindata.org/effective-policies-reducing-environmental-impacts-agriculture?utm_source=OWID+Newsletter&utm_campaign=9bcfaa7687-biweekly-digest-2024-04-26&utm_medium=email&utm_term=0_2e166c1fc1-3875482ed3-%5BLIST_EMAIL_ID%5D

How effective are policies in reducing the environmental impacts of agriculture?

All countries now have policies, but not all work as intended. Some drive trade-offs or lead to spillover impacts elsewhere, but there are many examples of successful stories.

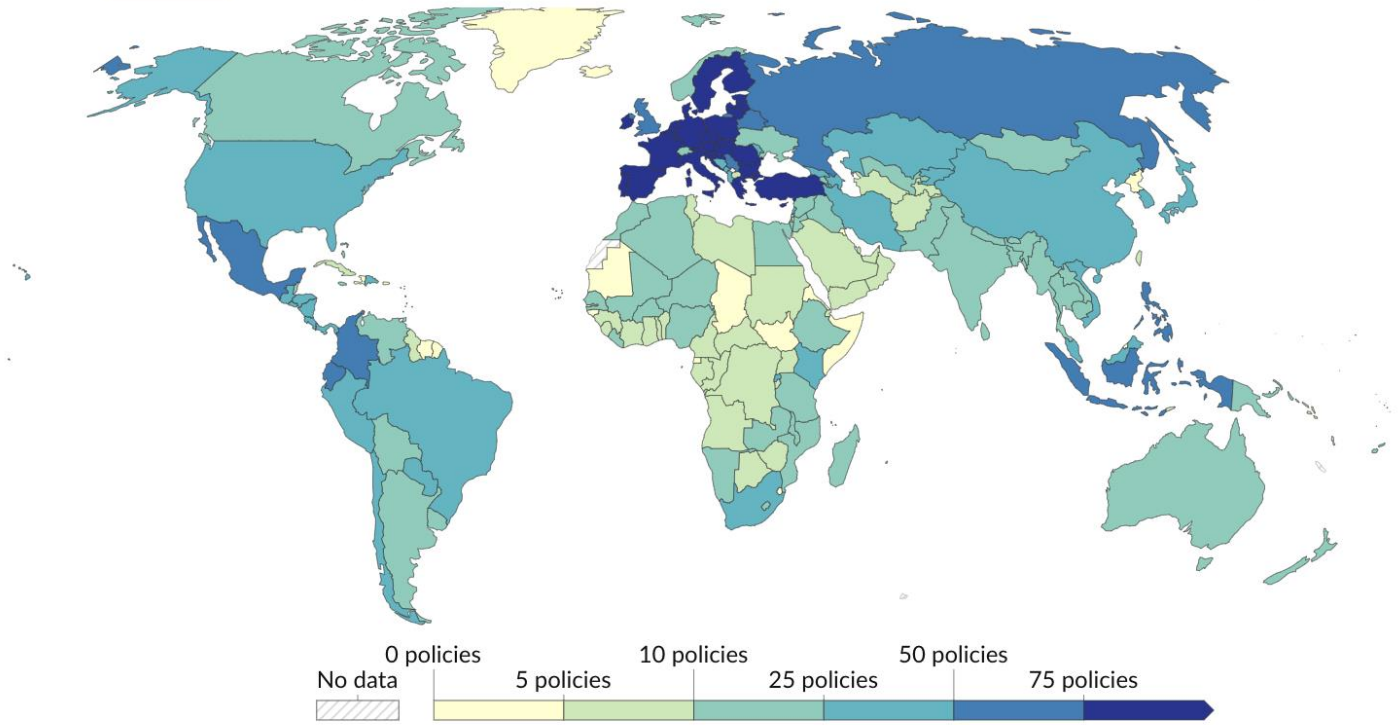
Number of agri-environmental policies in place, 2022

Policies include those targetting the environmental impacts of agriculture, which include outcomes such as fertilizer and pesticide use, land use, biodiversity and forests.

Our World in Data

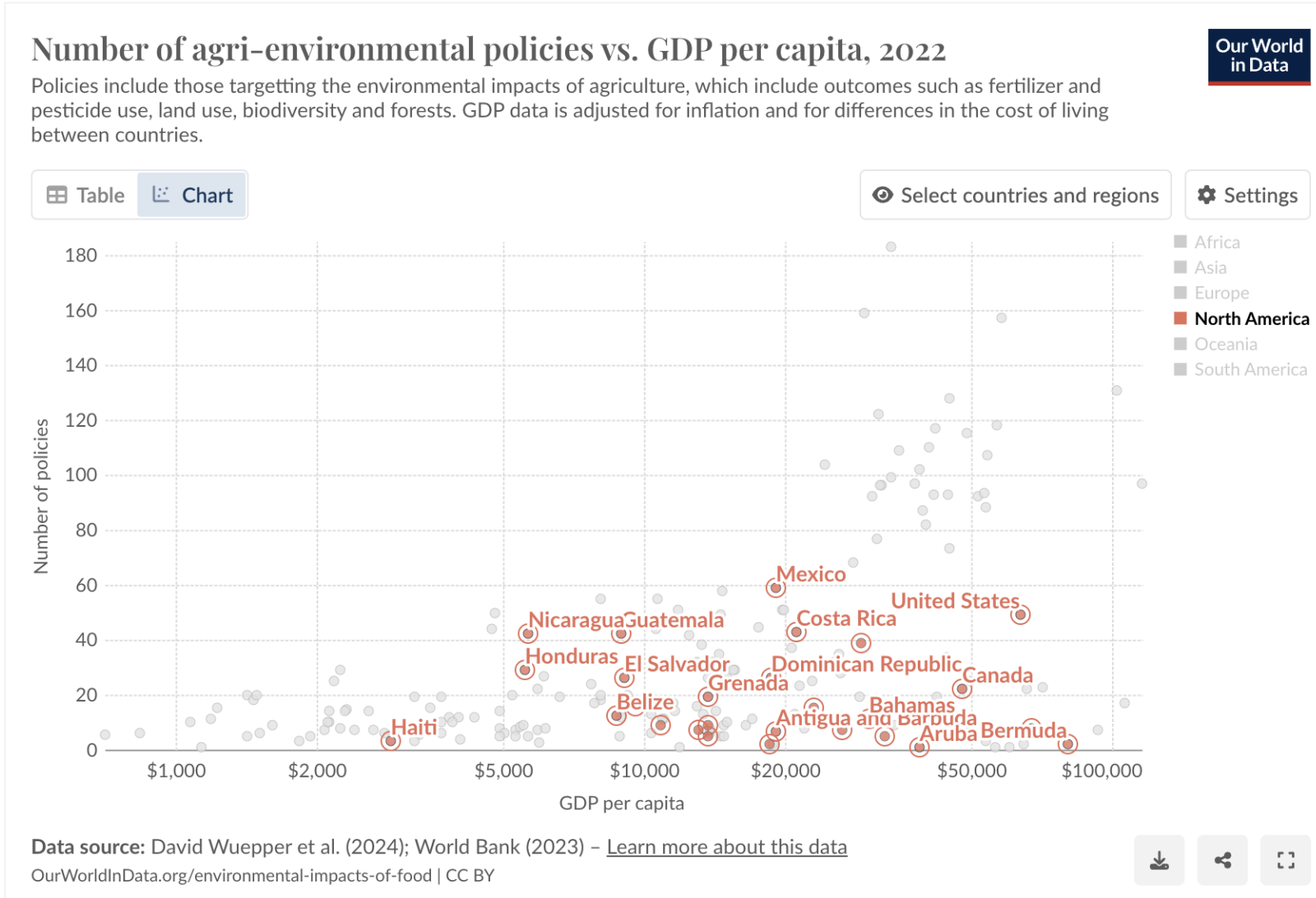
Table | Map | Chart

World

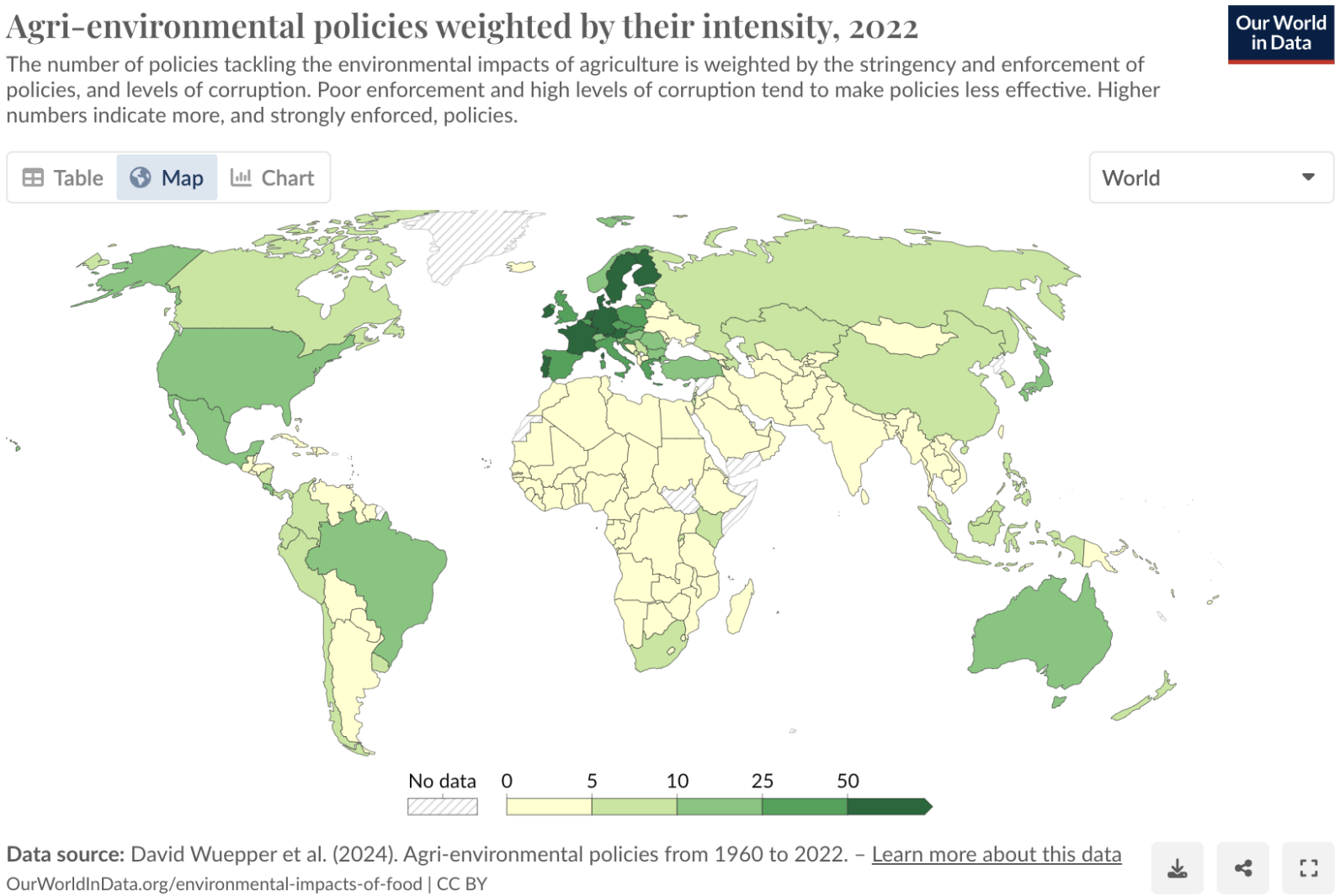


Data source: David Wuepper et al. (2024). Agri-environmental policies from 1960 to 2022. – Learn more about this data

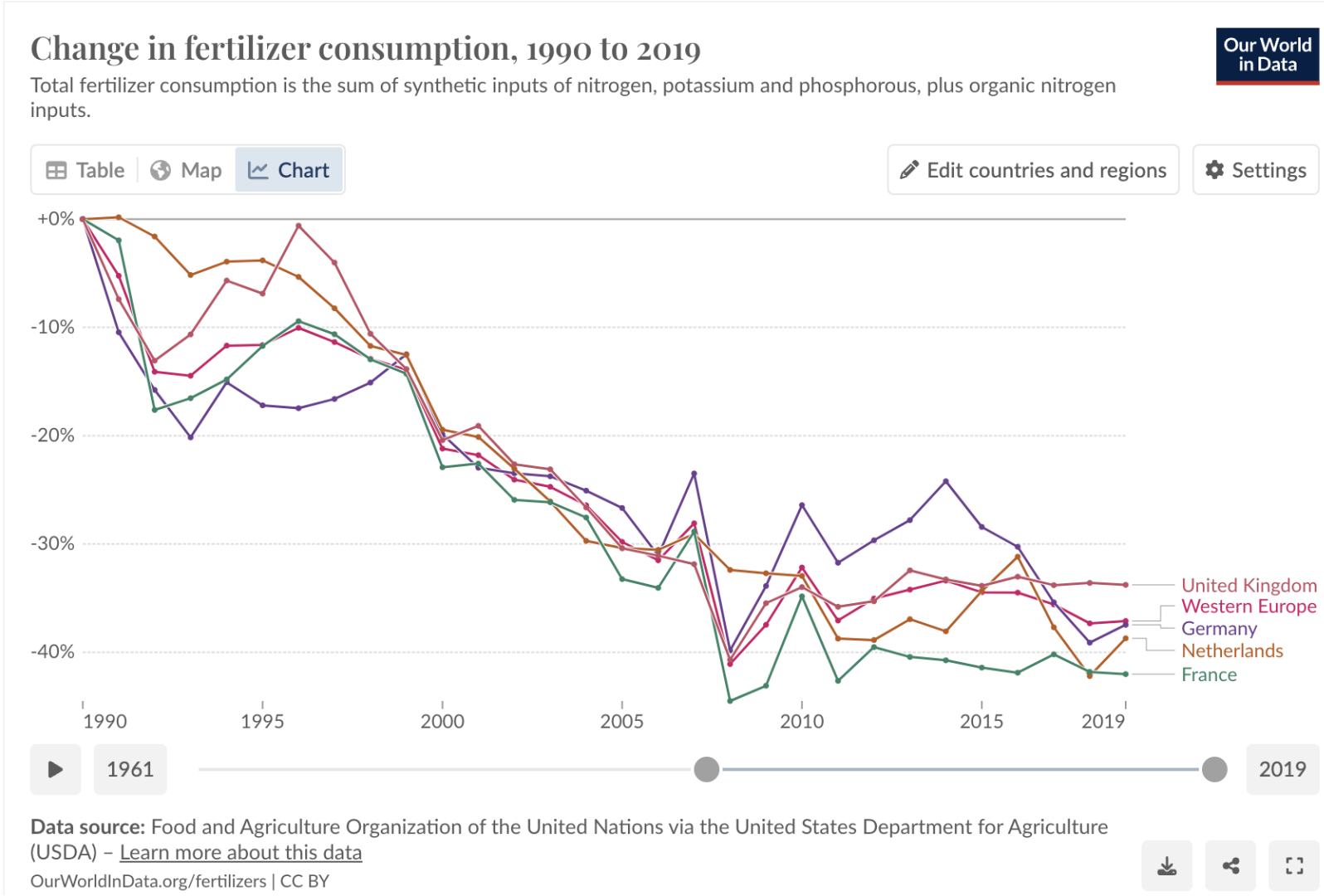
Note: EU-level policies are also assigned to individual countries within the European Union.



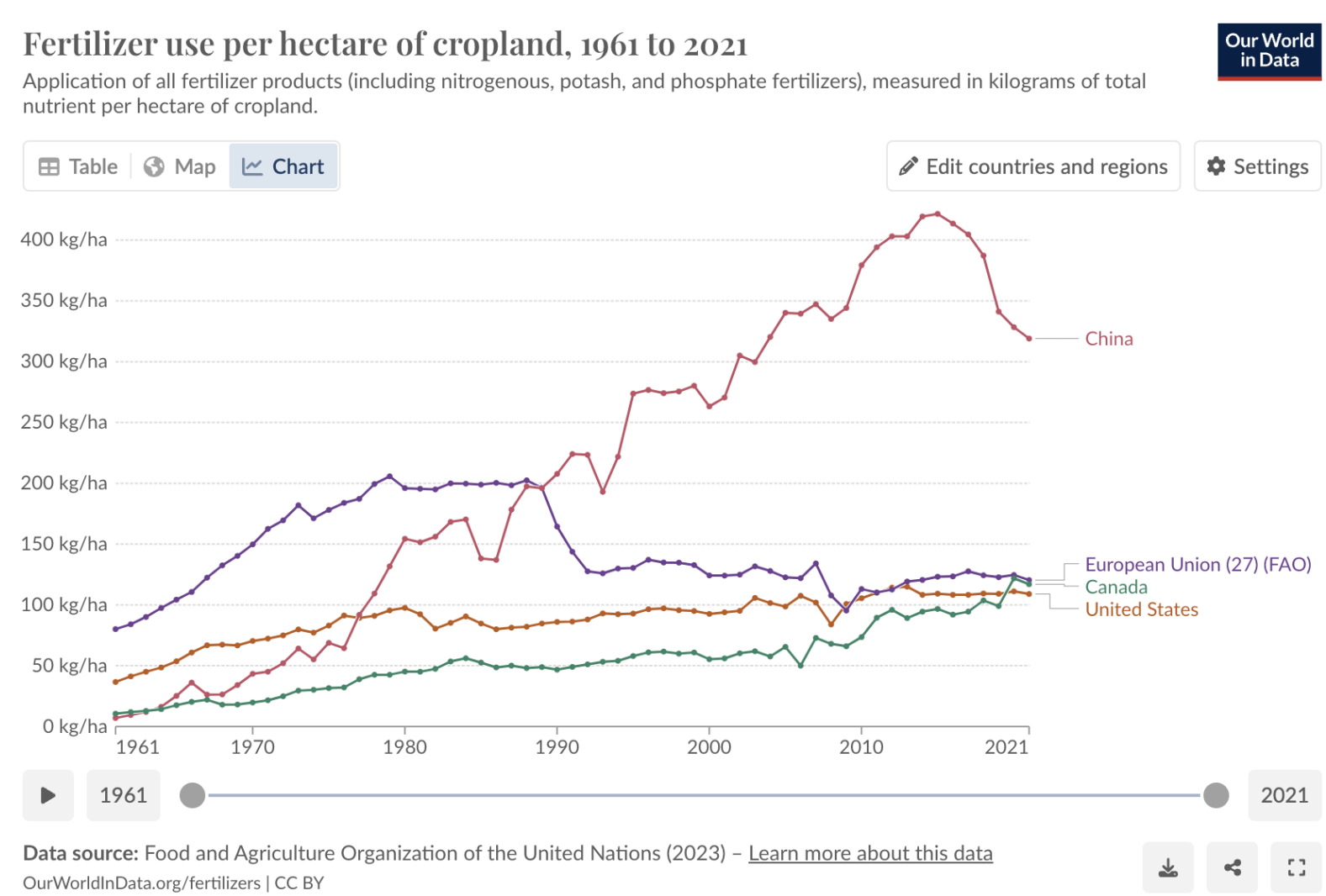
Canada si well below the USA and below Honduras, Gutamala, Mexico, Nicaragua, Costa Rica … but, how about the intensity of the policies????



Canada has the lest intensive agricultural policies in North America.



EU Policies HelpedThose Countries Buck the Trend in Fertilizer Usage.



Converging on about 125 kg per acre, Canada trending higher….

In a study published in *Nature Communications*, researchers looked at what would happen to greenhouse gas emissions from agriculture if England and Wales went fully organic.[9] Domestic emissions would fall; in this regard, it would be a policy "win". But there would also be a significant shortfall in food supplies, requiring the two countries to import more food from elsewhere. When these agricultural emissions are included, total emissions would *increase*. What appears to be a "win" when only considering England and Wales is, in fact, a "loss" for the world — and climate — as a whole.

You can imagine similar examples for measures such as land use or forestry. Countries could reduce their farmland area and increase their forest cover while driving more land use and forest loss in other countries. And it's not just about environmental spillovers: poor policies can also impact food prices, access, and security. Researchers note, for example, that a rise in organic farming in rich countries could raise food prices for consumers in poorer ones.[10]

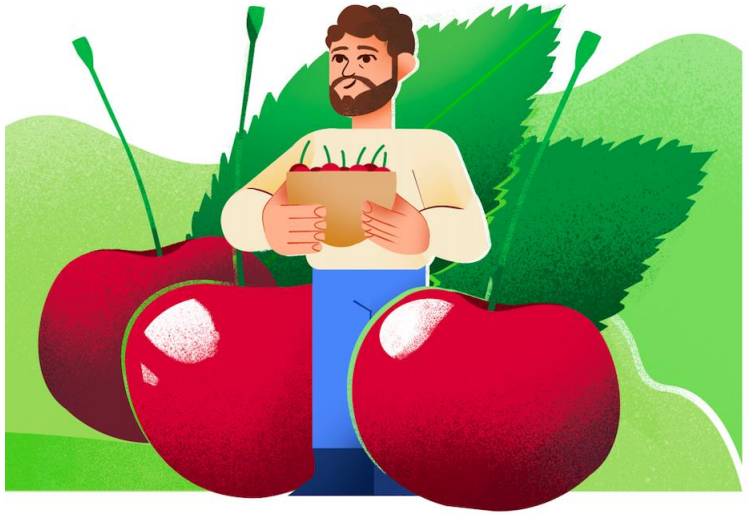
The statement in purple is not necessarily true, at least for Regenerative Farming. Regenerative Farming can be as productive as industrial farming. Furthermore, not only does GHG fall dramatically, but a vast soil carbon sink is utilized. Organic farming often includes tilling, which damages the soil carbon sink. Article saved in CACOR presentation
Another same-themed article
>>https://ideas.repec.org/a/nat/natcom/v10y2019i1d10.1038_s41467-019-12622-7.html

What would happen if regenerative farming was combined with a sustainable local food system everywhere? Is there any other solution to climate change that has the potential to reverse climate change if implemented globally?

- Toronto recorded the warmest February on record with an average temperature above freezing, the first time ever documented.

Weather Stats for Winter of 2023-2024

WHY *"Local"* Food Systems:
Indigenous varieties weather climate extremes better…



Email from Slow Food –

Today we are in Emilia-Romagna, a region in central Italy. In May, this area was **hit by devastating floods,** which submerged towns and fields and stripped people of their livelihoods. The agriculture sector suffered losses in excess of €1 billion.

But there were lessons to be learned from the disaster: that locally cultivated food proved most resilient to disaster, becoming the beacons around which local communities could begin to rebuild their economies.

"The Vignola Moretta cherry has grown here for more than 200 years," says Francesco Vaccari, a young producer. "But not too long ago it faced extinction, replaced by cultivars better suited for long-distance travel." Ten years ago, Francesco and 20 other producers formed a community to preserve the Vignola Moretta cherry and its traditional cultivating methods. Francesco attributes the fruit's resilience to the land on which it grows.

"Varieties which are indigenous to a territory and grown using traditional methods are always better at weathering the effects of climate change, droughts, floods or heat waves. **Consumers can do their part to fight climate change by choosing these food products and investing in produce grown in harmony with the land by producers whose work is rooted in their local communities."**

We’re going to increase our capability to measure both soil health and produce nutrient density (Judith Lockwood taking lead? (Jan 3, 2024 email sent)

https://cedarcirclefarm.org/blog/entry/testing-nutrient-density-in-our-vegetables#:~:text=One%20tool%20they%20use%20is,reflected%20back%20to%20the%20spectrometer
https://www.hortidaily.com/article/9073202/portable-spectroscopy-to-determine-nutritional-data-and-freshness-parameters/
https://www.bionutrient.org/bionutrientmeter#:~:text=What%20is%20the%20Bionutrient%20Meter,as%20carbon%20in%20the%20soil

USDA, one study concluded that since the 1950s there has been a decline in the amount of protein, calcium, phosphorus, iron, riboflavin (vitamin B2) and vitamin C in 43 varieties of vegetables and fruits! The study’s author, Dr. Donald Davis estimates that this is a direct result of breeding vegetables for size, growth rates, and pest resistance and not nutrition. Another factor in this nutrient loss is the depleted soils that most of our fruits and vegetables are grown in.

Today, September 8, 2020, our Research and Development department picked multiple samples of our

XRFRM

September 29 2023
ExerFarm Beets Grown
Regeneratively

No Tilling
No Fertilizer
No Insecticides,
Herbicides
No Irrigation

About 11 hours per week
of volunteer labor, ¼ acre

Weeded with
lawnmower, scythe,
string trimmer

Some fungal
amendments in 2022
(local Johnson-Su
Reactor)

Graphics of rhizophagy and Mycorrhizal web, Alberto’s video, Soil food web

Graphic of feedlot

That would be 33,000 lbs per acre of beets and carrots. If humans eat 2000 lbs per year, that would be 16.5 humans supported per acre or about 4 humans per quarter acre. Another way of looking at it would be by calories. If humans ate 2000 calories per day, each human would require about 730,000 calories per year. Carrots contain about 186 calories per pound and about 4.2 gm of protein - 19,500 lbs of carrots would provide the annual calorie needs of 5 people. Beets contain about the same, or 195 calories and 7.3 gm protein per pound - 13,200 lbs of beets would provide enough

Carbon Sequestration - Soil Food Web

If world's soils were regenerated globally,
CO2 levels could be
reduced to safe levels within 6 years

https://www.youtube.com/watch?v=ECHYChDUfhQ

(4.5 min video clip)

There's an "Inextricable Link Between Human Health and Environmental Sustainability"

From "Eat Lancet"

Inexplicable? – our *Agricultural and Processing Choices*

Ontarians who lack secure access to food are more likely to die prematurely

First population-wide study to look at food insecurity and mortality shows that unreliable access to food is an independent predictor of death

The study looked at linked health records for more than 90,000 Ontario adults who had completed the Canadian Community Health Survey, which includes questions about household food security.

The researchers accounted for other factors such as sex, age, education, housing, and family status, and then analyzed the independent influence of food security on the risk of dying within the study period (extending four years beyond the survey years 2005 - 2010).

Household food insecurity refers to uncertain, insufficient, or inadequate food supply at home, generally due to low income.

The study found that **a person's risk of death rises with their level of food insecurity,** independent of other health and social factors.

The authors say these findings point to the ongoing need for public policies that increase access to food for all people.

Gundersen C. et al. *PLoS ONE*. 2018.

Institute for Clinical Evaluative Sciences
ices.on.ca

PROOF
FOOD INSECURITY POLICY RESEARCH

UNIVERSITY OF TORONTO

camh
mental health is health

From Teela May 27 – Health and Climate Depend on What We Eat.

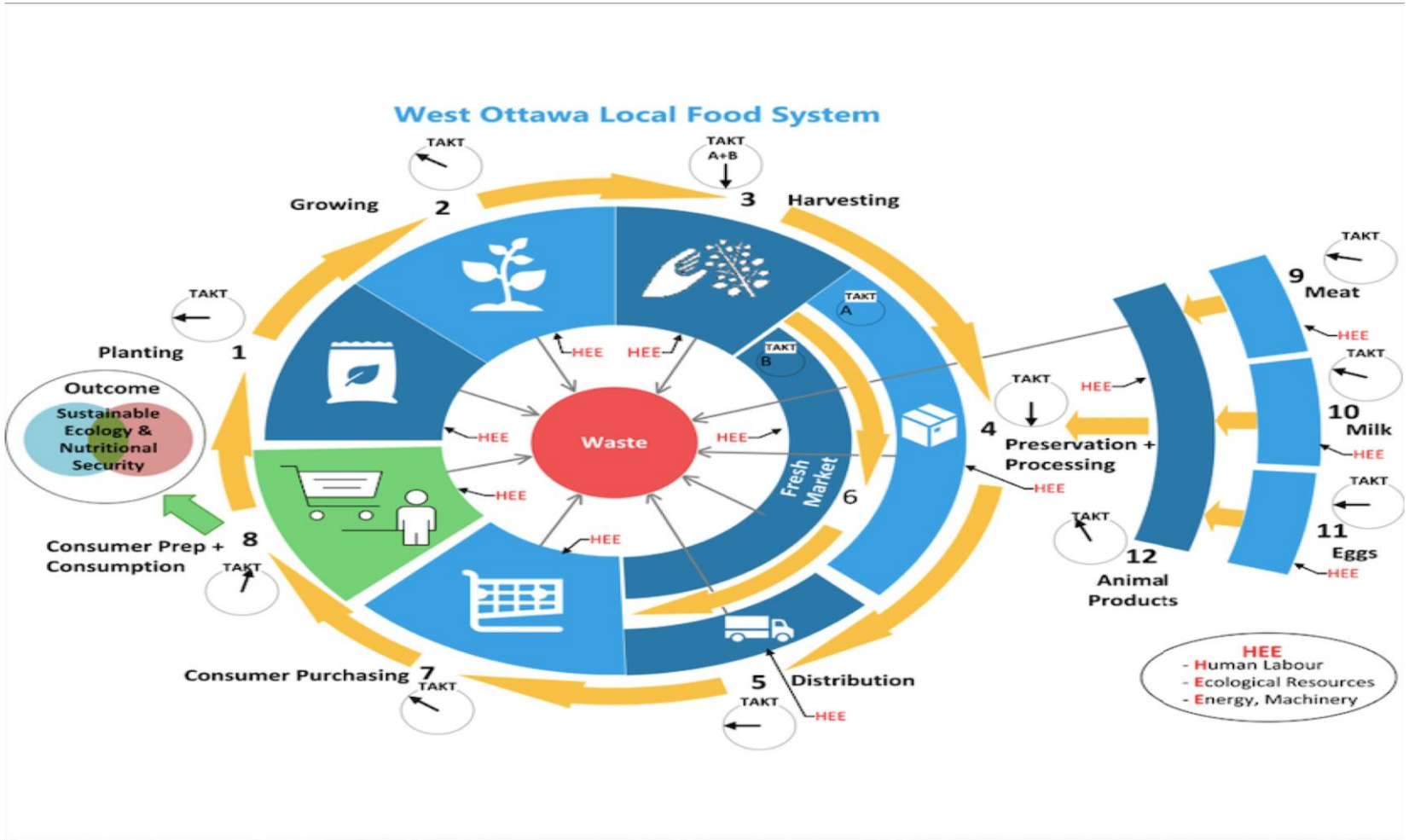
- Article https://doi.org/10.1038/s43016-023-00749-2 Low-carbon diets can reduce global ecological and health costs Elysia Lucas 1,2, Miao Guo 3 & Gonzalo Guillén-Gosálbez 2 Potential external cost savings associated with the reduction of animal-sourced foods remain poorly understood. Here we combine life cycle assessment principles and monetarization factors to estimate the monetary worth of damage to human health and ecosystems caused by the environmental impacts of food production. We fnd that, globally, approximately US$2 of production-related external costs were embedded in every dollar of food expenditure in 2018—corresponding to US$14.0 trillion of externalities. A dietary shift away from animal-sourced foods could greatly reduce these ‘hidden’ costs, saving up to US$7.3 trillion worth of production-related health burden and ecosystem degradation while curbing carbon emissions. By comparing the health efects of dietary change from the consumption versus the production of food, we also show that omitting the latter means underestimating the benefts of more plant-based diets. Our analysis reveals the substantial potential of dietary change, particularly in high and upper-middle-income countries, to deliver socio-economic benefts while mitigating climate change.

United Nations Sustainable Agriculture Data

- https://www.fao.org/sustainability/news/detail/en/c/1274219/#:~:text=Globally%20agricultural%20land%20area%20is,and%20pastures)%20for%20grazing%20livestock
- The above distinguishes between agricultural and cropland areas..

Large Scale Approaches to “Bioeconomy”

- https://www.scalingupconference.ca/speakers
- Above could represent the attempt for **big money** to make more money out of the climate stresses, guilt, economic failures associated with climate change. The sort of large organizations that **big government** would throw tens of millions to even billions at in the hope that they could do something to reverse climate change and with that perception, get re-elected.
- **VS…** The opposite approach is DRFH – start small, be subversive, transform using the force of many small but effective actions, providing an irresistible food system alternative to the ordinary person…….and eventually, even to governments, and the direction of flow of big money.



The Food System

Regenerative

Local

Animals Feed Themselves

2021 Produce Sample

ExerFarm

Good Evidence that Regenerative Works

- Research is showing that vegetables produced with regenerative practices after 5-10 years show increased levels of critical vitamins and minerals
  - B1, B3, B5, Ca, K, Zn, Mg
  - Carotenoids, phytosterols
- Beef from animals in regenerative systems
  - 3x n3 FA
  - 6x n3 ALA FA
  - Lower n6
  - Similar findings for pork

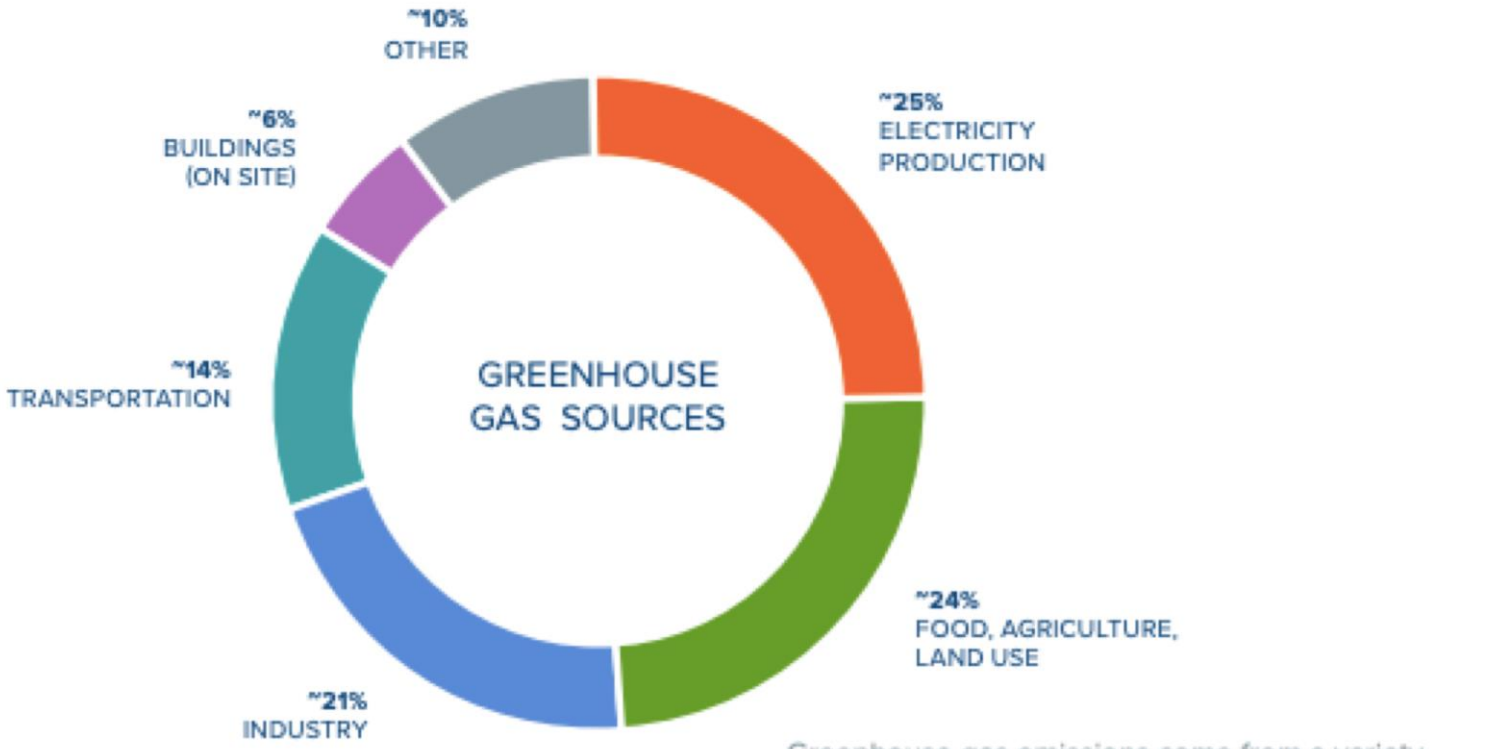
Healthy food comes at a premium cost

- An economic problem, not a failing of the production system per se
- Advocating for better access to quality food is a matter of social & environmental justice

If people can't afford food, that's an economic problem. We need to advocate for universal access to high quality food.

But…..if the inputs for regenerative are cheaper, is it true that healthy food costs more – I think it's not necessarily true – end of Dr. Loring's slides.

Figure 1.2 — Primary Sources of Greenhouse Gas Emissions



Greenhouse gas emissions come from a variety of secotrs, including electricity, food, agriculture and land use (FALU), industry, transportation, buildings, and other. It is important to note that food, agriculture, and land use is nearly tied with electricity as a leading contributor to climate change.

In 2021, the UN credited the AgriFood system with *31 % of GGEs ,* up from the 24 % depicted above

Meat makes for curious math: about 25 calories is required to create just 1 calorie of beef. The ratio for pork is nearer 15-to-1. Even the most efficient meat, chicken, requires 9 calories of input to produce just 1 calorie of food.

https://cbey.yale.edu/our-stories/disrupting-meat#:~:text=Meat%20makes%20for%20curious%20math,just%201%20calorie%20of%20food.

Comparison of Soil Impacts of Current Mono Cropping Techniques to Regenerative Techniques

Mono Cropping	Impact	Regenerative	Impact
Tilling	Destroys mycorrhizal nets, high input costs for farmers, carbon released to atmosphere, soil erodes	No Tilling	Mycorrhizal nets form, carbon sequestration happens
Inorganic Fertilizer	• Plant root exudates stop • Excess N and Phosphorus leach into waterways • High input costs for farmers	Mulch, compost, plant material left in place, recycled	Soil structure improves, roots partner with bacteria and fungi Bacteria fix nitrogen, which is recycled via rhizophagy, fungi scavenge for micronutrients in return for root exudates, nematodes/worms/single celled orgs, insects recycle endlessly, carbon sequestration happens

Comparison of Soil Impacts of Current Mono Cropping Techniques to Regenerative Techniques

Mono Cropping	Impact	Regenerative	Impact
Herbicides	Weeds die, no roots in ground to feed subsoil life, residuals have potential health impacts, excess evaporation, limited photosynthesis producing organic matter, high input costs, low soil organic matter and low carbon sequestration	No herbicides	Soil is covered, evaporation of moisture limited, subsoil life supported via root exudates of crop and other non-crop plants. Carbon sequestration happens

Comparison of Soil Impacts of Current Mono Cropping Techniques to Regenerative Techniques

Mono Cropping	Impact	Regenerative	Impact
Pesticides	Death of subsoil life animal life, loss of soil structure, pollenating insects die and fail to pollenate, resistant pests dominate, residuals potentially impact human, bird and animal health, pest resistance requires new generation pesticides, high input costs	No pesticides	Subsoil life and pollinators flourish, plant growth and maturation supported, carbon sequestration happens

OPEN FOOD NETWORK | CANADA

Why do we need better food and farming systems?

Most of the food that Canadians buy and eat is part of the conventional global agrifood system. It is produced by large-scale, industrial farms. This system is convenient for consumers and profitable for corporations, but it comes with huge environmental and social costs:

- Intensive industrial agriculture is a major contributor to climate change and the destruction of global ecosystems
- Transportation of products over long distances results in greater energy use and carbon emissions
- Large amounts of food are wasted due to spoilage during transport or display in grocery stores
- Complex global supply chains are brittle and vulnerable to disruption
- Workers are frequently exploited and paid less than living wages
- Small-scale farmers struggle to access markets and maintain profitability

Who Do I Trust for Information and Inspiration
?

- Project Drawdown
- IPCC
- The Soil Food Web/Dr. Elaine Ingham
- The World in Data
- Jeff Lowenfels – “Teaming With..Nutrients, Microbes, Fungi, Bacteria”
- Braiding Sweetgrass – Robin Kimmerer
- Katherine Hayhoe – Saving Us…
- Gabe Brown – Dirt to Soil
- ICES

It’s important to grow food, but it’s very important how that food is grown, and where, and what it is - and who is growing it determines the sustainability of the method. So, who, what , where, when, how and why…..<<develop this line of thought further. >>

There's an "Inextricable Link Between Human Health and Environmental Sustainability"

From "Eat Lancet"

Inexplicable" – it's our *Agricultural and Processing Choices*


2018/07/26

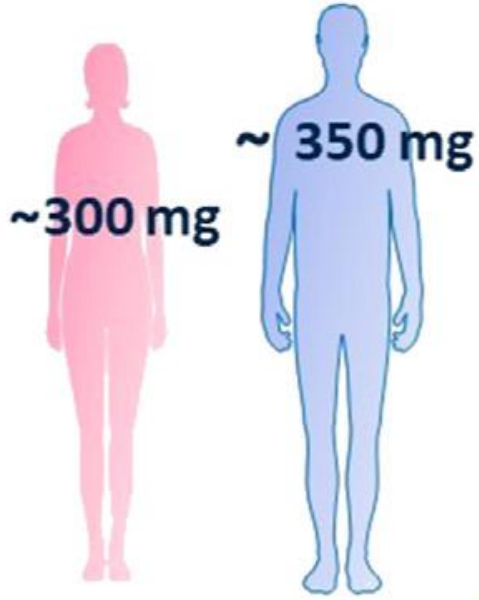
Going to the roots of reduced magnesium dietary intake: A tradeoff between climate changes and sources

Roberta Cazzola a,*, Matteo Della Porta a, Michele Manoni b, Stefano Iotti c,d, Luciano Pinotti b,
Jeanette A. Maier ……..

(This work was developed as part of the PhD program in Nutrition
Sciences, University of Milan.)

Heliyon - journal homepage: www.cell.com/heliyon

low Mg status, a sneaky trigger of inflammatory and oxidative stress and, therefore, diseases.

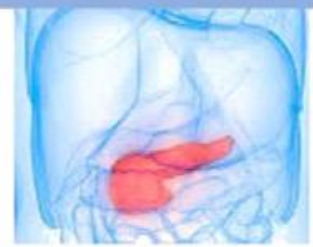


Mg food chain

Mg intake

Chronic inflammation

Oxidative stress



Bone density

Glucose intolerance Diabetes

Neurological & Phychiatric Disorders

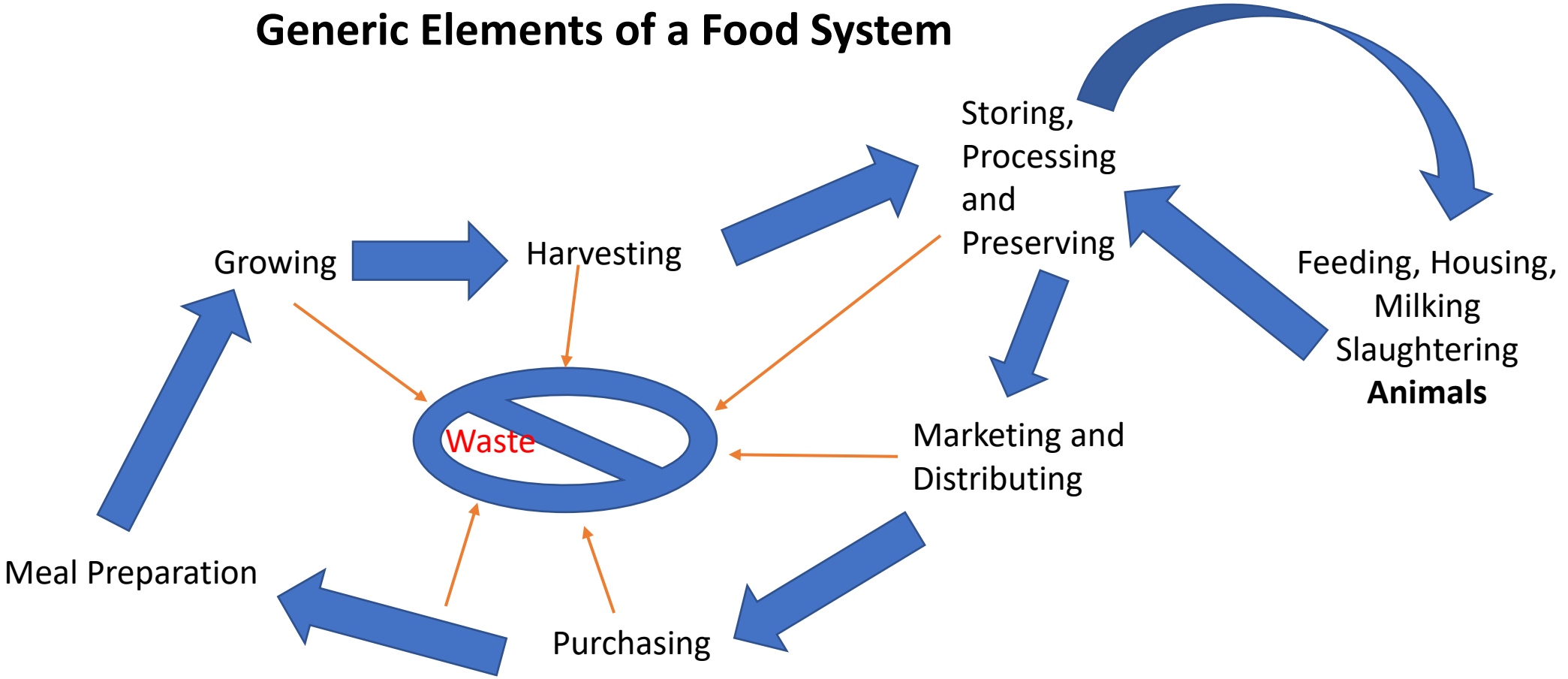
Hypertension Ischemic heart disease Stroke

Skeletal muscolar mass

the massive use of **K fertilizer** has determined a progressive reduction in the ability of plant roots to absorb Mg from the soil. Over time, this has resulted in a gradual widespread **decline of Mg in soils** [34, 36] **and consequently in cereals, fruits, and vegetables** [37]. Therefore, while the green revolution has led to indisputable benefits by increasing the availability of food energy per capita per day by 35%, on the other hand, the consumption of cereals increasingly poor in Mg has contributed to a **growing deficiency of this nutrient in the world population**.

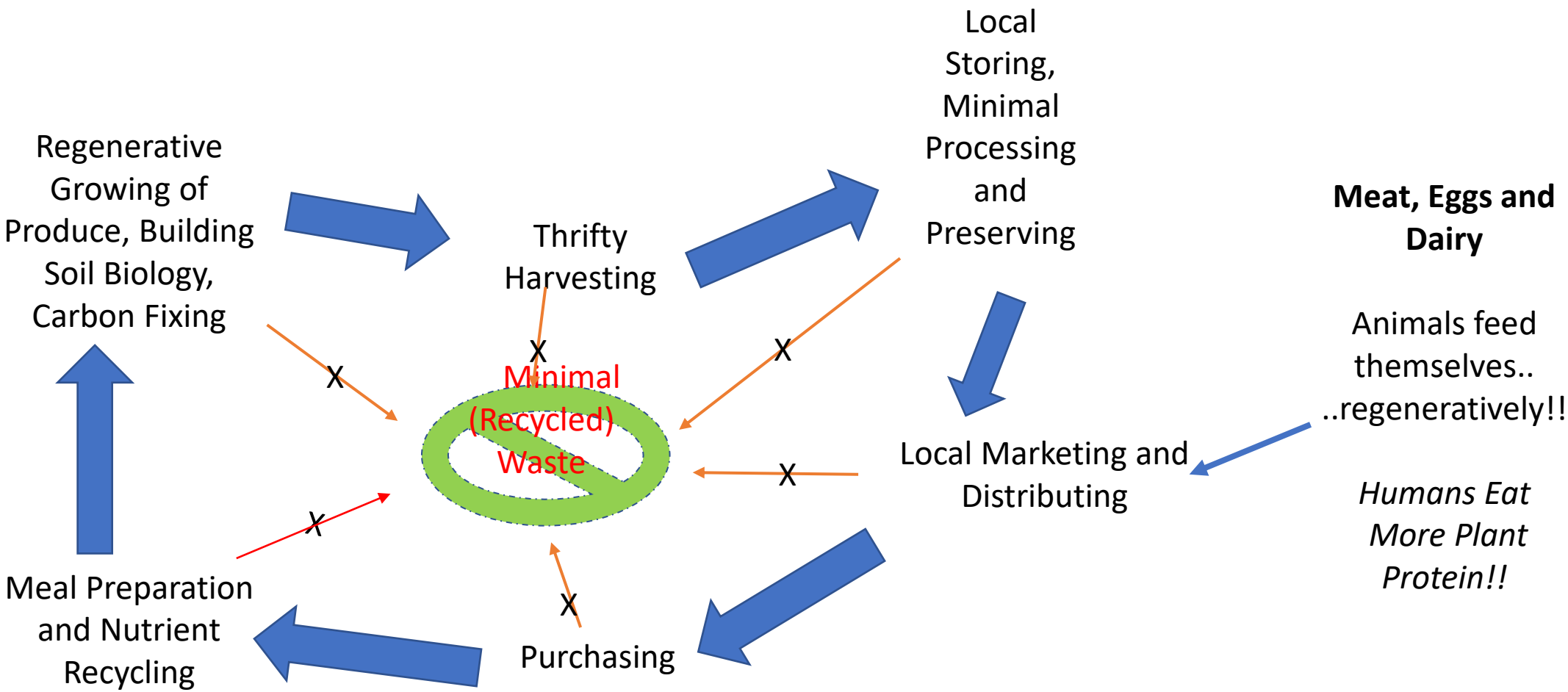
elevated CO_2 on crop plants mineral concentrations
[45]. In particular, it has been shown that an elevated CO_2 decreases N,
Mg, Fe, and Zn, but not P, K, S, Cu, Mn concentrations in the edible part of
vegetables.

Generic Elements of a Food System



Barry Bruce MD, FCFP
Deep Roots Food Hub
https://www.deeprootsfoodhub.ca/

Generic Elements of a Sustainable Local Food System



Barry Bruce MD, FCFP
Deep Roots Food Hub
https://www.deeprootsfoodhub.ca/

3 Sisters Nutritional Analysis

https://ojs.ethnobiology.org/index.php/ebl/article/view/721/413#:~:text=The%20Three%20Sisters%20produced%20more,any%20of%20the%20monoculture%20mixtures

Abstract Scholars have studied the Three Sisters, a traditional cropping system of the Haudenosaunee (Iroquois), from multiple perspectives. However, there is no research examining food yields, defined as the quantities of energy and protein produced per unit land area, from the cropping system within Iroquoia. This article compares food yields and other nutrient contributions from the Three Sisters, comprised of interplanted maize, bean and pumpkin, with monocultures of these same crops. The Three Sisters yields more energy (12.25 x 106 kcal/ha) and more protein (349 kg/ha) than any of the crop monocultures or mixtures of monocultures planted to the same area. The Three Sisters supplies 13.42 people/ha/yr. with energy and 15.86 people/ha/yr. with protein. Nutrient contents of the crops are further enhanced by nixtamalization, a traditional processing technique where maize is cooked in a high alkaline solution. This process increases calcium, protein quality, and niacin in maize.
Keywords Haudenosaunee, Iroquois, Three Sisters, Nutrition, Nixtamalization

Food in the Anthropocene: the EAT–*Lancet* Commission on healthy diets from sustainable food systems

Prof Walter Willett, MD et al

Food systems have the potential to nurture human health and support environmental sustainability; however, they are ***currently threatening both***. Providing a growing global population with healthy diets from sustainable food systems is an immediate challenge. Although global food production of calories has kept pace with population growth, more than 820 million people have insufficient food and many more consume low-quality diets that cause micronutrient deficiencies and contribute to a substantial rise in the incidence of diet-related obesity and diet-related non-communicable diseases, including coronary heart disease, stroke, and diabetes. Unhealthy diets pose a greater risk to morbidity and mortality than does unsafe sex, and alcohol, drug, and tobacco use combined. Because much of the world's population is inadequately nourished and many environmental systems and processes are pushed beyond safe boundaries by food production, ***a global transformation of the food system is urgently needed.***

https://www.thelancet.com/journals/lancet/article/PIIS0140-6736(18)31788-4/fulltext

Katie Ward, National Farmers Union, vid about Agroecology – Katie and her group are much more aligned with DRFH/EXRFRM thinking than I thought.

https://www.nfu.ca/campaigns/agroecology/

See Lancet report 2023 – PP slides made - some good graphs
Also, is there a digital version of Earth for Now?

https://www.plantbaseddata.org/

This is Dr. Tushar Mehta's web site –

PLANT BASED DATA

Explore studies and summaries on why we need a plant based food system:

Environment | Health | Zoonoses | Economics & Policy

Reviewed articles include:

Soil carbon sequestration through regenerative agriculture in the U.S. state of Vermont
PLOS Climate
2022
https://journals.plos.org/climate/article?id=10.1371/journal.pclm.0000021#pclm.0000021.ref014

•Article shows that long term Afforestation without tree harvest (which could include reforestation) sequesters far more carbon compared to any form of optimized / rotational grazing
•It shows effect of SOC (Soil Organic Carbon) increase from ruminant production vs afforestation
•Afforestation shows indefinite SOC increase rates, vs rotational grazing which will reduce / plateau
•But does not show effect of
- Massive carbon sequestration in trees and roots in afforestation
- Increased enteric methane emissions from grazing cattle vs feeding them crops
- Decreased stocking rates and lower meat production from most regenerative grazing studies which leads to higher emissions per unit of meat
- Increased land use / deforestation when switching from feed crops to grazing

•Cropping systems are considered here for animal feed, not human food (which is exponentially more efficient)

This slide hopefully explains the one to follow bb

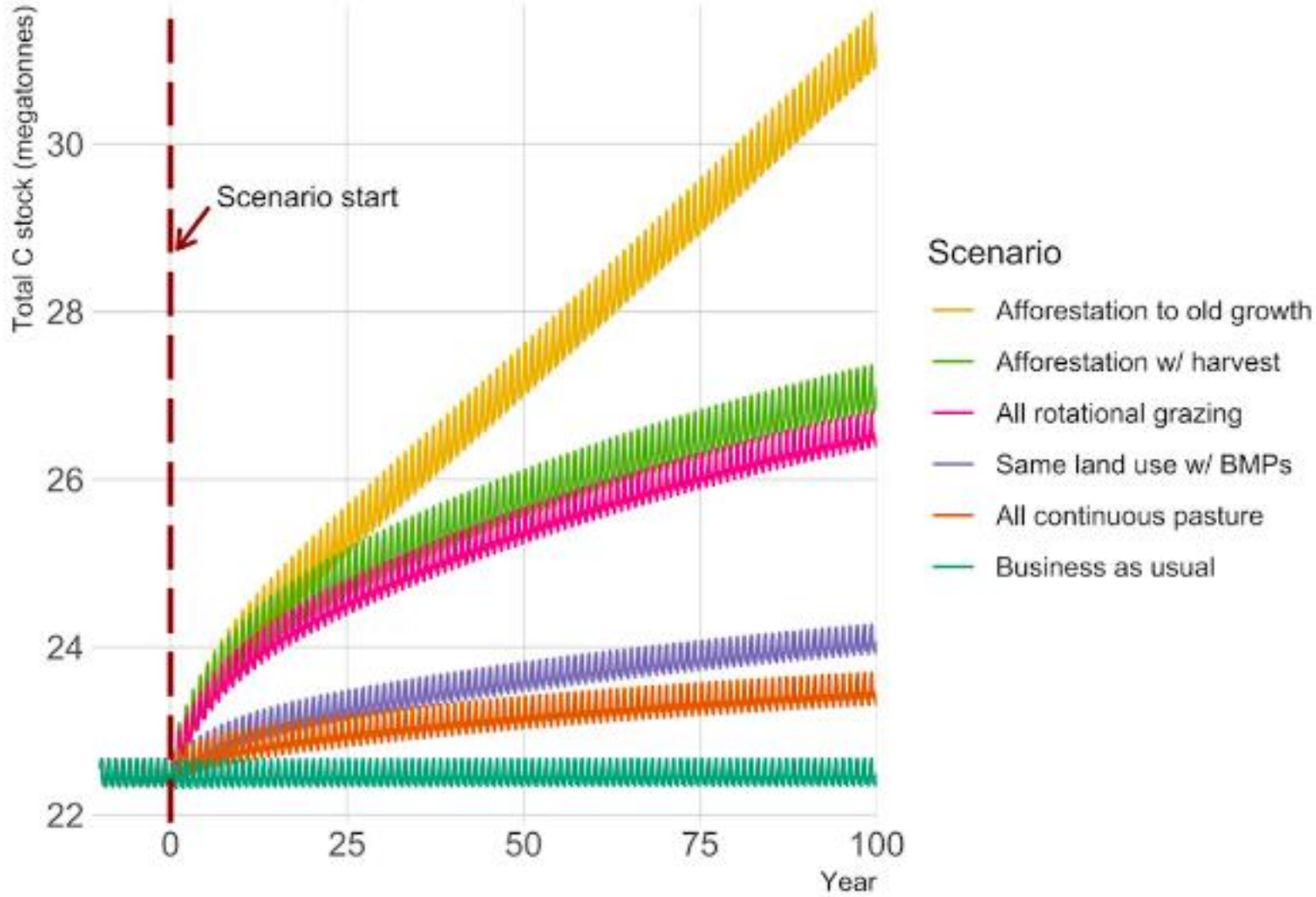
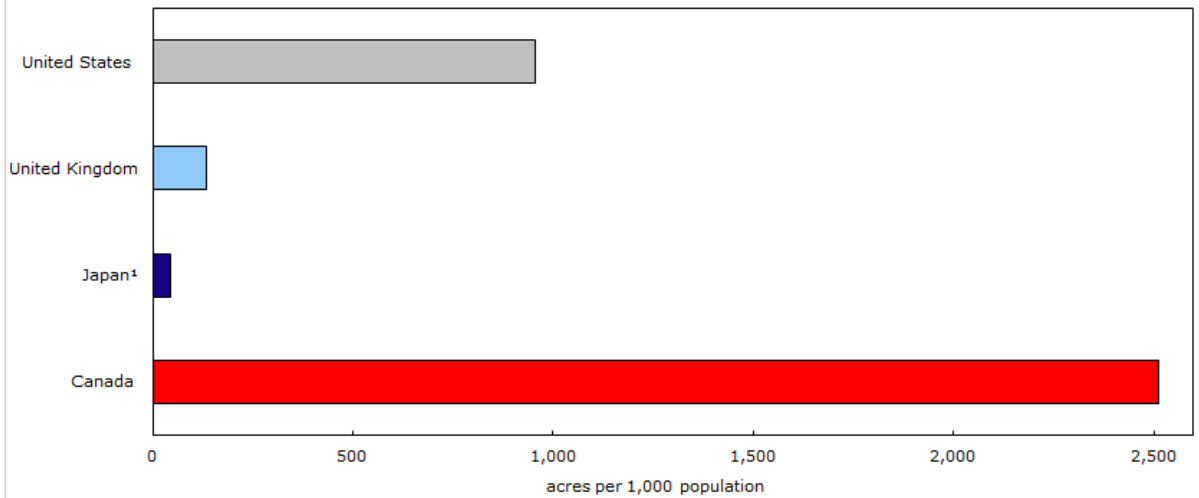


Fig 7. Total SOC stock over time for each scenario summed across all VT farmland. With land use and management changes to Vermont's farmland, SOC stocks increase over baseline. Old-growth afforestation yields the maximum gain in SOC, whereas total conversion to rotational grazing offers the highest sequestration among the regenerative agriculture scenarios.

Chart 2
Farm area for field crops and hay per 1,000 population by selected country, 2021



1. Data for Japan were from the year 2020.
Sources: Statistics Canada, Census of Agriculture, 2021 (3438); United States National Agricultural Statistics Service; United Kingdom's 2021 Census of Agriculture and Horticulture; and Japan's 2020 Census of Agriculture and Forestry.

▼ Data table for Chart 2

Country	Acres per 1,000 population
United States	956.0
United Kingdom	133.4
Japan [1]	42.6
Canada	2,511.5

[1] Data for Japan were from the year 2020.

Sources: Statistics Canada, Census of Agriculture, 2021 (3438); United States National Agricultural Statistics Service; United Kingdom's 2021 Census of Agriculture and Horticulture; and Japan's 2020 Census of Agriculture and Forestry.

- From the book "**You Can Farm" by Joel Salatin** – he was raised on a farm, educated as a journalist, and then, came back to farming – he promotes what he calls "Bioregional Food Sufficiency" - "Advocates of the macrobiotic diet say that food produced more than 40 miles from your home contains a different kind of energy. I don't know about that, but it only stands to reason that in nature, things eat local food."
  - "Right now, it takes 15 cal of energy to put 1 calorie of food on the American table: 4 calories of that is for transportation."
  - "As soon as we require unseasonable production, the farmers' costs go up and the caloric requirements increase."
- **Decentralized Food Systems:** "We need an agriculture that stimulates "spread out" modeling rather than centralized production and processing." – he goes on to comment on the meat industry, feed one place, manure another, food-borne pathogens in huge processing facilities…."<why not> backyard operations, neighborhood canneries and processing."…"mass production….assembly lines must run on close tolerances. It just won't do to have a carcass that's 10 % bigger or smaller, or a tomato that's a different size."……make these junk foods edible and create concoctions that the human body was never designed to ingest.
- **If you want to farm, don't buy land. There's lots of land around**

Japan (10.2 acres per farm).

Data from the 2021 Census of Agriculture show that Canada reported 189,874 farms and 153.7 million acres of total farm area. By comparison, the United States had 2,012,050 farms and 895.3 million acres of total farm area, and the United Kingdom had 219,000 farms and 46.0 million acres of total farm area. One distinctive comparative feature of agriculture in Japan was its small size of farmland, which was just under 11.0 million acres. Conversely, Japan had the second-largest number of farms (1,075,705) among the four nations.

Despite having the second-largest land mass in the world, Canada had the smallest proportion of its total area dedicated to farming of the four countries being compared. In 2021, 6.2% of Canada's land was reported as total farm area. This was significantly lower than the United Kingdom (75.0%), the United States (36.8%) and Japan (11.8%).

(so, how many farms per 1000 Japanese vs Canada? = population/# farms
Canada = 38250000/189,874= 201 people per farm or about 5 farms per 1000 people. Number of acres per person = 153.7 million/38250000 = 4 acres per person. (or, according to chart above, 2511 acres/1000 people = 2.5 acres per person. There's

those dismal figures. Yet eating seafood is a central part of national food culture — so much so, says Greenpeace Japan's oceans campaign manager Wakao Hanaoka, that "some people think they have a right to eat it, and they don't want outsiders telling them not to." That, along with other cultural and institutional factors, means the notion of sustainable seafood still faces an uphill fight in Japan.

If more Japanese consumers embrace seafood sustainability, they could have a significant impact on ocean ecosystems. The Japanese eat six percent of the world's fish harvest, 81 percent of its fresh tuna, and a significant chunk of all salmon, shrimp, and crab. Japan also imports more seafood than any other country and caught 4.2 million metric tons of fish in 2008.

MSC, the world's leading wild-caught seafood standard setter, is also making inroads in Japan. Although total market share for MSC-labeled products remains below one percent, nearly 30 food retailers — including four of the top ten — carry about 250 different products from various fisheries certified as sustainable. One in six consumers recognizes the label, and three fisheries — for skipjack tuna, flounder, and snow crab — have won certification. MSC's Tokyo office, opened in 2007, remains

<<I would say that the steadily increasing CO2 levels are, if not proof that the Breakthrough Institute is wrong, are a very strong indicator that we're heading for disaster. >>

https://en.wikipedia.org/wiki/Breakthrough_Institute

Criticism[edit]

Scholars such as Professor of American and Environmental Studies Julie Sze and environmental humanist Michael Ziser criticize Breakthrough's philosophy as one that believes "community-based environmental justice poses a threat to the smooth operation of a highly capitalized, global-scale Environmentalism."[12] Further, Environmental and Art Historian TJ Demos has argued that Breakthrough's ideas present "nothing more than a bad utopian fantasy" that

Hand written Dec 28….to quote myself….

“We humans may be unique amongst all living things in that we know the consequences of remaining true to our nature of over-consumption, and that those consequences threaten our extinction.

Having eaten of the fruit of the tree of knowledge, we must counteract this part of our nature with respect to our consumption of food and energy. No other animal has such knowledge, knowledge which can enable us to turn away from over-consumption and thus survive. In so doing, we can speak for all other living things.

Since I’m focussed on the agri-food system, there needs to be a transformation, given its importance both as an important ongoing contributor to GHG emissions but as a solution through the re-capture of over a century’s worth of tilling and removal of forests, and the consequent loss of up to 75 % of the carbon stored in the soil. The solution is regenerative agriculture and the restoration of forests, wetlands and natural plains given that over 80 % of land previously needed for agriculture to (only partially) feed us can be released back to nature.

The good news is that not only will planetary health improve, but so will human health.

We are not living “natural” lives right now (although we got here by catering to our human nature) – we’ve never had the option of eating mass produced meat or cheezies and fruit loops.

My presentation to CACOR (copied from another word file I'd started)

https://www.youtube.com/watch?v=6R_06t5ZaVQ&feature=youtu.be

A TED talk on food supply chains, and how mountains of food are spoiling while food banks are running short of food

https://www.ted.com/talks/amanda_little_climate_change_is_becoming_a_problem_you_can_taste?utm_source=newsletter_daily&utm_campaign=daily&utm_medium=email&utm_content=button__2020-10-27

An article which points out the urgency and frustrations around reversing climate change…

https://www.counterpunch.org/2020/11/20/expert-ipcc-reviewer-speaks-out/


DESIGN
FORTHE WORST
BELIEVING
WE ARENOT SEPARATE FROM ORABOVE NATURE
DESIGN FORTHE POWER DOUBLE DOUBLE
DESIGN YOUR OWN ECONOMY
SKETCH: HEY EVERYBODY LETSFAIL!
THINK LIKEYOU ARE LOSTIN THE FOREST
BE WHOLE BRAIN CREATIVE ITSATALENT ANDA SKILL
COMPETE WITH BEAUTY
DESIGN FOR ALLTHE SENSES
RISE ABOVE THE NOISE
DESIGN THE DIFFERENCE NOT THE OBJECT
DESIGN THE PLATFORM FOR CONSTANT DESIGN
DESIGN THE INVISIBLE
DESIGN THENEW NORMAL
DESIGN WHAT YOUDO TOTELL YOUR STORY
NEW WICKED PROBLEMS DEMAND NEW WICKED TEAMS
THOSE WHODO TEACH GETOUT THERE ANDDO
WORK ON WHAT YOU LOVE

Before and After the Great (Agricultural) Leap (June 23)

Before (Now, July 3,2024…):

- GHGs from CO_2 and Methane and NO_3 high
- Drawdown of CO_2 from atmosphere net negative
- 10 % of the world starves, many more are food insecure
- Much of the 1st world is overfed and dies from nutrition-based disease
- Glyphosate residues exist in soils and probably in food grown in those soils
- Nitrogen from fertilizers wash into waterways, creating dead zones
- Pesticide use kills insects, including pollinators, indiscriminately
- Beneficial weeds are killed by glyphosate (eg. milkweed that Monarch Butterflies rely on
- Most of the arable global land mass is farmed, occupying about 11.2 billion acres
- Soils are degraded, with poor organic content, a lack of soil microbiome, and compaction layers.
- Global temperatures and atmospheric CO_2 and Methane and NO_3 levels continue to rise.

After:

- CO_2 levels back to safe levels, methane and NO_3 levels falling
- All of the world's populations have access to a sustainable local food system
- Starvation virtually unknown globally, nutrition related disease rates are falling, increased numbers of atherosclerotic diseases reversed.
- Glyphosate residues nonexistent in soils and food – glyphosate-related human microbiome diseases nonexistent
- Ocean life recovered from nitrogen poisoning, and ocean temperatures stabilized..
- Pesticides have been banned, insect populations have rebounded, including pollinators
- Monarch Butterfly numbers have rebounded

United Nations On Importance of Carbon Sequestration in Land Sinks

•Repurposing in the next decade ***just $US 1.6 trillion of the annual $700 billion in perverse subsidies given to the fossil fuel and agricultural industries would*** enable governments to meet current pledges to **restore by 2030 some 1 billion degraded hectares** – an area the size of the USA or China – including 250 million hectares of farmland

•Restoring land, soils, forests and other ecosystems **would contribute more than one-third of the cost-effective climate change mitigation needed to limit global warming to 1.5°C** while supporting biodiversity conservation, poverty reduction, human health and other key sustainable development goals

•Many traditional and modern regenerative food production practices can **enable agriculture to pivot from being the primary cause of degradation to the principal catalyst for land and soil restoration**

https://www.unccd.int/news-stories/press-releases/chronic-land-degradation-un-offers-stark-warnings-and-practical

(re the previous slide)
This is important but conservative – key to the DRFH plan is an acceptance that all current humans could be fed on 2 billion acres (1/4 acre per person per year) of regenerative farmland. These 2 billion acres would themselves sequester enormous amounts of carbon, but the remaining 9.2 billion acres currently being farmed unsustainably would no longer be needed for agriculture. These 9.2 billion acres could be returned to nature, growing restored forests, jungles, and wetlands and sequestering vast amounts of carbon in the process. An important part of the strategy would be to repurpose as much of the $7 trillion to be spent on "perverse" fossil fuel and agricultural incentives as possible, not just a token $1.6 trillion (23 %) and spend it on restoring carbon land sinks and at the same time, nature habitats and waterways as agricultural pollutant levels drop massively.

This is consistent with the fact that over 75 % of agricultural production is fed to animals which return only a small percentage of the calories and nutrients fed to them. Additionally, the enormous amount of waste that is inherent (in my opinion) in the way our food is harvested and distributed. The next slide indicates that production rates with regenerative agriculture do not need to be less than that of our dominant methods using fertilizer, tilling, chemicals and monocropping. Moreover, if tied to local food systems that do not grow food for animals but for people, only a fraction of the land currently used in agriculture could feed all.

The land use of livestock is so large because it takes around 100 times as much land to produce a kilocalorie of beef or lamb versus plant-based alternatives. This is shown in the chart.[1] The same is also true for protein – it takes almost 100 times as much land to produce a gram of protein from beef or lamb, versus peas or tofu.

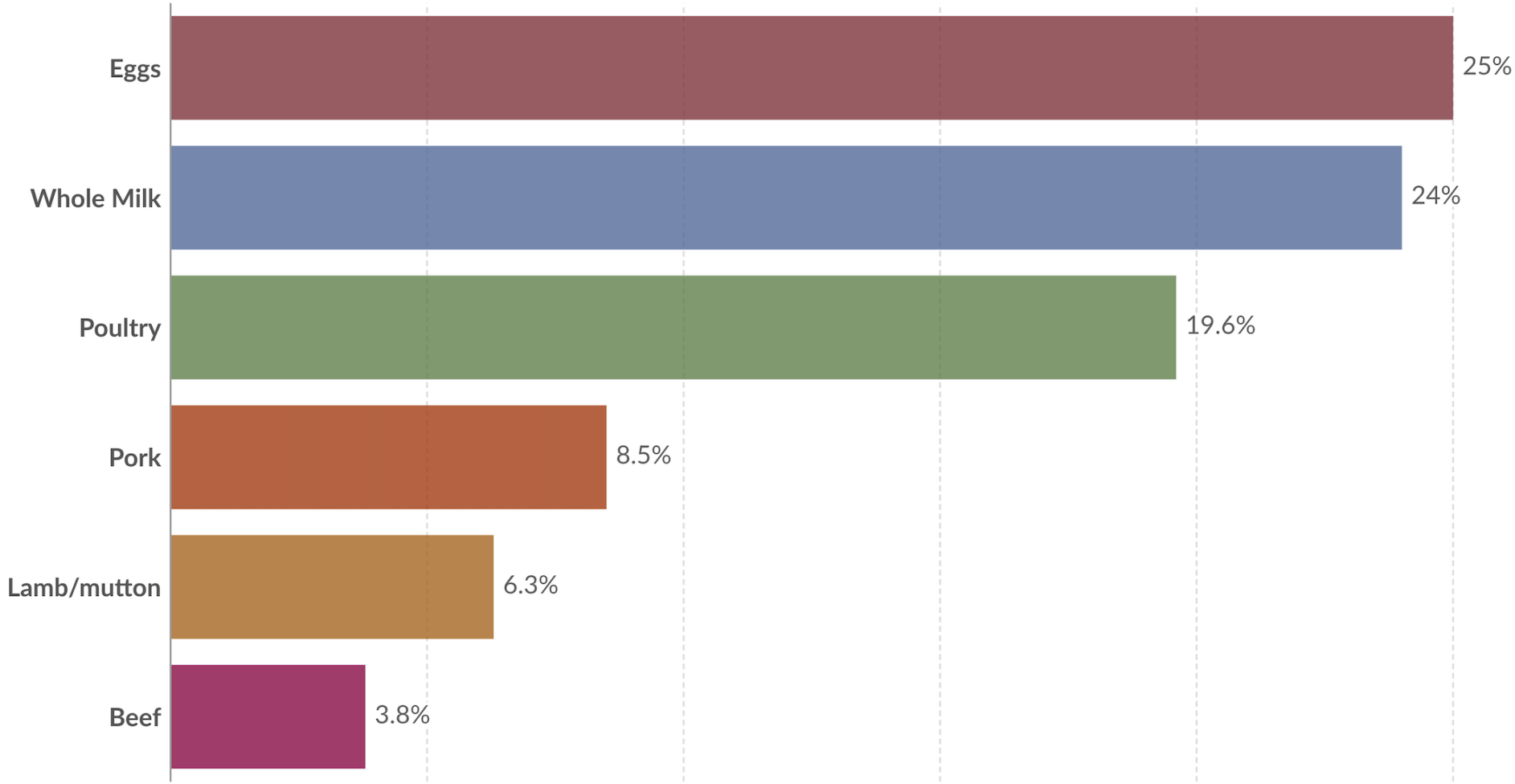
Globally agricultural land area is approximately five billion hectares, or 38 percent of the global land surface. About one-third of this is used as cropland, while the remaining two-thirds consist of meadows and pastures) for grazing livestock.
https://www.fao.org/sustainability/news/detail/en/c/1274219/

Hannah Ritchie (2021) - **“If the world adopted a plant-based diet, we would reduce global agricultural land use from 4 to 1 billion hectares**” Published online at OurWorldInData.org. Retrieved from: 'https://ourworldindata.org/land-use-diets' [Online Resource]

Protein efficiency of meat and dairy production

Our World in Data

The protein efficiency of meat and dairy production is defined as the percentage of protein inputs as feed effectively converted to animal product. An efficiency of 25% would mean 25% of protein in animal feed inputs were effectively converted to animal product; the remaining 75% would be lost during conversion.



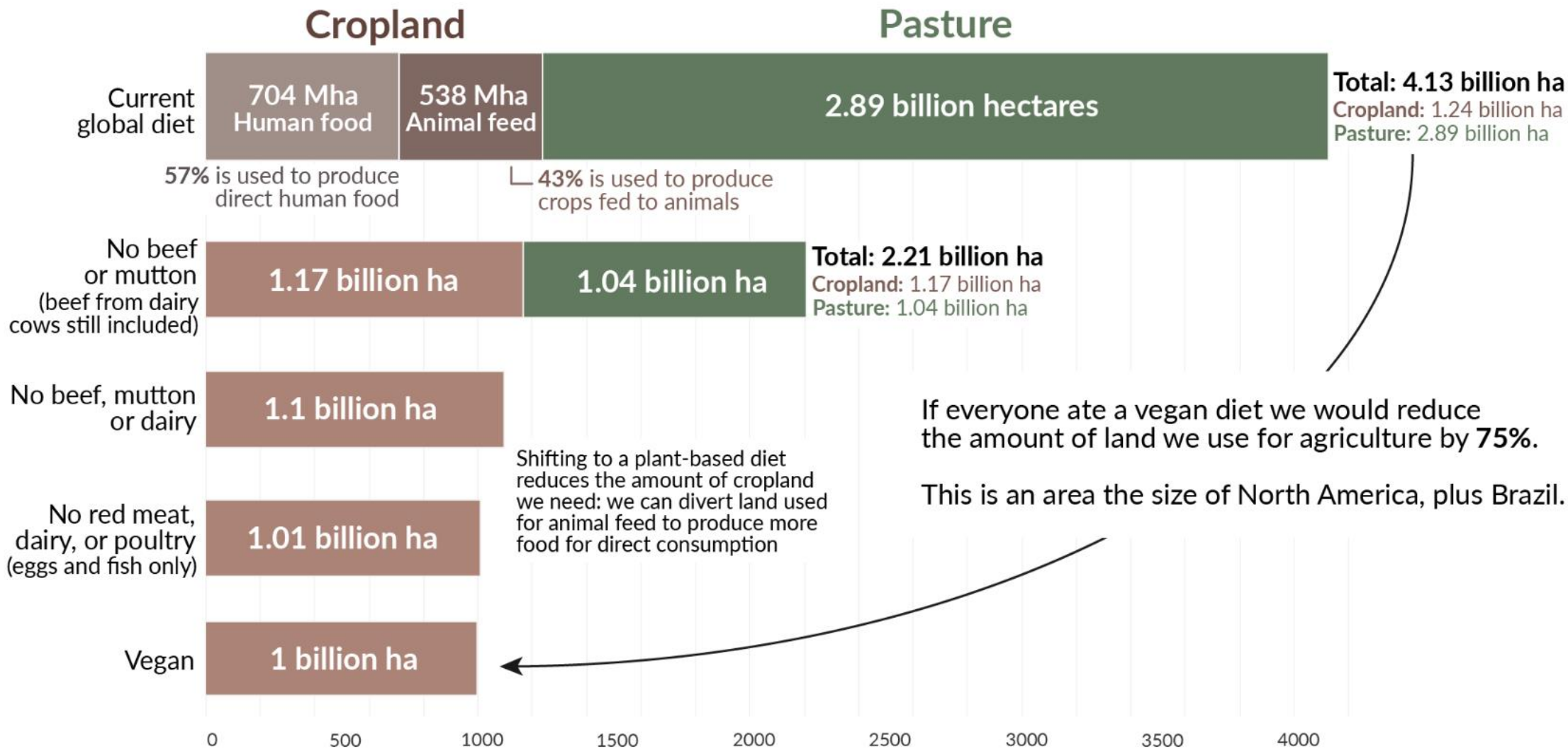
Data source: Alexander et al. (2016). Human appropriation of land for food: the role of diet. Global Environmental Change.
OurWorldInData.org/meat-production | CC BY

https://ourworldindata.org/land-use-diets#article-citation

Global land use for agriculture across different diets

Our World in Data

Global agricultural land use is given for cropland and pasture for grazing livestock assuming everyone in the world adopted a given diet. This is based on reference diets that meet calorie and protein nutritional requirements.

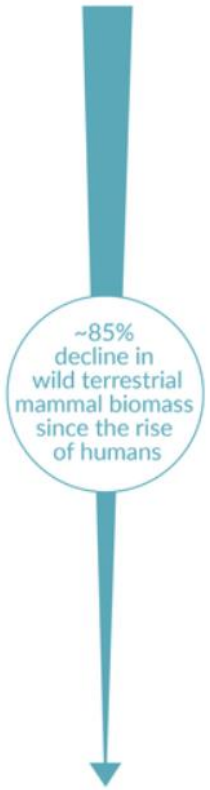


Data Source: Joseph Poore & Thomas Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*.

OurWorldinData.org – Research and data to make progress against the world's largest problems.

Changing

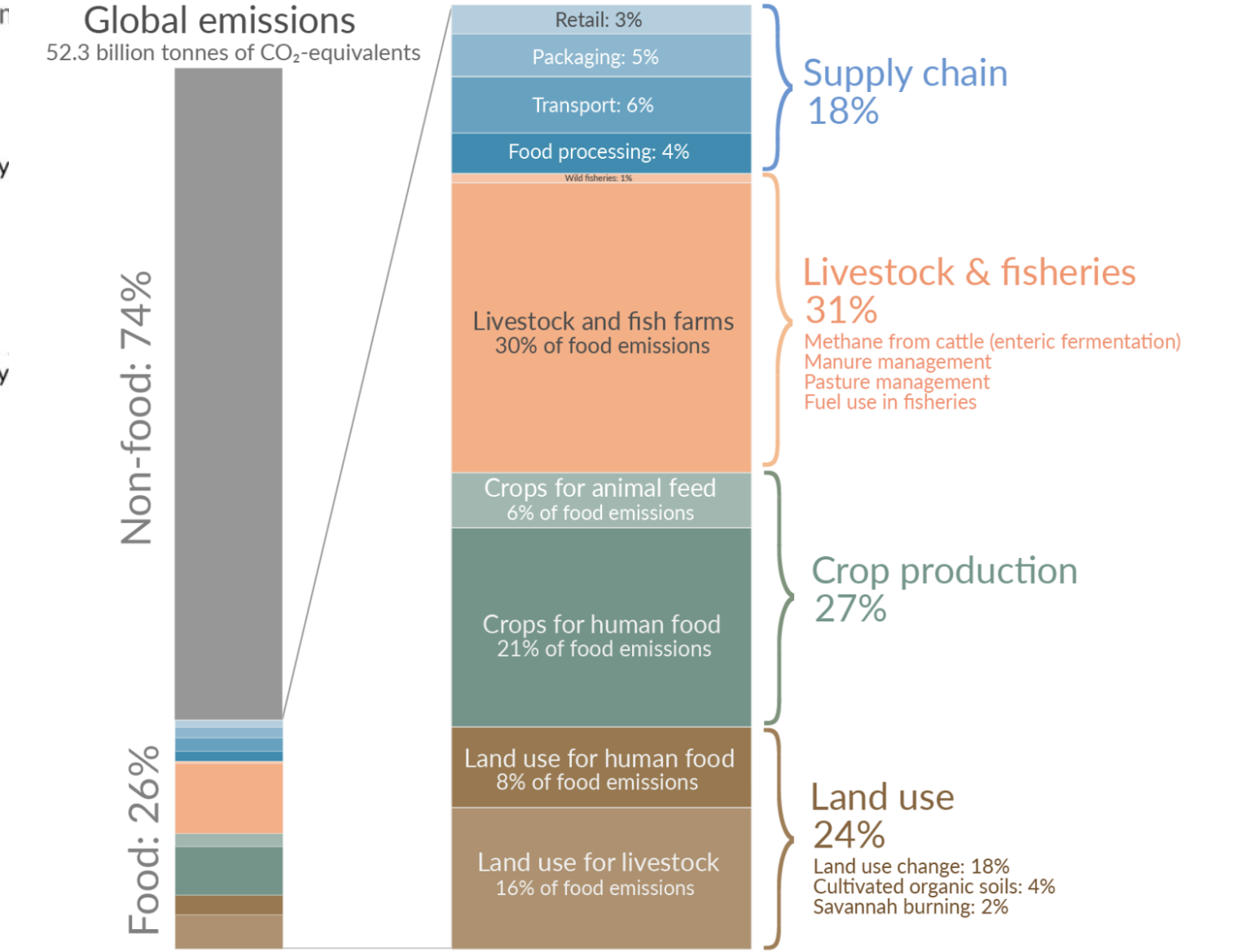
Mammals are cor



Global greenhouse gas emissions from food production

Our World in Data

Our World in Data



One tonne of carbon is equal to either:

Note: Estimates of long-

Sources: Barnosky (200

OurWorldinData.org —

Data source: Joseph Poore & Thomas Nemecek (2018). Reducing food's environmental impacts through producers and consumers. Published in *Science*.

chie and Klara Auerbach.

Agricultural diversification promotes multiple ecosystem services without compromising yield

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