Dairy system resilience and net zero C emission

How Are they Linked?

Alan Fredeen, PhD., PAg.
Dairy systems
Department of Animal Science and Aquaculture
Faculty of Agriculture
Dalhousie University

DALHOUSIE UNIVERSITY
Inspiring Minds

Resilience: Necessary global agriculture cornerstone

OECD ministers of agriculture, 2016

- Improved sustainability

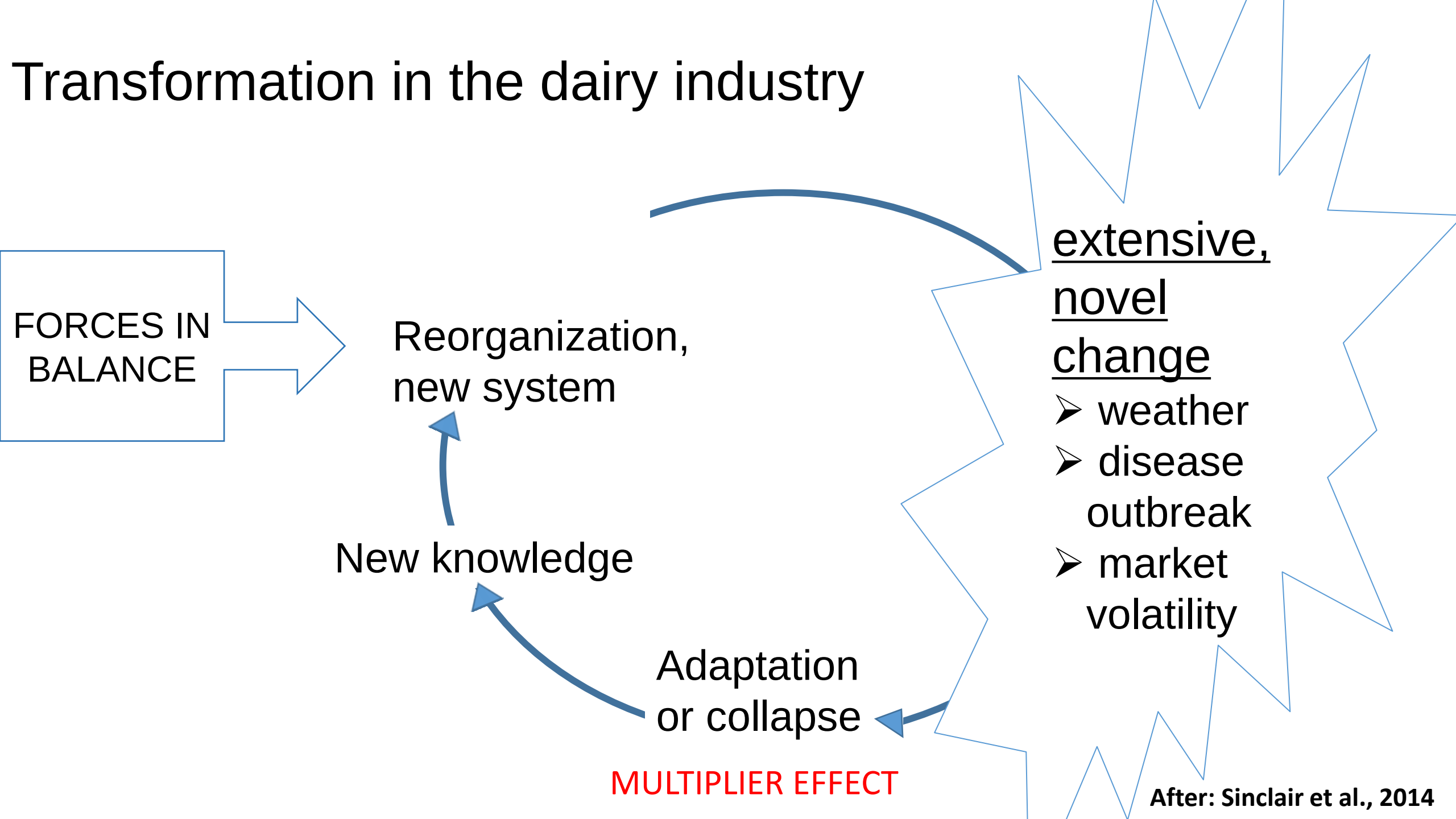
  - Fewer dependencies. Less vulnerable

- More than improving efficiency

- Not degrading the environment

- Role for traditiovation?

Transformation in the dairy industry



After: Sinclair et al., 2014

Evolution in farm system

- Good at achieving goals…
- Terrible at seeing all side effects
- Economics usually trumps environment
- BAU = substantial negative consequences for agriculture

Wright, 2010

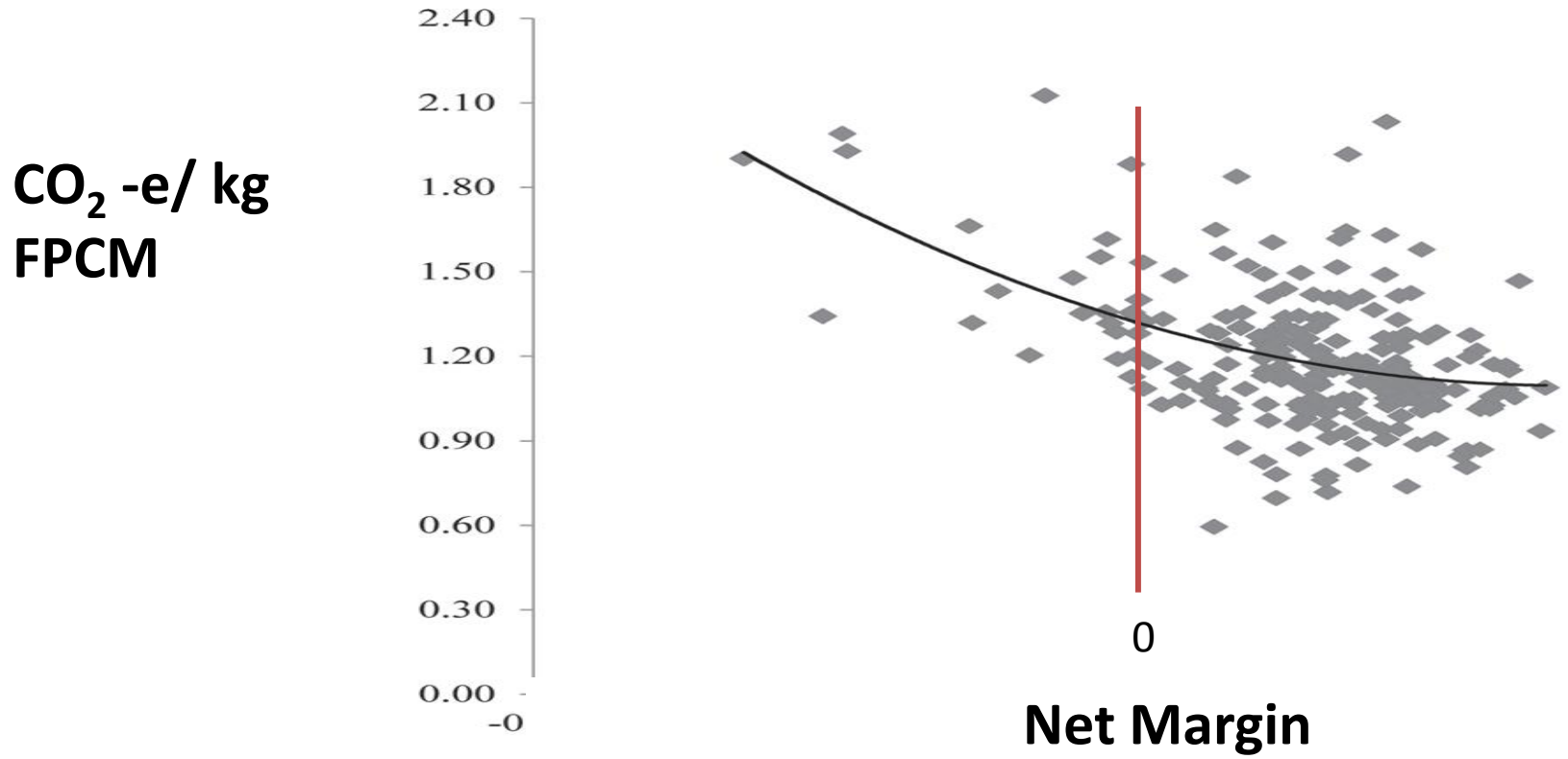
Cost of milk greater than we’re aware of

“Using up nature’s assets instead of living off its interest.”

High revenue/ cow associated with negative environmental impacts

Hawken, 1999

Higher milk profit appears to lower GHG emission



- Feeding concentrate - Increased carbon footprint,
  -Reduced profitability.

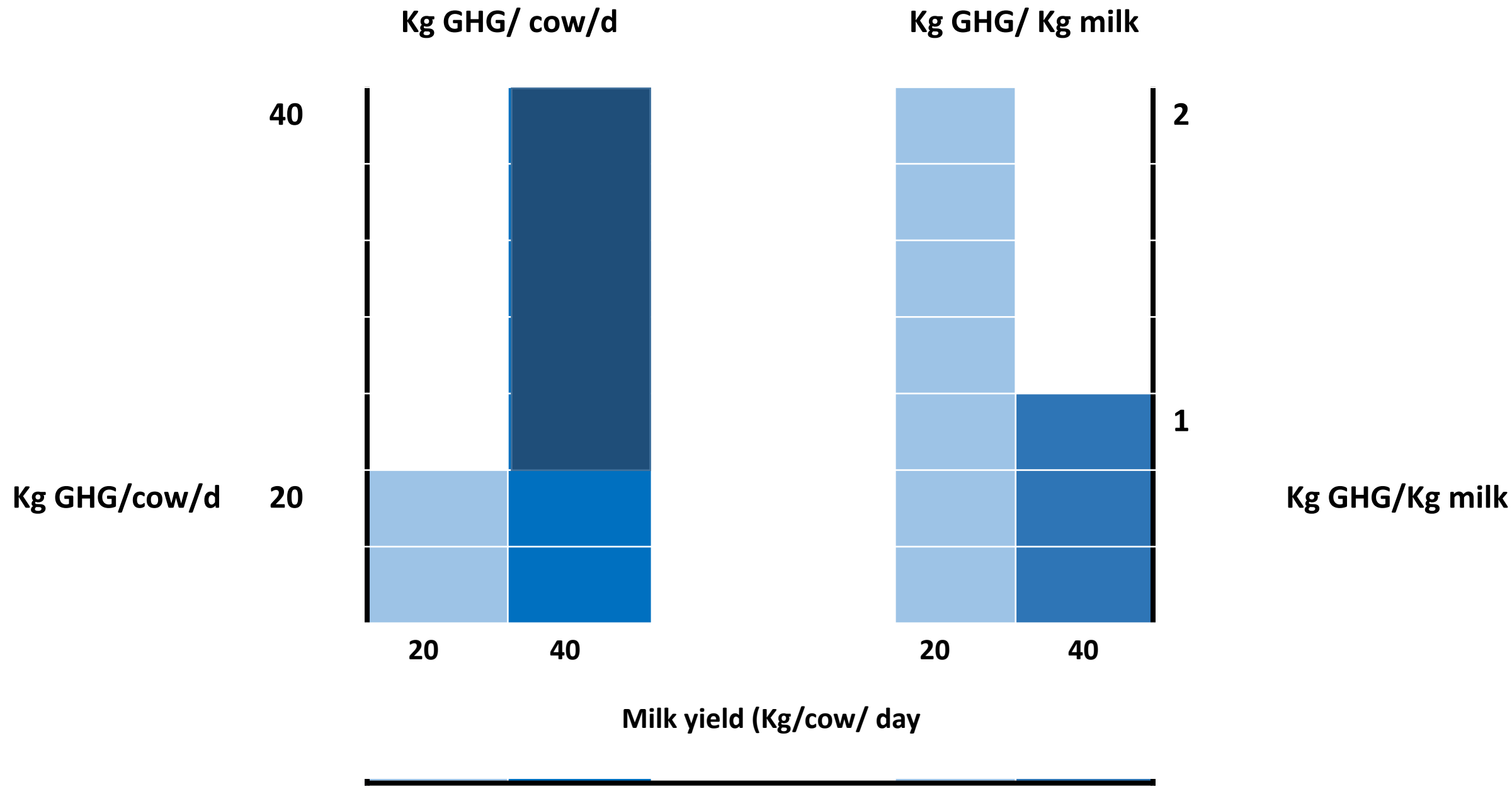
O'Brien, Hennessey et al, 2015

GHG from milk from Irish farms based on gross margin

	GROSS MARGIN / ha		
	bottom	middle	top
Kg CO_2-e	5717	5706	6233
Kg FPCM/ cow	4331	4962	5566
Kg CO_2-e /Kg FPCM	1.32a	1.15b	1.12b

O’Brien, Shalloo et. al., 2015

Schematic of level of milk yield on possible GHG emission



Focus on high milk yield/ cow

Where do we draw the farm boundary?

Increases use of purchased inputs

Negative environmental impacts

- GHG emission
- water quality deterioration
- eco- and human toxicity
- soil degradation

Ontario dairy industry trends, 1991- 2011

	Magnitude of change
# dairy farmers	-60%
total milk	NC
milk/ cow	+43%
herd size	+65%
# cows	-38%
GHG, Tg CO_2-e	-13.3%

Statistics Canada
Dyer et al., 2008
Jayasundara and Wagner- Riddle, 2014

High milk yield increases dependence on fuel in production of feed and feeding

Feed type	L fuel/ t feed DM	Mcal Fuel : Mcal Feed
grazed forage	0.0	0.0
corn grain	12.0	85.4
corn silage	19.0	150.0
hay	17.0	167.8
haylage	25.0	232.7

- Cost of C emission?
- C trading possible?

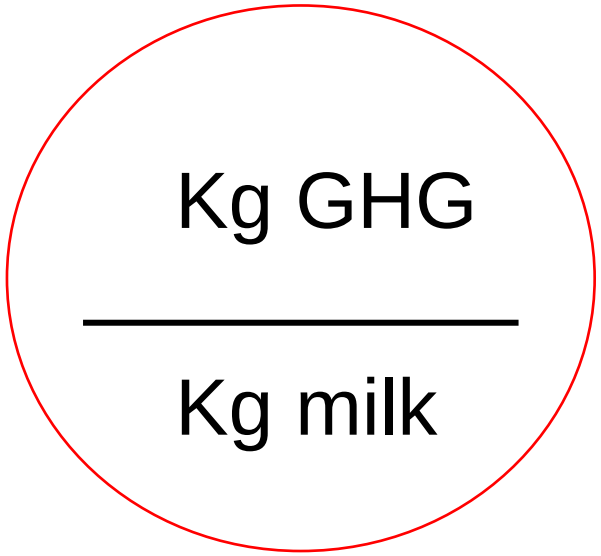
Adapted from Rotz, 2010

System- related GHG

	PASTURE	CONFINEMENT
FPCM, Kg/cow/ y	6,639	8,040
Kg CO_2-e/ Kg FPCM		
concentrate	6.0	67.3
pasture	33.4	3.4
haylage	9.0	25.7
corn silage	0	11.9
TOTAL	**49.3**	**108.3**
Kg CO_2-e/ Kg FPCM	**0.7**	**0.9**
System land use	23% less	

O'Brien et al., 2012

Current driver

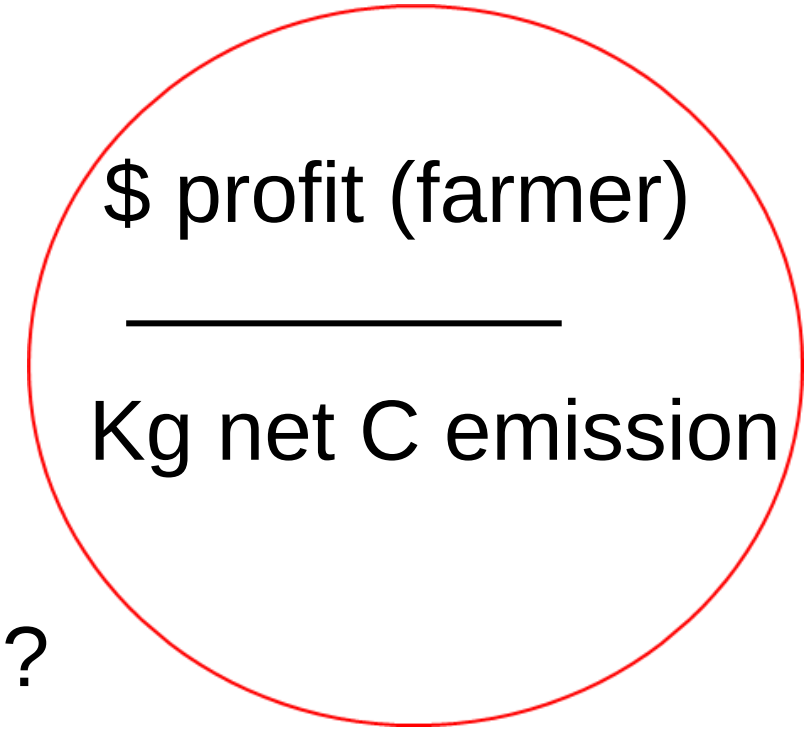


Equal weight on:

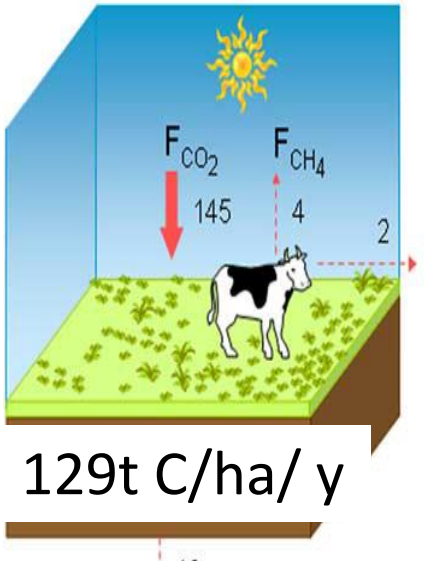
- increasing kg milk/cow
- reducing number of cows
- reducing kg GHG

GHG intensity measurement may not accomplish needed change

Improved target for dairy industry ?

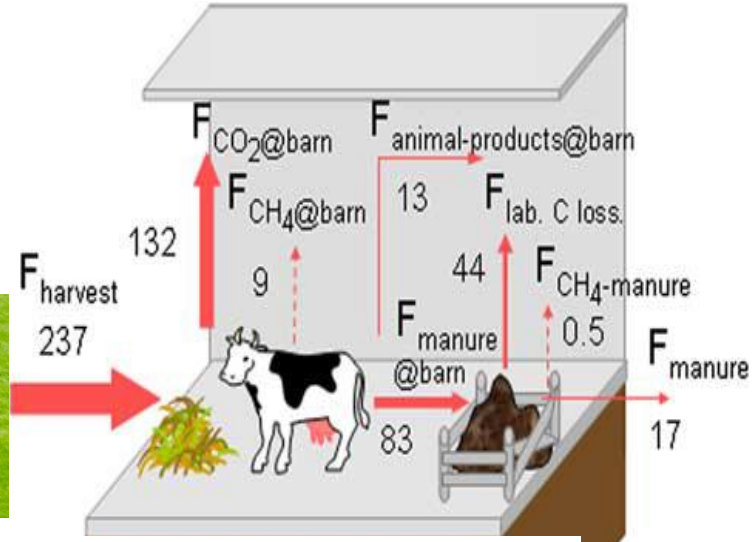


- Role for DHI?



129t C/ha/ y

GRAZED



Neg to22t C/ ha/ y

CONFINEMENT

Net soil C sequestration of dairy systems depends on soil type and its management

Soussana, 2010

CO_2 sequestration (t/ ha/ y) by replacing, growing trees

Poplar	Oak	Walnut	Spruce	Cedar	Soybean
2.12	1.58	0.84	1.81	1.36	-1.15

Wotherspoon et al., 2014

<u>Spruce trees needed for net zero C emission</u>

Rows of 350 spruce trees @3.5m spacing

- Confinement (99t CO_{2e}): 1.0 Km
- Pasture (78t CO_{2e}): 0.5 Km

More diversification needed

Resource- based industries are dependent on nature

High input system requiring high milk yield dominates industry

Diversity within and across farms improves industry resilience

Need improved support for alternatives

Duru and Therond, 2015

What could 6 months of grazing provide?

- Cow H and W
- Biodiversity
- Profitability
- Milk healthfulness
- C sequestration
- Soil cover

Full toolbox to build resilient, C- neutral, profitable dairy farms

Local RD and E win-wins

Crops

- restore biodiversity
- legumes, diverse mixes
- perenniality
- reduce water risk

New and rebuilt C sinks

- trees
- set asides
- pasture

C emission

- off the grid farms
- reduced fossil energy, electricity use
- biofuel crops, residues

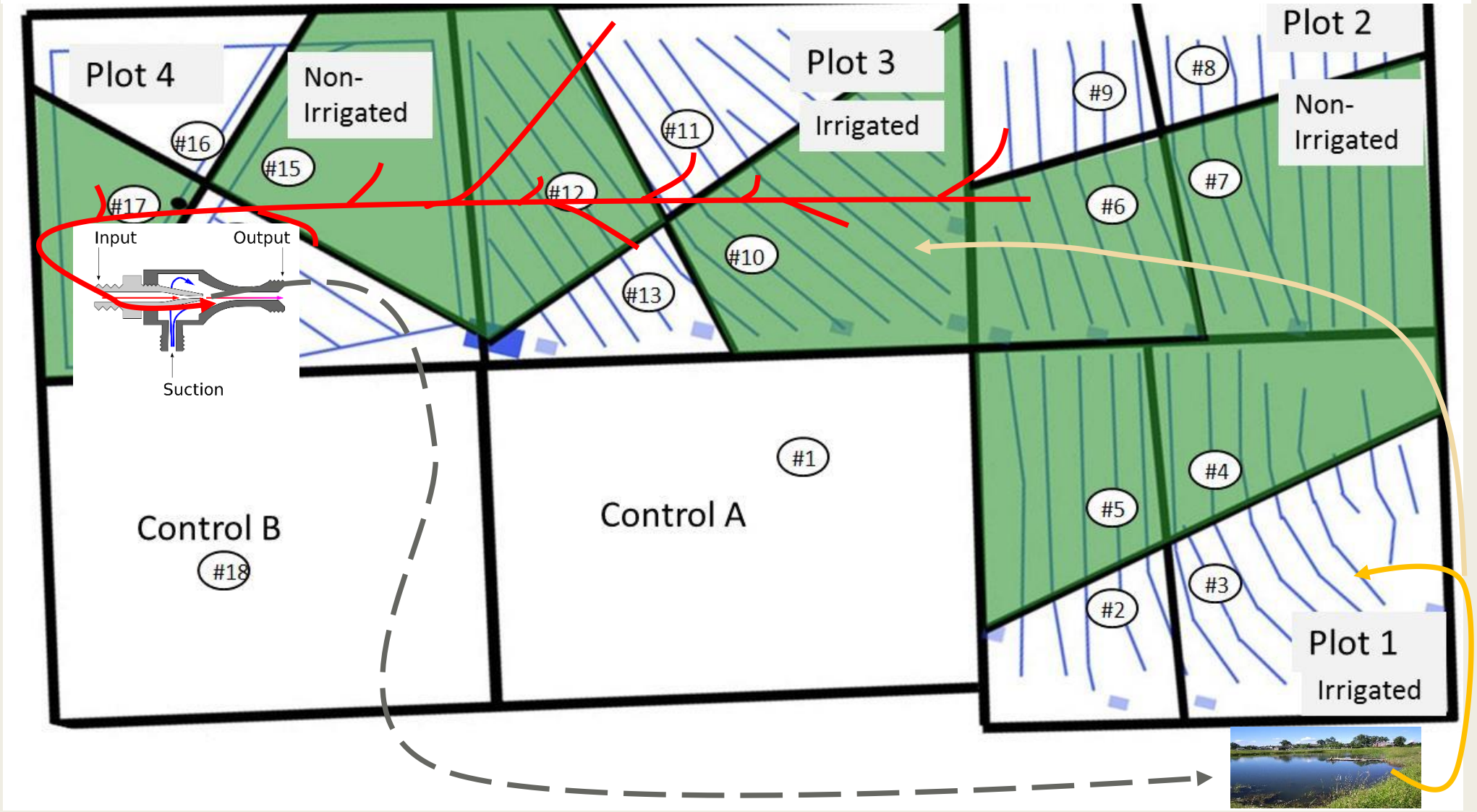
Livestock

- breed for fitness
- enteric methane mitigation
- reduce number

Farm

- locally embedded in community
- Manure management

Recycling sub-surface irrigation/ drainage



Management intensive grazing, a crucial element

...Reduces reliance on dairy ration, diesel and the equipment that burns it in seeding, fertilizing, mowing, raking, harvesting, storing, spreading manure etc.

...Improves fertility through nutrient recycling, with no acidification of the soil... reseeding using hoof action of cattle counters winterkill.

... Every 1% increase in OM holds a 1 inch" rain fall. Drought has less impact, soil can absorb more water...

Nick vanVulpen