

# Quantifying the Upstream Flux of Phosphorus to Minnesota's Twin Cities Urban Food-shed

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DYNOLIGHTS

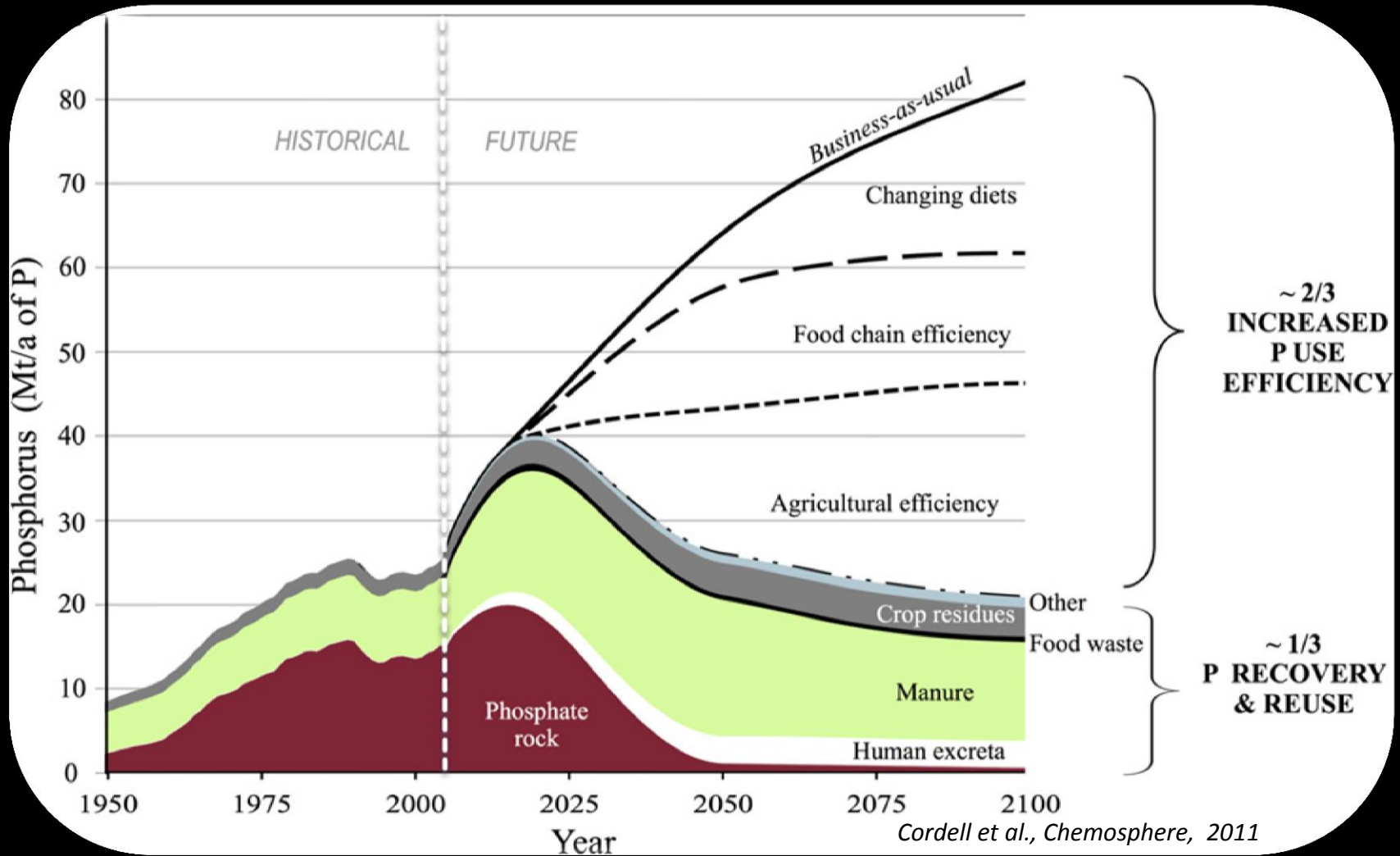
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# Phosphorus Overview



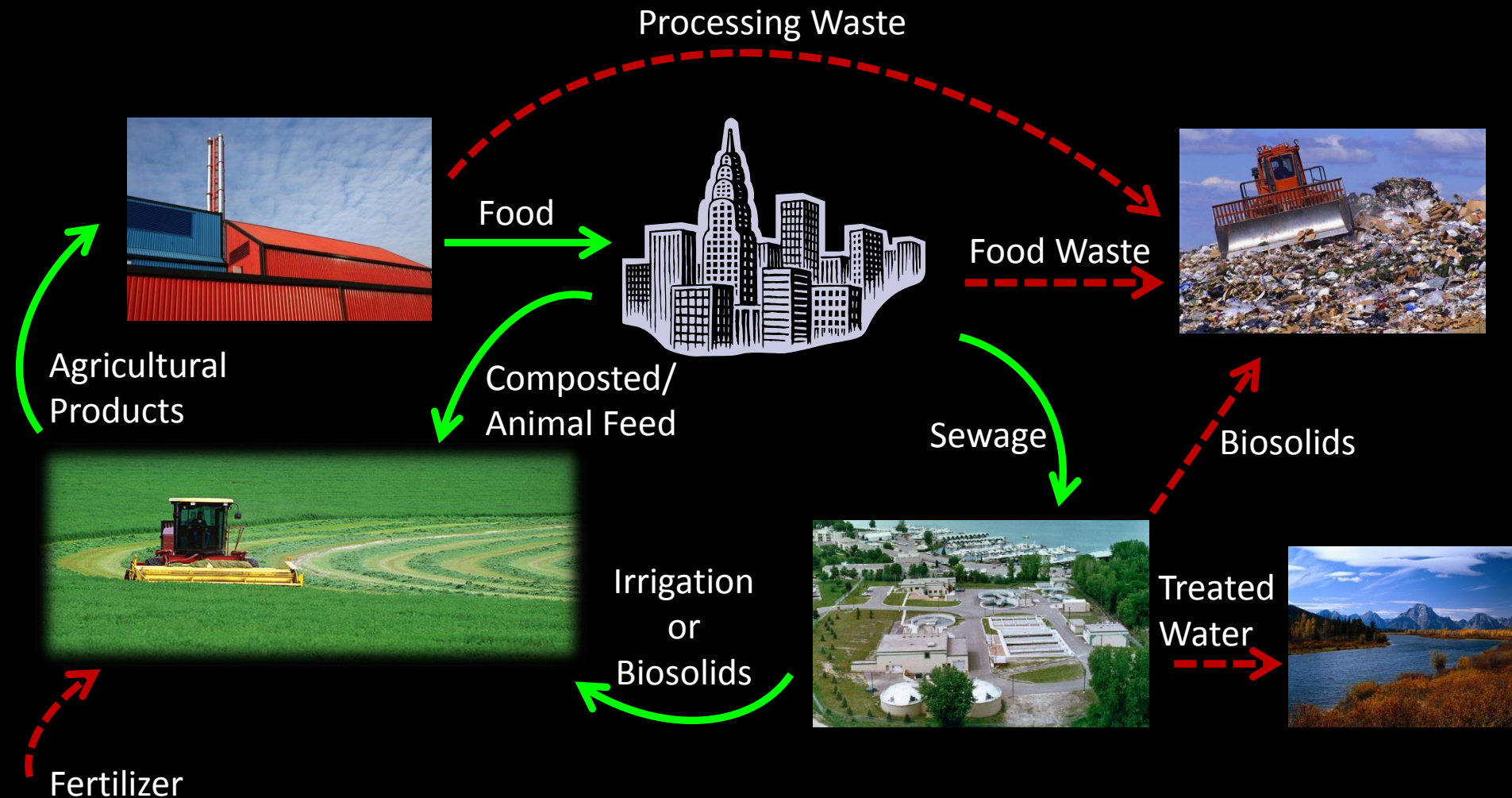
- Essential nutrient for sustaining life
- Essential fertilizer ingredient
- Non-renewable resource

# Phosphorus Overview



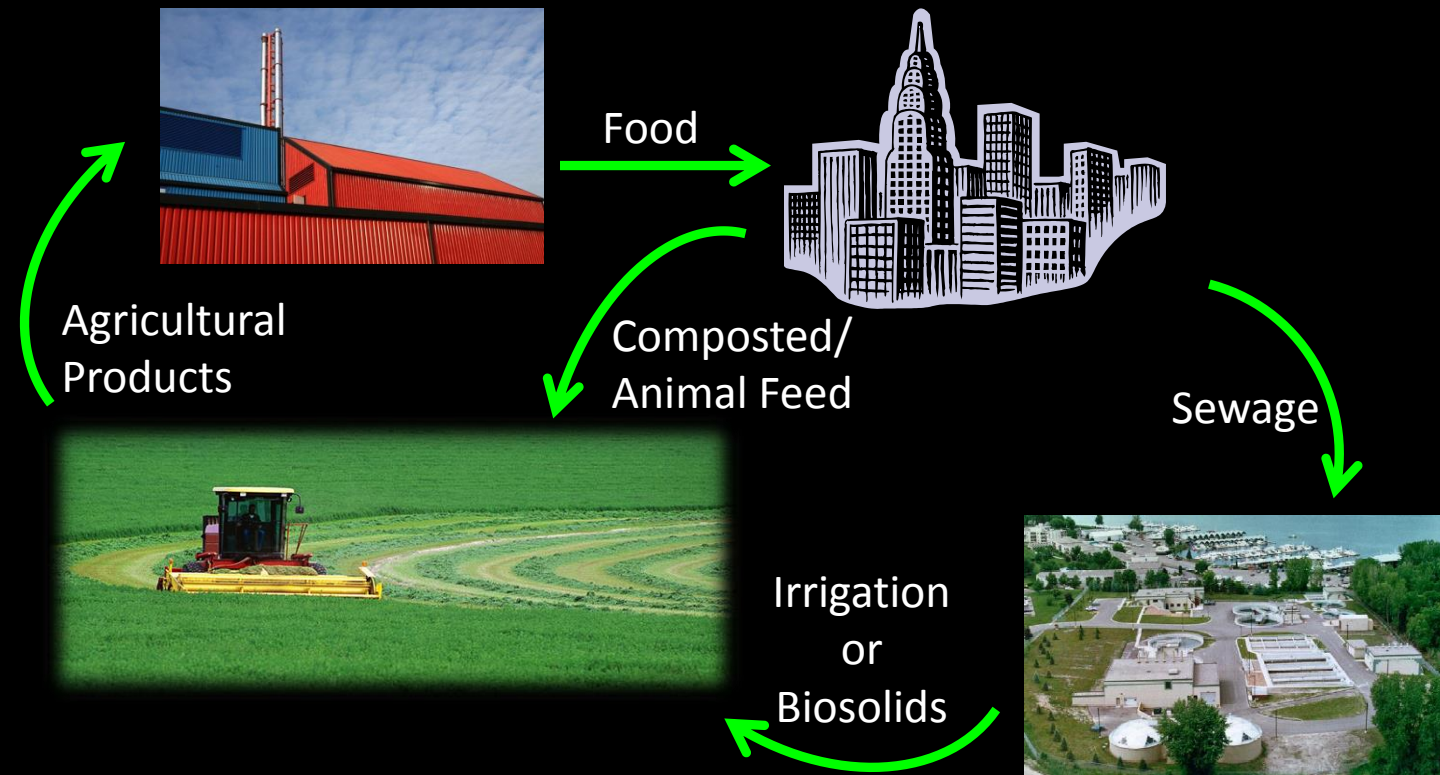
# Phosphorus (P) Flows

**Goal:** Identify opportunities to shift current P flow through system toward a circular P economy



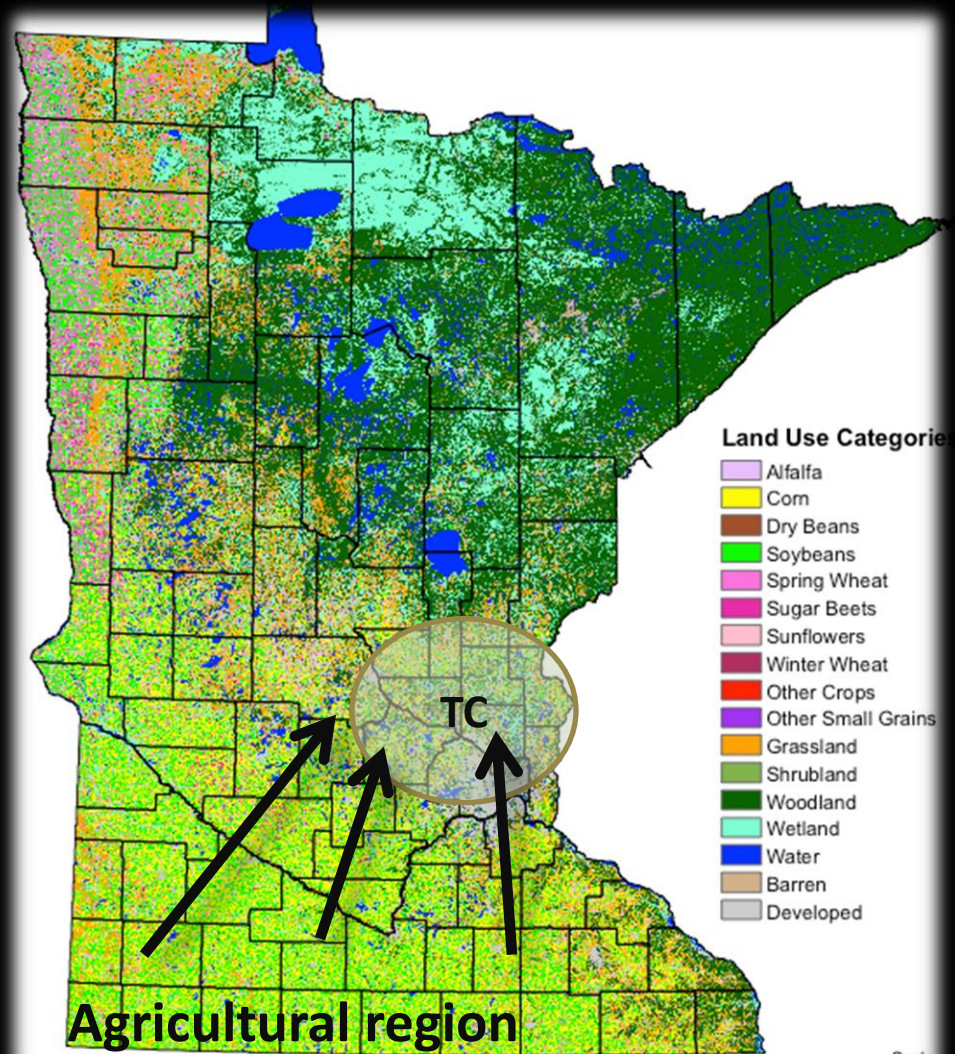
# Phosphorus (P) Flows

**Goal:** Identify opportunities to shift current P flow through system toward a circular P economy



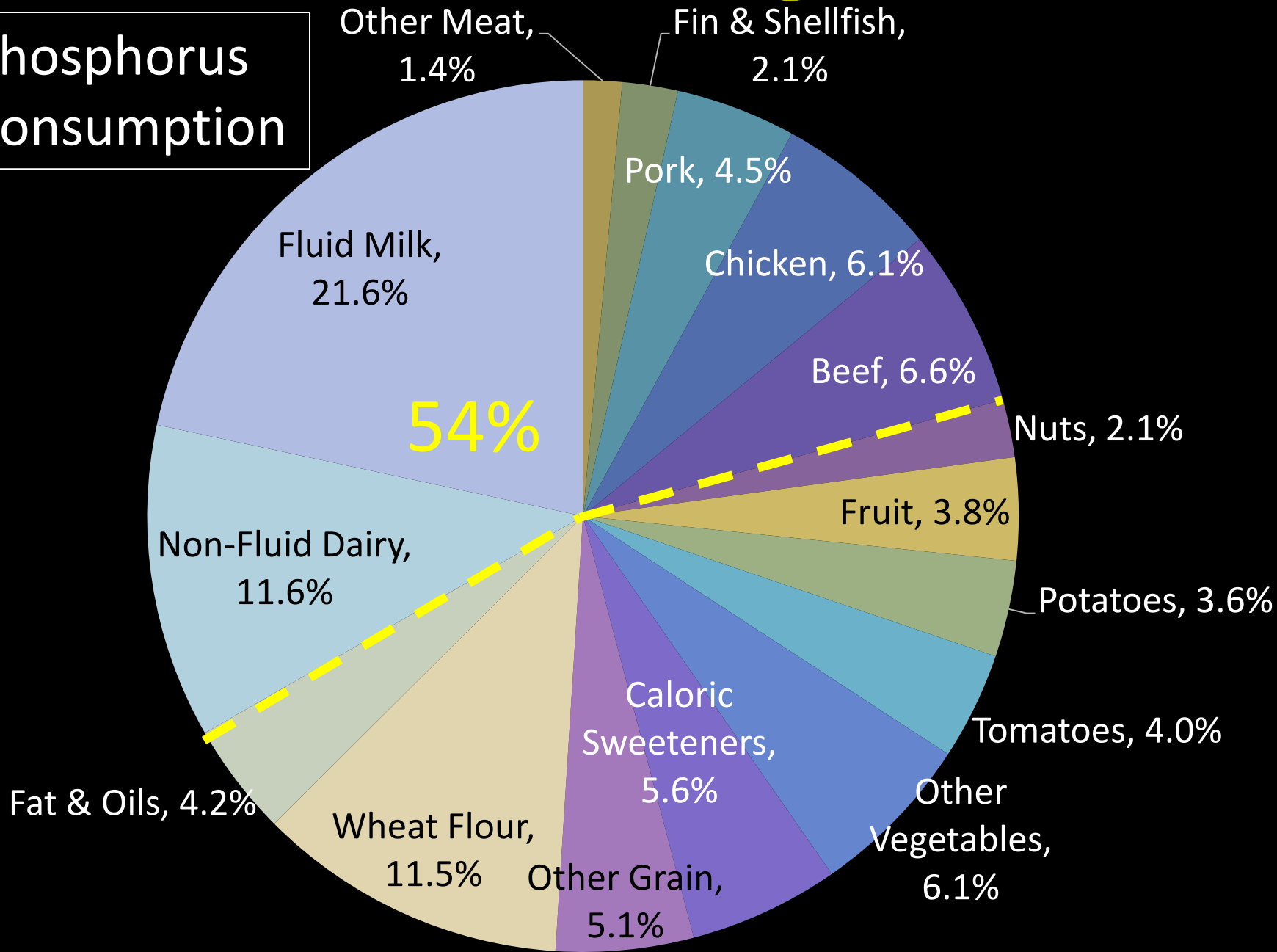
# Upstream P Flows: “Food-shed Approach”

1. Most food consumed in the Twin Cities (TC) is produced in MN, making findings actionable
2. Allows regional scale analysis of top-down & bottom-up scenarios
3. Detailed and realistic analysis could guide implementation of circular P economy



# What are we eating in the TC?

Phosphorus Consumption



# TC Consumption vs MN Production

TC food consumption as % of MN Production → Exported  
← Imported

Wheat Flour	3.5%	→
Pork	4.2%	→
Milk & Dairy	7.3%	→
Potatoes	12.9%	→
Beef	23.3%	→
Chicken	98.2%	←



# P Flow through MN Swine System



Stage	Count	Feed P	Manure P
---Gg/Yr---			
Piglet	10,800,000	3.2	1.4
Feeder	10,800,000	12.2	5.6
Sow	306,000	1.6	1.3
Gilt	291,000	1.4	0.6
Boar	2,150	.008	.007



## Output P (Gg/Yr)

- 8.1 Pork Produced
- 0.3 Rendered
- 0.2 Composted

# P use Efficiencies for Minnesota Livestock Operations

System	P Input	Product P	P Use Efficiency
	----- (Gg/Yr) -----		
Beef	12.7	2.5	20%
Dairy	12.5	4.3	35%
Pork	17.9	8.3	47%
Broilers	1.3	0.6	47%
Turkey	8.4	4.2	50%

Atmospheric Deposition

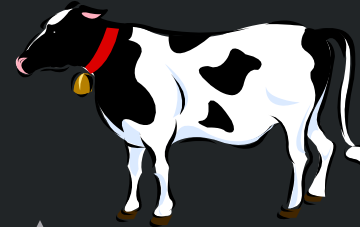
Units: Gg

10.5

Feed Imports

2.9

Chicks 0.004



Manure 0.6

Feed 0.9

Manure 4.2

Feed 6.3

Manure/  
Compost 9.3

Feed 18.4

Dairy &  
beef feed 25.5

Manure 18.9

Pork 8.3

Chicken 0.2

Milk 3.7

Beef 3.1

Turkey 2.1

Crops 121

Fertilizer

80.6



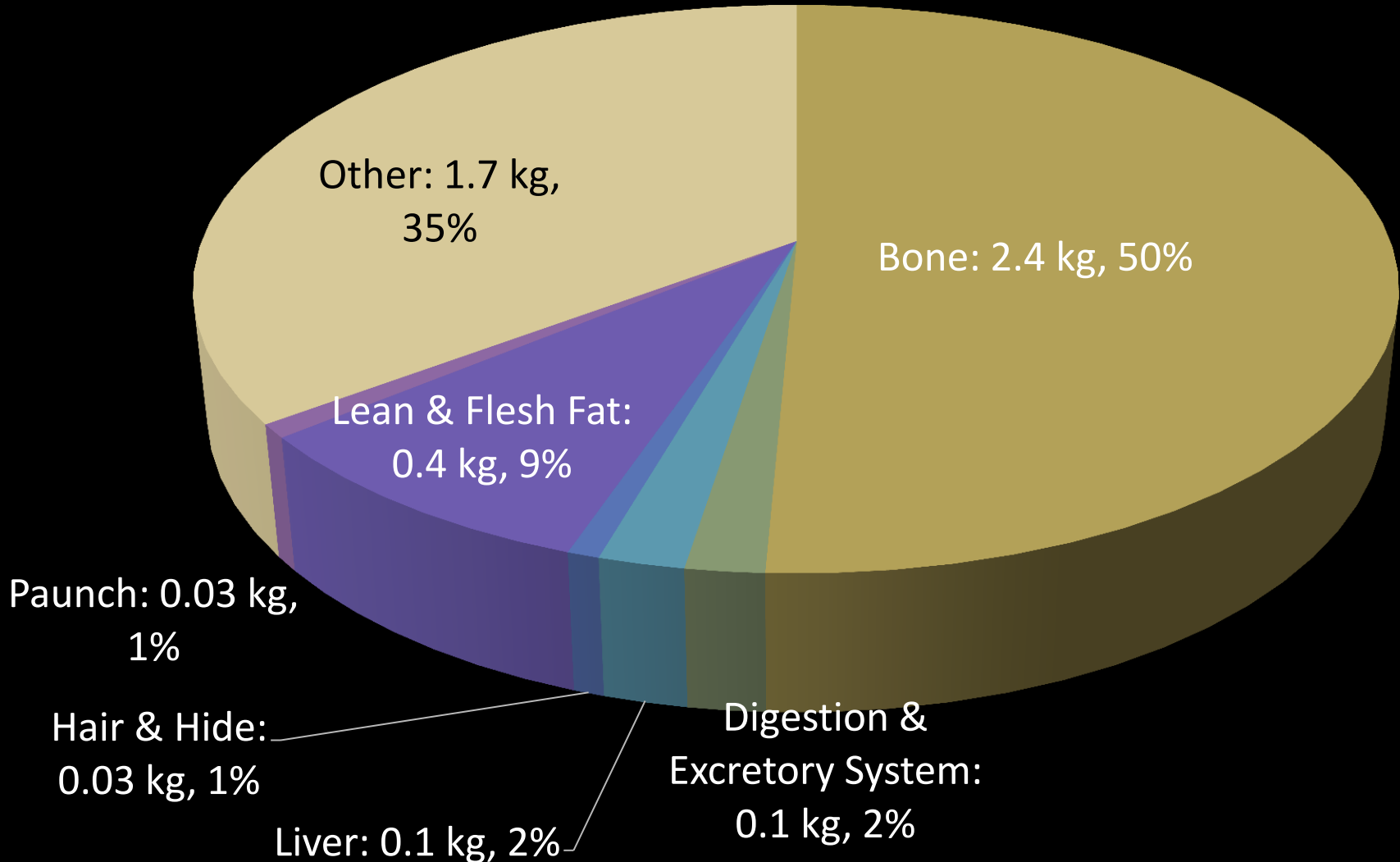
Inputs = 94

Deliberate exports: 138

Minnesota P use efficiency = 1.47

# Distribution of P within Steer Carcass

(Total P approx. 4.75 kg / 634 kg steer)



Moulton, C.R. *et al.*, (1922) *Changes on Different Planes of Nutrition*. Univ. of Missouri. Columbia, Missouri.

Ockerman, H.W. and C.L. Hansen (2000) *Animal By-Product Processing & Utilization*. Technomic Publishing, Lancaster, PA.

# TC Balance:

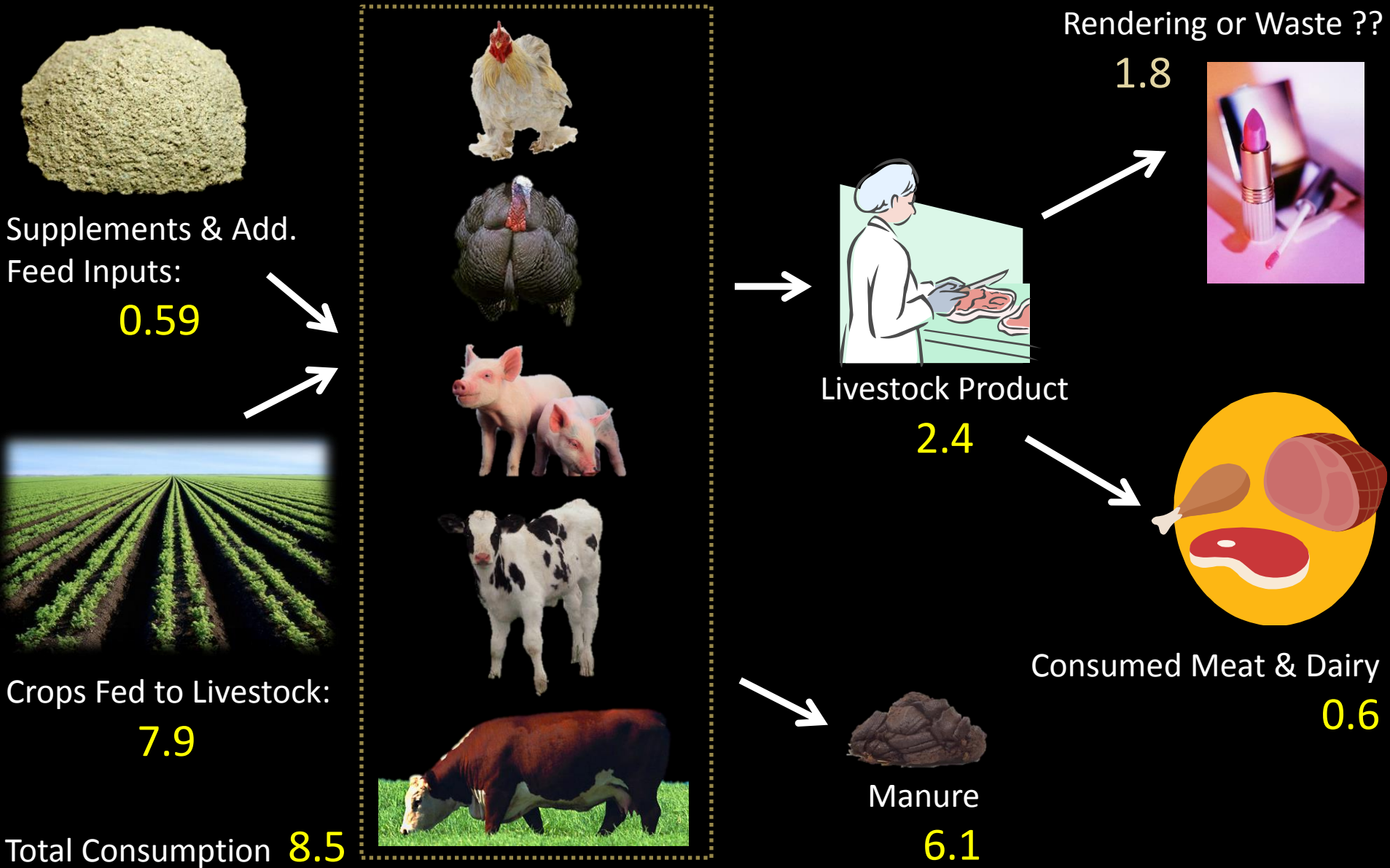
## P in Livestock versus P Consumed

System	Average Slaughter Wt.	Edible Yield	Livestock P Consumed
	kg	%	% P
Turkey	12	45.1	9
Beef	634	40.2	9
Broilers	2.5	47.0	12
Pork	122	52.8	16

Produce 2.0 Gg P in livestock, but only consume 0.22 Gg meat.

Units: Gg

# TC Livestock P Balance



# Vision for Future Research



1. Identify the fate of P “losses” in the farm-urban-farm system
2. Determine the drivers and constraints in progressing toward a circular P economy





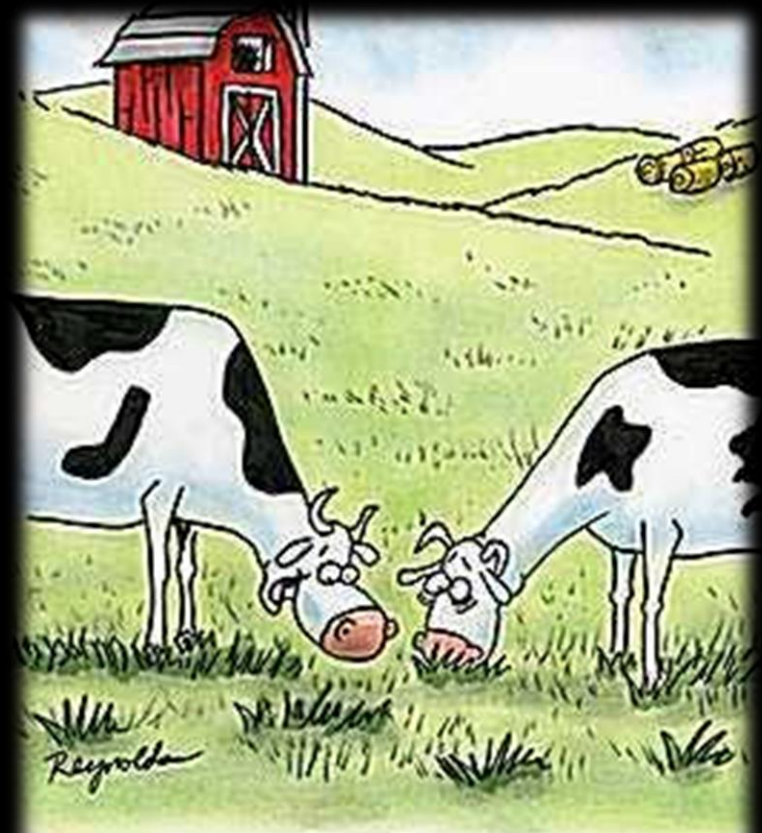
# Thank you!

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"Just think... our pies feed the soil, the soil feeds the grass, the grass feed us.."

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