

Opportunities for Treating Food Processing Waste

Nutrient Issues

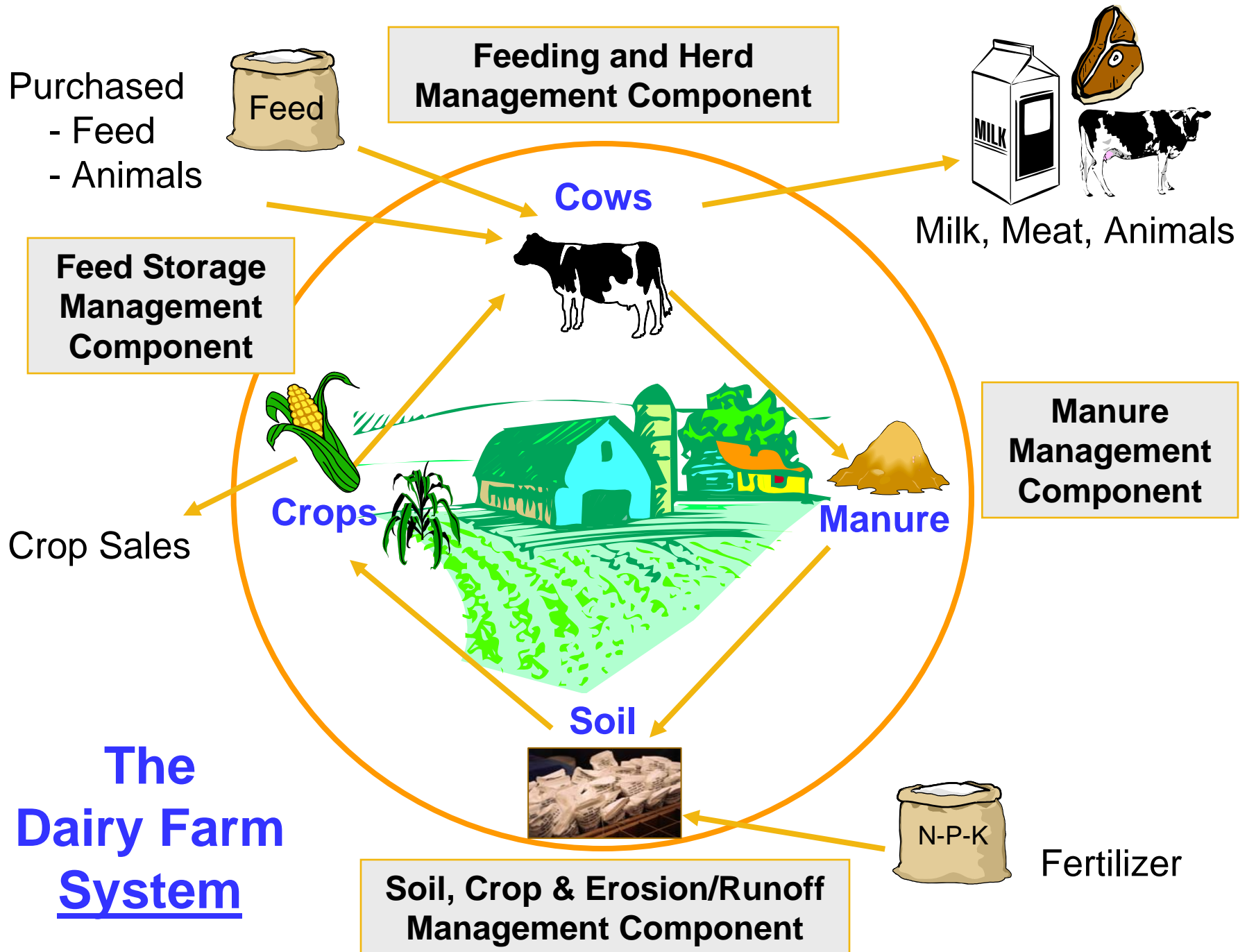
Keep the bigger picture in mind when deciding on use of food processing waste.



Quirine M. Ketterings

Nutrient Management Spear Program

Cornell University



Purchased
- Feed
- Animals



Feeding and Herd Management Component



Milk, Meat, Animals

Feed Storage Management Component



Crops

Crop Sales



Manure

Manure Management Component

Soil

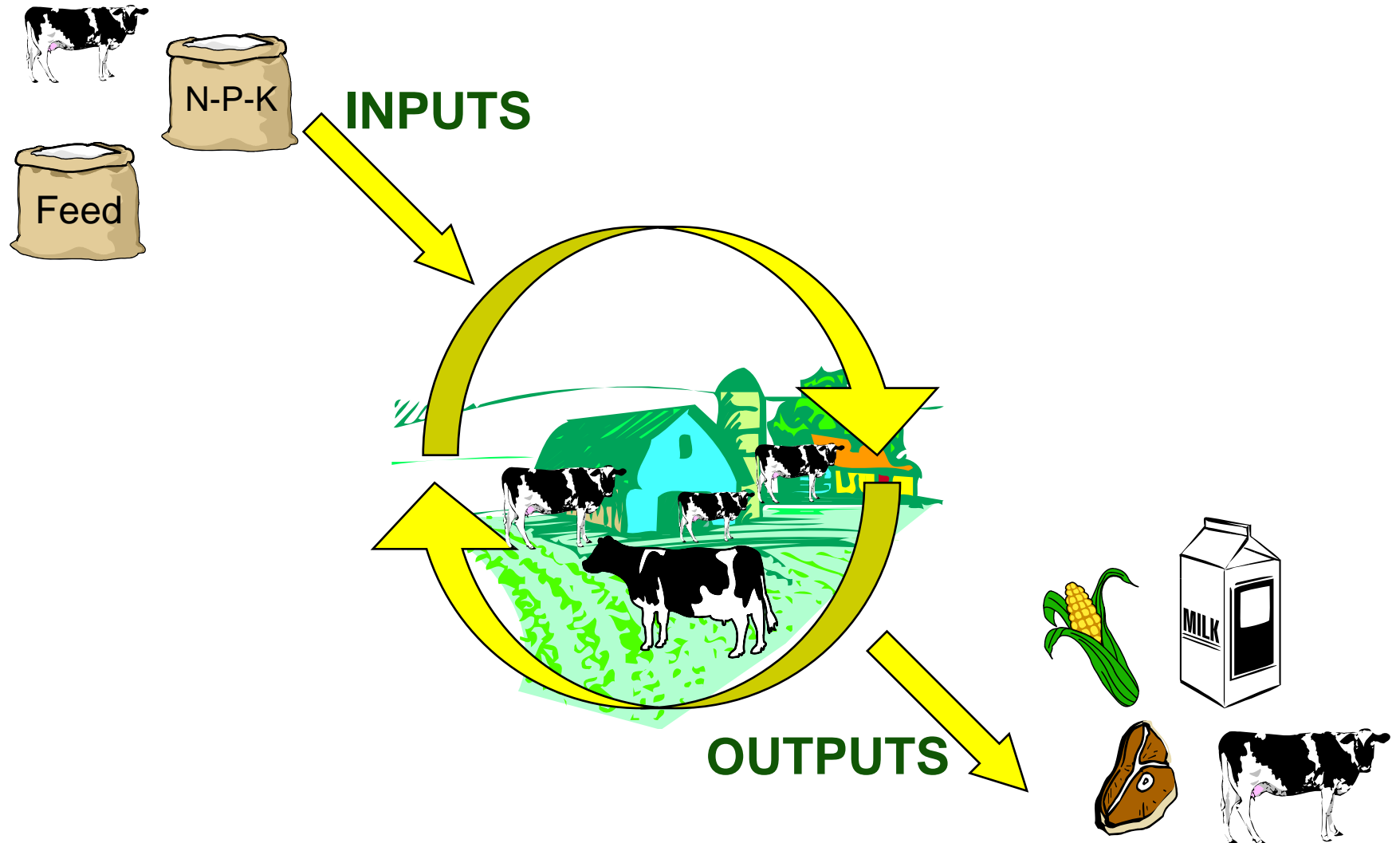


Fertilizer

Soil, Crop & Erosion/Runoff Management Component

The Dairy Farm System

Mass Nutrient Balance: Whole Farm



		Farm A	Farm B	Farm C	Farm D
Annual imports		----- <i>Phosphorus (P)</i> -----			
Feed	tons/year	7.88 (62%)	1.24 (60%)	20.00 (88%)	0.78 (67%)
Fertilizer	tons/year	4.15 (33%)	0.65 (31%)	2.47 (11%)	0.39 (33%)
Animals	tons/year	0.01 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Bedding	tons/year	0.71 (6%)	0.18 (9%)	0.14 (1%)	0.00 (0%)
Total	tons/year	12.70 (100%)	2.07 (100%)	22.61 (100%)	1.17 (100%)
Annual exports					
Milk	tons/year	3.57 (89%)	0.66 (77%)	5.28 (85%)	0.20 (91%)
Animals	tons/year	0.42 (11%)	0.19 (22%)	0.96 (15%)	0.02 (9%)
Crops	tons/year	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Manure	tons/year	0.00 (0%)	0.00 (0%)	0.00 (0%)	0.00 (0%)
Total	tons/year	3.99 (100%)	0.86 (100%)	6.24 (100%)	0.22 (100%)
Import-export	tons/year	8.76	1.22	16.36	0.94
“Remaining”	%	69	59	72	81
	lbs P/acre/year	18	12	30	13
	lbs P ₂ O ₅ /acre/yr	41	28	69	30

Back of the envelope calculations

Assume:

A milking cow eats 45 lbs of feed dry matter per day

Of the 45 lbs of dry matter:

50% from concentrate

50% from forage

This gives a yearly dry matter intake from forage:

$45 * 0.5 * 365 = 8200$ lbs of forage dry matter per year

Back of the envelope calculations

8200 lbs of dry matter + losses + supply buffer

~5 tons of dry matter from forage crops/cow

Average crop yield: 5.3 tons of dry matter/acre

(15 tons/acre at 35% dry matter)

Enough feed for one milking cow

Good to excellent crop yield: 7.7 tons of dry matter/acre

(22 tons/acre at 35% dry matter)

Enough feed for one milking cow plus replacement

The other end.....

- A milking cow excretes ~10% of body weight/day as manure
- A 1400 lbs cow excretes ~25 tons per year
- Cow + replacement excretes ~36 tons per year
- Let's say an average manure sample from storage contains:
 - 4 lbs P_2O_5 per ton of manure
- Under very good crop management, we can have a cow plus replacement per acre forage produced on the farm
- This gives 144 lbs of P_2O_5 /acre each year!

Back of the envelope calculations

If under very good crop management, we can have a cow plus replacement per acre forage produced on the farm

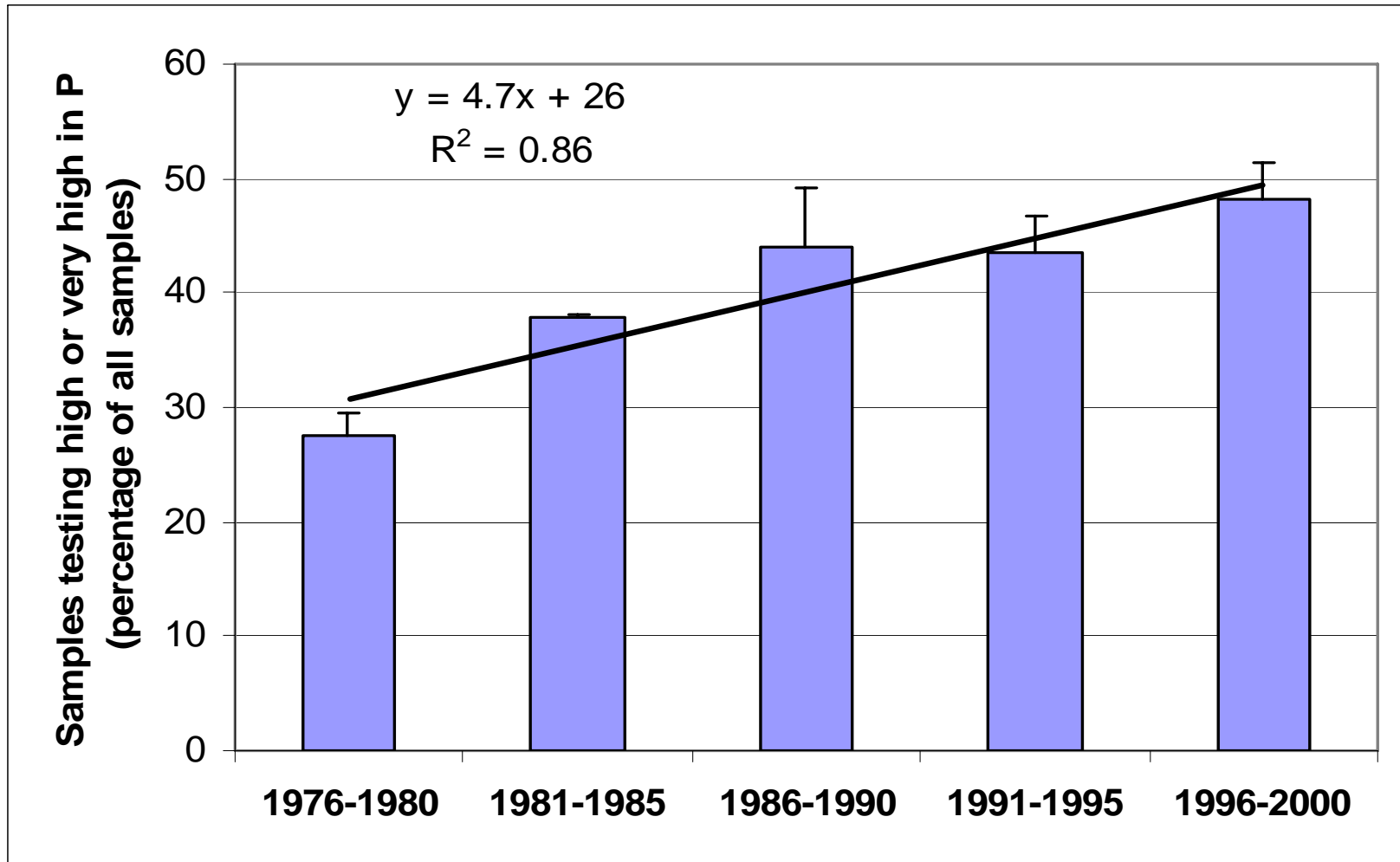
- This gives **144 lbs of P₂O₅/acre** per year!

How much P do we remove with a corn crop from this one acre?

- Assume 0.23% P on dry matter basis (3.7 lbs/ton at 35% dry matter):

Yield (tons/acre at 65%dm)	15	17	19	21	23	25
P₂O₅ removal (lbs/acre)	56	63	70	78	85	93

Temporal Trends



How does NY compare to the Mid-Atlantic States for P?

	Manure	Fertilizer	Crop	----- P Balance -----	
	-----Million lbs P -----				lbs P ₂ O ₅ /acre
New York	46	28	46	28	17
Pennsylvania	65	46	59	52	29
Delaware	9.5	4.5	6.0	8.0	39
Maryland	16	21	16	21	35
Virginia	40	54	32	62	55
West Virginia	10	4.0	7.0	7.0	28

Phosphorus Excess/Loss

- ✓ Past beliefs:
 - ✓ Soil can hold an infinite amount of P.
 - ✓ P does not leach.
 - ✓ Erosion control will prevent P movement.
- ✓ Now we know that:
 - ✓ Soils are not bottomless pits.
 - ✓ Soils high in P can act as a source of P.

Nutrient Balance: Solutions?

Nitrogen

Reduce rates?

Conserve NH_4
during field
application?

Research on diets?

Export excess?

Treatment - may
enhance export?

Phosphorus

Adjust diet

Adjust fertilizer use

Crop sales?

Rotations?

Export excess
manure?

Treatment - may
enhance export?

Economics and neighbors?

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