

Grazing Livestock and Nutrient Management Systems



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Presentation Outline

- Discuss the impact of nutrient management for grazing verses confinement animal operations.
- Balancing nutrients for grazing systems.
- Outline various nutrient distribution methods for grazing systems

Grazing vs Confinement System

- Feed
 - Forage vs grain
 - Supplements

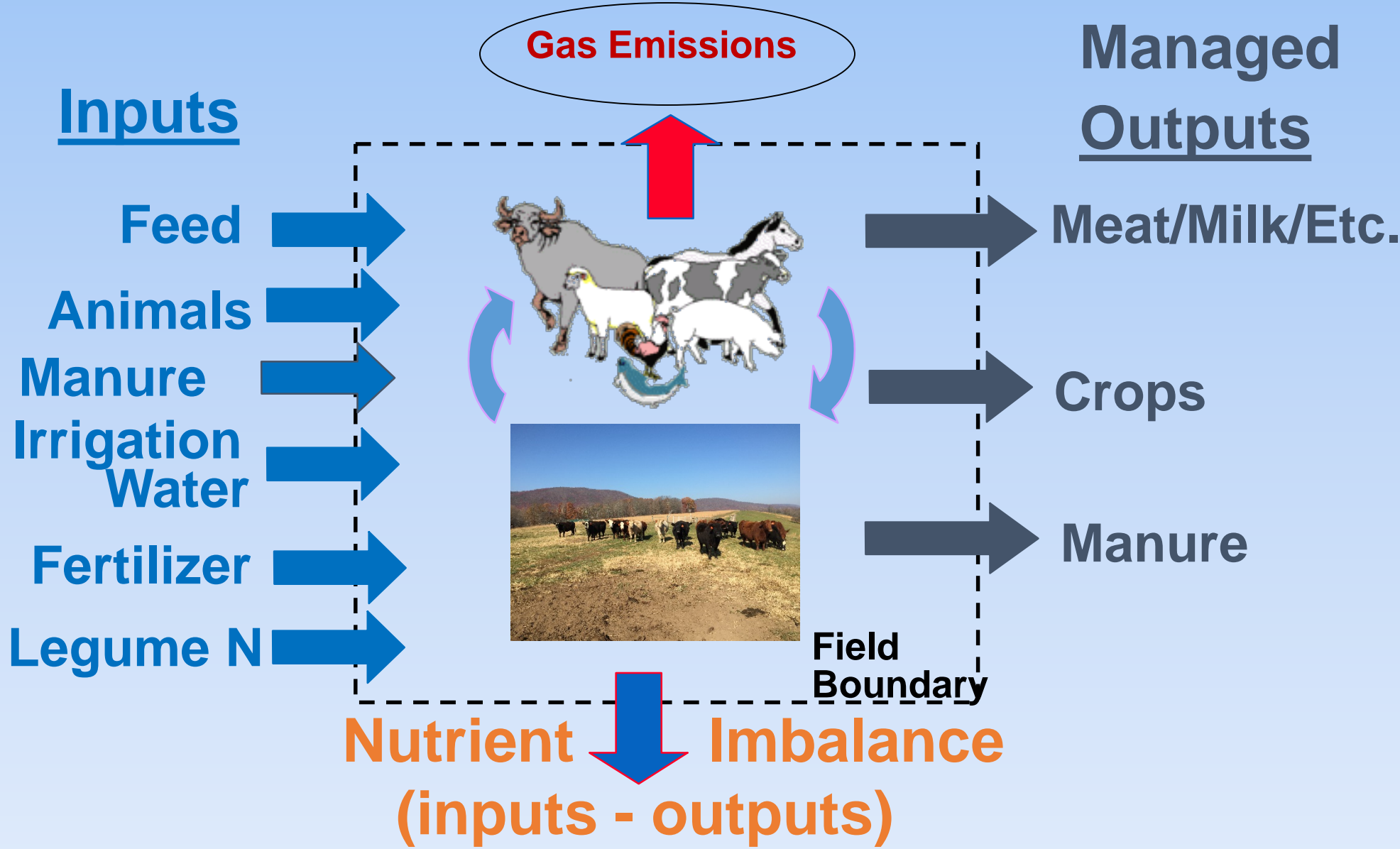


Grazing vs Confinement System

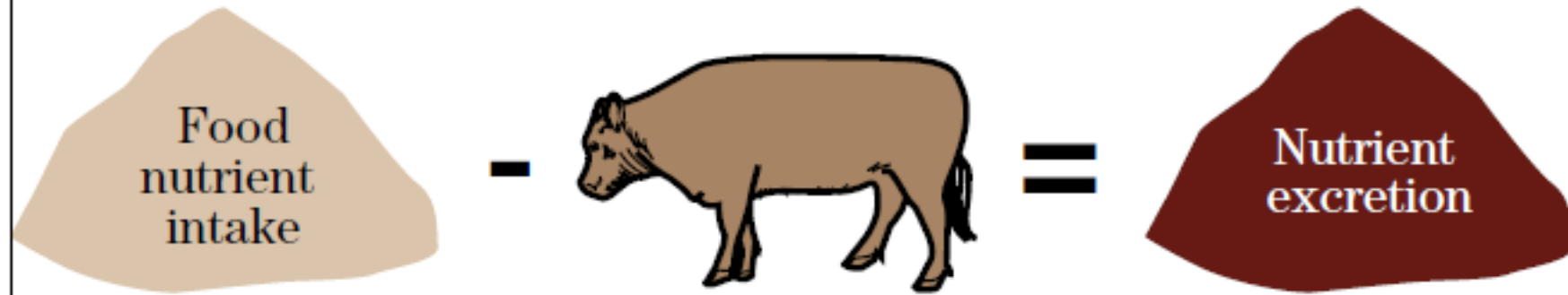
- Manure
 - Stored/land applied
 - Land applied immediately
- Nutrients
 - Most book values are for confinement
 - Values generally higher than grazing



Pasture/Range Nutrient Balance



Feed nutrient intake



Nutrient retention by animal or in the animal's products such as eggs or milk

Manure Nutrient Forms

- Majority of nitrogen in fresh manure is in the organic form (60-80%)
- Depending on temperature and moisture 40 to 90% of organic nitrogen is converted to ammonia within 4 to 5 months
- On average more than 70% of phosphorus in fresh manure is in the organic form

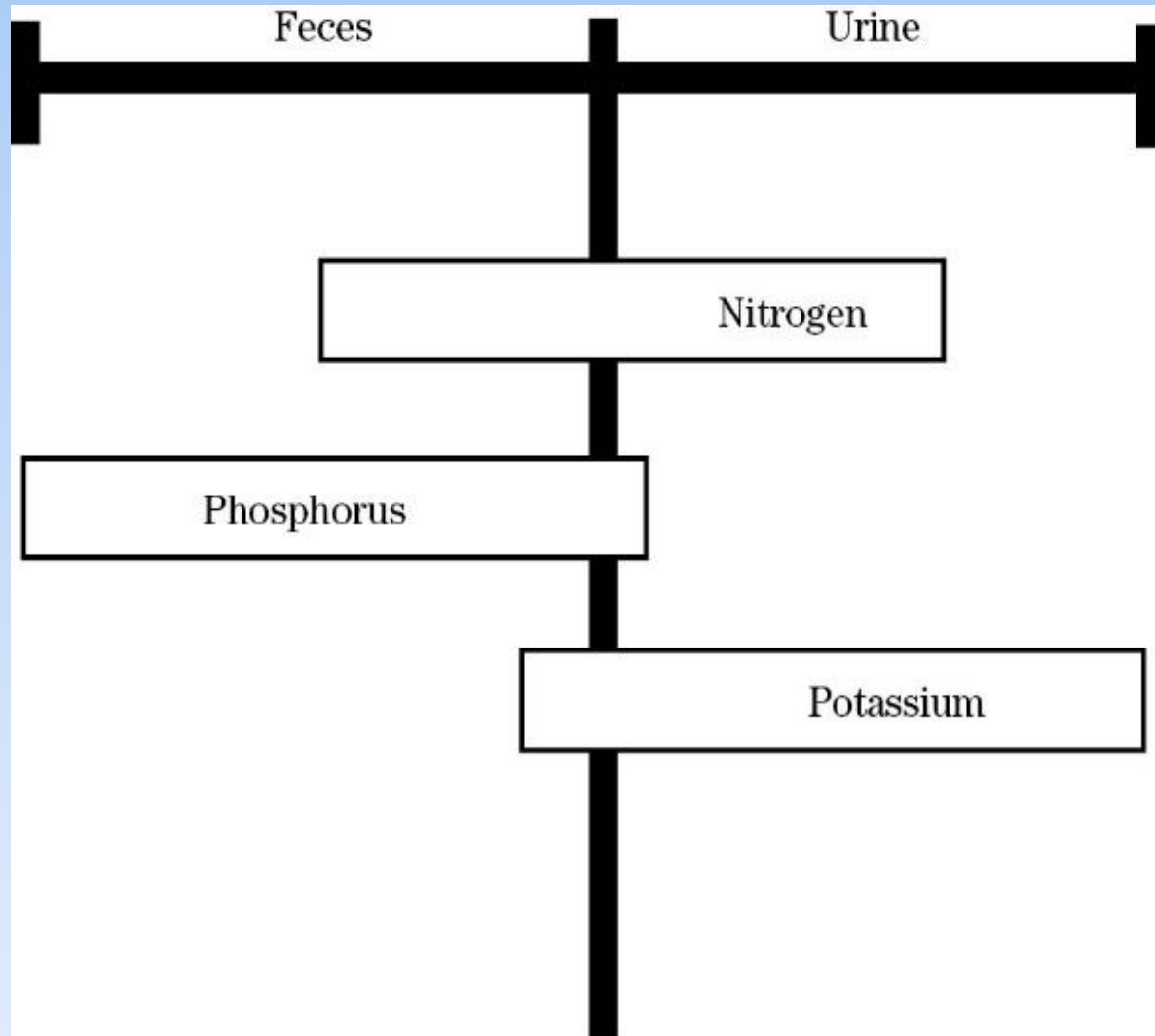
Manure Nutrient Characteristic Sources

- American Society of Agricultural and Biological Engineers (ASAE D384.2 MAR2005 (R2014))
- Agricultural Waste Management Field Handbook, Chapter 4 – Agricultural Waste Characteristics
- Midwest Plan Service (MWPS) – 18, Section 1 – Manure Characteristics
- Land Grant Recommendations (Extension publications)
- Most of the sources are for confinement facilities
- On-site sampling

Nutrient Excreted

- Varies between animal type, age, feed, etc.*
 - 75% Nitrogen
 - 80% Phosphorus
 - 90% Potassium
- On average, a little more than *one-half of the N*, about *90% of the P*, and about *40% of the K* is found in the solid manure.

Distribution of Nutrients Between Feces and Urine



Source: NRCS AWMFH

Pasture Crop Selection

<u>Crop</u>	<u>Yield/ac</u>	<u>Removal (lb/ac)</u>		
		N	P ₂ O ₅	K ₂ O
Cool Season Grass Mix*	3 T	150	51	186
Fescue	3.5 T	135	65	185
Bahiagrass	4 T	145	42	178
Bermudagrass	5 T	250	57	215
Orchardgrass	3 T	108	39	162
Kentucky Bluegrass	2.5 T	75	30	115
Alfalfa*	4 T	180	59	180

* Bluegrass, Orchardgrass, Timothy

**Nitrogen fixing crop

Manure Nutrient Values

Animal Type	Nitrogen	P ₂ O ₅	K ₂ O
Dairy	0.38	0.32	0.42
	(139)	(117)	(154)
Beef	0.18	0.10	0.30
	(66)	(37)	(109)
Swine	0.08	0.11	0.13
	(29)	(41)	(48)
Broilers	0.48	0.64	0.65
	(175)	(234)	(236)

Source: AWMFH Chapter 4

Values are lb/day/1000 lb AU - assuming 50% N loss (Numbers in parentheses are on an annual basis)

Nutrient Imbalance ($N - P_2O_5 - K_2O$)

(Phosphorus Based)

	Cool Season	Manure/Crop Nutrient Ratio		
		50% N	75% N	100% N
	3.0 T/ac			
Dairy	2.9-1.0-3.6	0.4-1.0-0.4	0.6-1.0-0.4	0.8-1.0-0.4
Beef	2.9-1.0-3.6	0.6-1.0-0.8	0.9-1.0-0.8	1.2-1.0-0.8
Swine	2.9-1.0-3.6	0.2-1.0-0.3	0.4-1.0-0.3	0.5-1.0-0.3
Broilers	2.9-1.0-3.6	0.3-1.0-0.3	0.4-1.0-0.3	0.5-1.0-0.3

Nutrient Imbalance ($N - P_2O_5 - K_2O$)

(Phosphorus Based)

	Cool Season	Manure/Crop Nutrient Ratio		
	3.0 T/ac	50% N	75% N	100% N
Dairy	2.9-1.0-3.6	0.4-1.0-0.4	0.6-1.0-0.4	0.8-1.0-0.4
Beef	2.9-1.0-3.6	0.6-1.0-0.8	0.9-1.0-0.8	1.2-1.0-0.8
Swine	2.9-1.0-3.6	0.2-1.0-0.3	0.4-1.0-0.3	0.5-1.0-0.3
Broilers	2.9-1.0-3.6	0.3-1.0-0.3	0.4-1.0-0.3	0.5-1.0-0.3

Grazing Example

- 50 beef on pasture (1,000 lb average weight)
- 100 acres
- Cool season mix pasture
- Poultry litter used for fertilizing pasture
- 50,000 birds average weight 4 pounds
- How much litter can be applied and are any supplemental nutrients required?

Grazing Example (continued)

- Nutrients removed by grazing (3.0 tons/ac cool season mix)
 - 7,500-2,550-9,300 (N-P₂O₅-K₂O) (assume 50% removal by animals)
 - Nutrients returned to pasture by animals
 - 75% N (5,625 lb) – assume 50% loss (**2,813** lb N available)
 - 80% P₂O₅ (**2,040** lb)
 - 90% K₂O (**8,370** lb)
- Annual Nutrient Deficiency (based on nutrients returned)
 - Nitrogen: $7,500 - 2,813 = 4,687$ lb
 - P₂O₅: $2,550 - 2,040 = 510$ lb
 - K₂O: $9,300 - 8,370 = 930$ lb

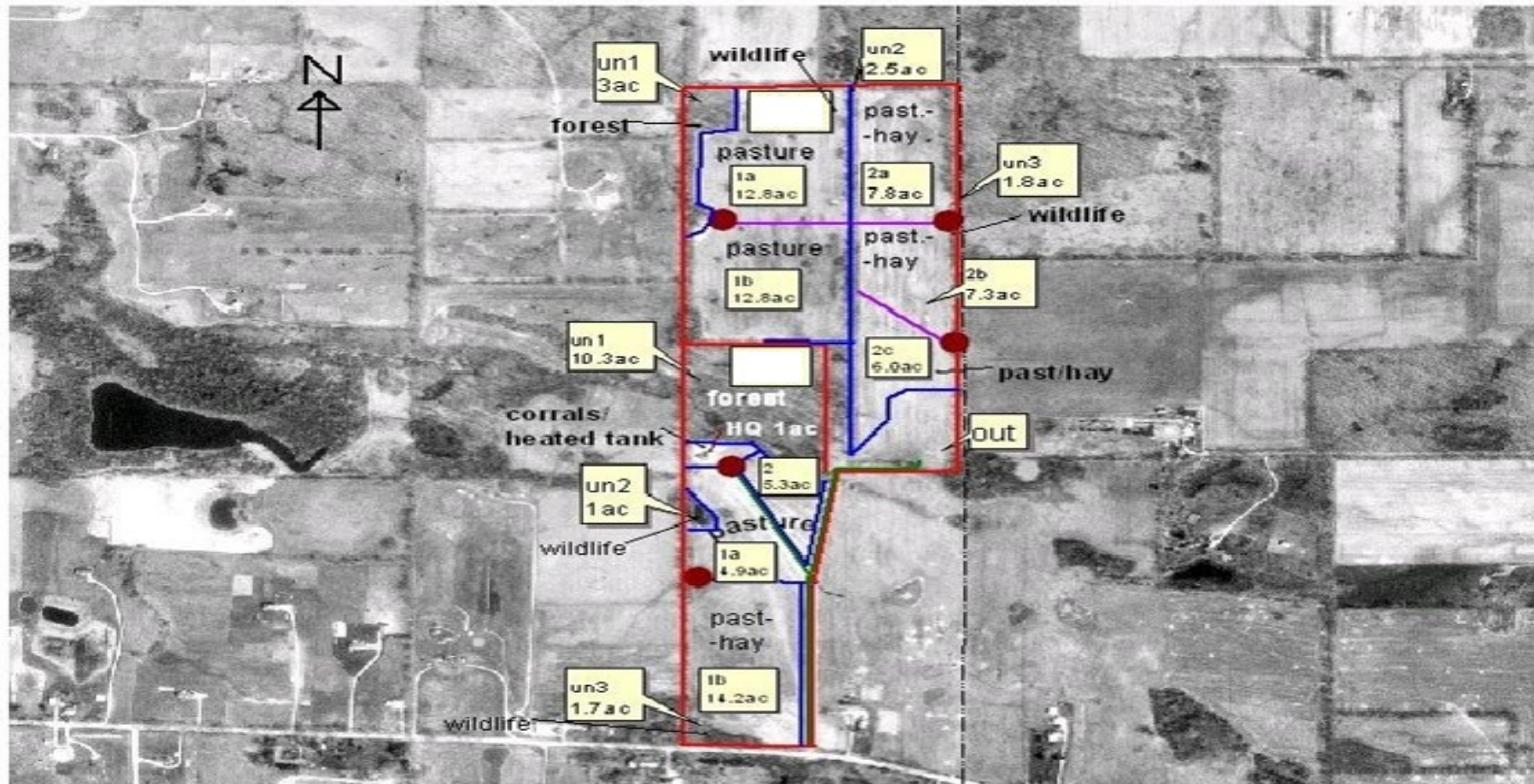
Grazing Example (continued)

- Nutrients from poultry litter
 - 0.48-0.64-0.65 (lb/day/1,000 lb animal) (assumed 50% N loss)
 - 50,000 animals equivalent to 200 animal units
 - 96-128-130 lb/day
 - 35,040-46,720-47,450 lb/yr (available for land application)
- Apply nutrients based on phosphorus requirements
 - N: 381 lb
 - P₂O₅: 510 lb
 - K₂O: 514 lb

Grazing Example (continued)

- Pasture Deficiency
 - N: $4,687 - 381 = \underline{4,306 \text{ lb}}$
 - P_2O_5 : $510 - 510 = \underline{0 \text{ lb}}$
 - K_2O : $930 - 514 = \underline{416 \text{ lb}}$
 - Approximately 35 tons of poultry litter needed

- Pasture Excess Nutrients (based on nitrogen application)
 - N: $4,687 - 4,687 = \underline{0 \text{ lb}}$
 - P_2O_5 : $510 - 6,267 = \underline{-5,757 \text{ lb}}$ (excess)
 - K_2O : $930 - 6,321 = \underline{-5,391 \text{ lb}}$ (excess)
 - Approximately 430 tons of poultry litter needed



- — stock tank
- — interior exclusion fence
- — perimeter fence & field border
- — portable electric fence
- — lane



Pasture Fields Detailed Data

Home	35 pairs, 5 heifers, 2 bulls – 50 acres
Headquarters	2 acres
Pasture #1	7 acres
Pasture #2	5 acres
Pasture #3	6 acres
Pasture #4	6 acres
Pasture #5	6 acres
Pasture #6	6 acres
Pasture #7	8 acres
Pasture #8	4 acres
	AVERAGE 6.5



Grazing Season Pasture Data

No. of Paddocks/No. of Rotations	Pastured Acres	Number of Animals	Avg. Total Days Grazed/Year	Total Grazing Season Length Avg.
8 Pastures 6 to 7 times	50 With add. 45 hay field	35 cows w/calf 5 heifers 2 bulls	21	215

This is a tentative rotation schedule 2 to 4 days per paddock – it depends on weather and available forage growth.

Bulls are on pasture with the cows during breeding season only - May 15-July 15.

Supplemental feed will be provided if needed as indicated by forage growth but usually not needed.



Animal Output Production and Calculations Per Growing Season

Location/animal Type/number/size Or waste generations	Production And Characteristics	Estimated Annual Production and calculations
<u>Pasture</u> Cows - 35@ 1250 lbs Heifers – 5@ 1000 lbs Bulls – 2@ 1500 lbs Calves – 35@ 500 lbs	<u>Solid Manure</u> Pasture Pasture Pasture	$35 \times 1250 \times 1 \text{ cu ft}/1000\# \times 215=9406 \text{ cu ft}$ $5 \times 1000 \times 1 \text{ cu ft}/1000\# \times 215=1075 \text{ cu ft}$ $2 \times 1500 \times 1 \text{ cu ft}/1000\# \times 215=645 \text{ cu ft}$ $35 \times 500 \times 1 \text{ cu ft}/1000\# \times 215=3763 \text{ cu ft}$ Total in Pasture 14,889 cu ft $14,889 \times 62\#/\text{cu ft} \div 2000 = 462 \text{ T}$

Estimated Manure Nutrient Production, As Excreted (MWPS 18, Section 1) Actual Values Could Vary + or – 30% - 215 Days in Pasture/Paddocks

Plant uptake of nutrients estimated by averaging several eastern U.S. land grant universities published numbers

The amount of nutrients needed (uptake) of N, P, and K for the pasture plants based on

50 acres of Cool Season Grasses dominant pasture averaging 3 tons per acre are:

- 7500 pounds of N
- 2550 pounds of P₂O₅
- 9300 pounds of K₂O

The Nutrients produced from the manure for the grazing season by the 35 cows, 35 calves, 5 heifers and 2 bulls, after N volatilization and availability to the plants through the soil are:

- 2415 pounds of N
- 2851 pounds of P₂O₅
- 3832 pounds of K₂O

When we see what's left over for nutrients not needed or in shortfall to supply the pasture plants the nutrients they need, we find there would be:

For the 215 day growing season -

- Short 5085 pounds of N
- Excess of 301 pounds of P₂O₅
- Excess of 5468 pounds of K₂O

Which is on the pasture per acre basis:

- Short 102 pounds of N
- Excess 6 pounds of P₂O₅
- Short 109 pounds of K₂O

These calculations inherently ASSUME that the waste nutrients are evenly distributed across the pasture. Are they? NO!

Is that what is really happening on this farm? NO!

The herd is moved every 2 to 4 days based on forage growth or lack thereof, so we will use a 3 day average. The producer had records to show that they average 6 to 7 rotations per grazing season. We used 7 rotations to be conservative with our numbers.

During the non-grazing season, the herd is kept in confinement and the manure is part of the CNMP including the calculations of waste, its storage, and application to the land.

So each acre of pasture gets grazed an average of only 21 days during the grazing season and therefore, the entire year. So plant nutrients needed for the 6.5 acre paddocks and the manure nutrient production are:

Plants need -

- 975 pounds of N
- 332 pounds of P2O5
- 1209 pounds of K2O

Manure produces -

- 242 pounds of N
- 279 pounds of P2O5
- 374 pounds of K2O

This is What Is Happening on the Pasture:

Because of a rotational grazing system, during 21 days of the grazing season and therefore, the entire year, the entire pasture nutrients are short by:

- 491 pounds of N
- 53 pounds of P₂O₅
- 835 pounds of K₂O

For each avg. size paddock of 6.5 acres, the pasture plant nutrients needed are short by:

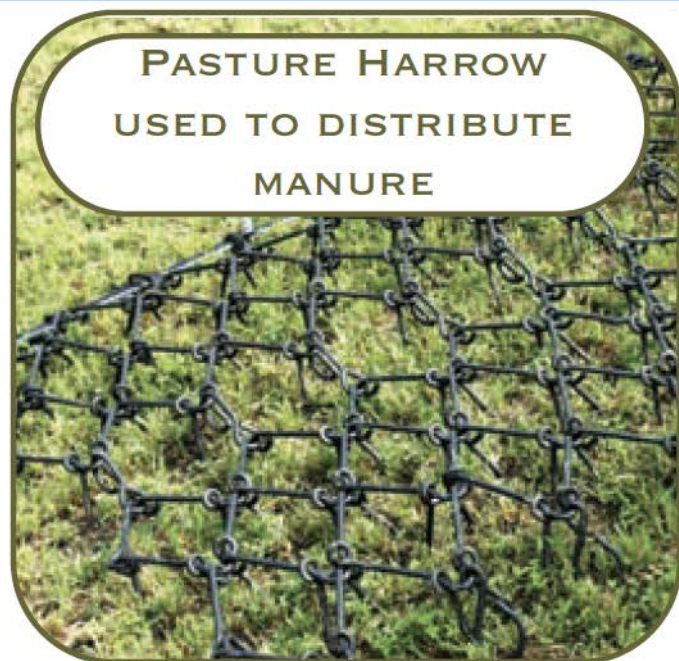
- 76 pounds of N
- 8 pounds of P₂O₅
- 128 pounds of K₂O

OR short by:

- 12 pounds of N per acre
- 1 pound of P₂O₅ per acre
- 20 pounds of K₂O per acre

Nutrient Distribution on Grazing Systems

- Mechanical
 - Stored Manure
 - Redistribute deposited manure



Nutrient Distribution on Grazing Systems

- Natural
 - Field size
 - Feed/Water Areas
 - Topography
 - Shade
 - Grazing Application
 - Dairy
 - Beef
 - Etc.
- Grazing System





Goats

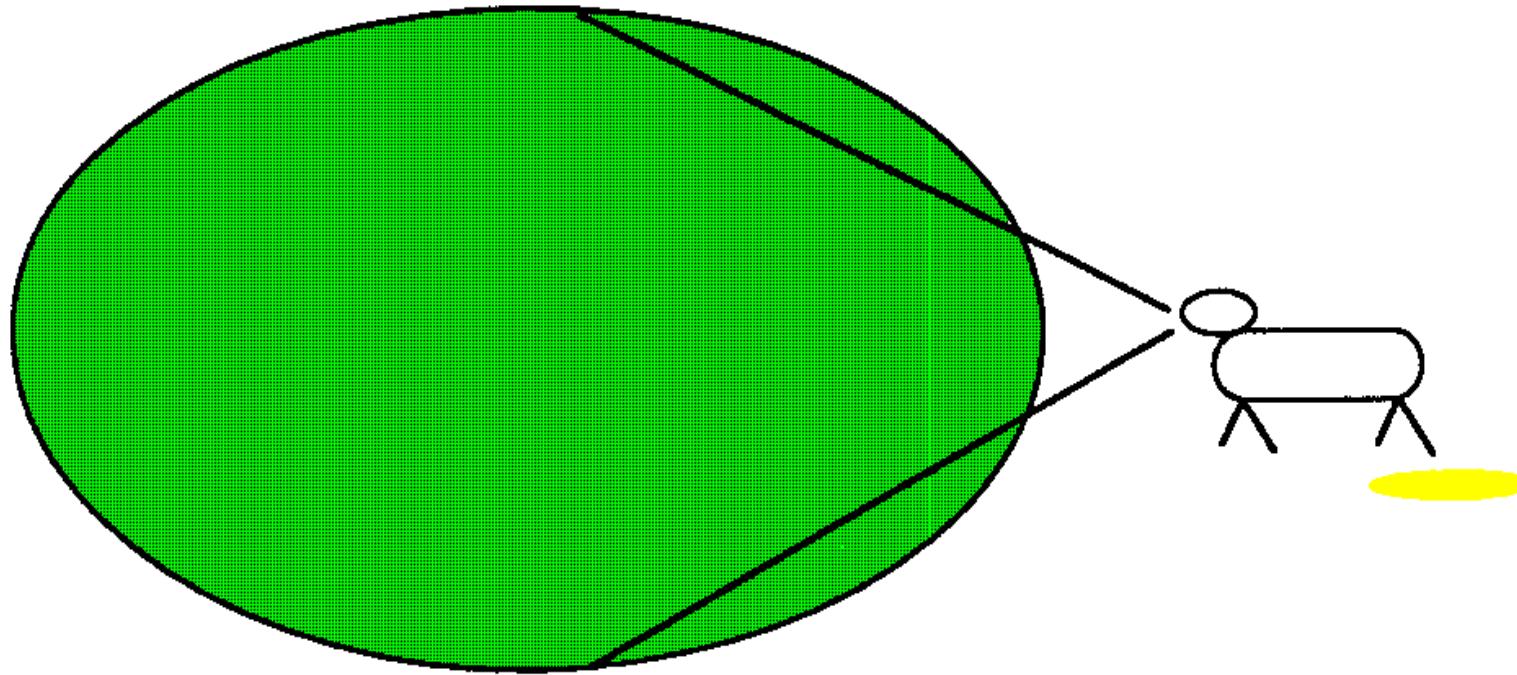


Swine



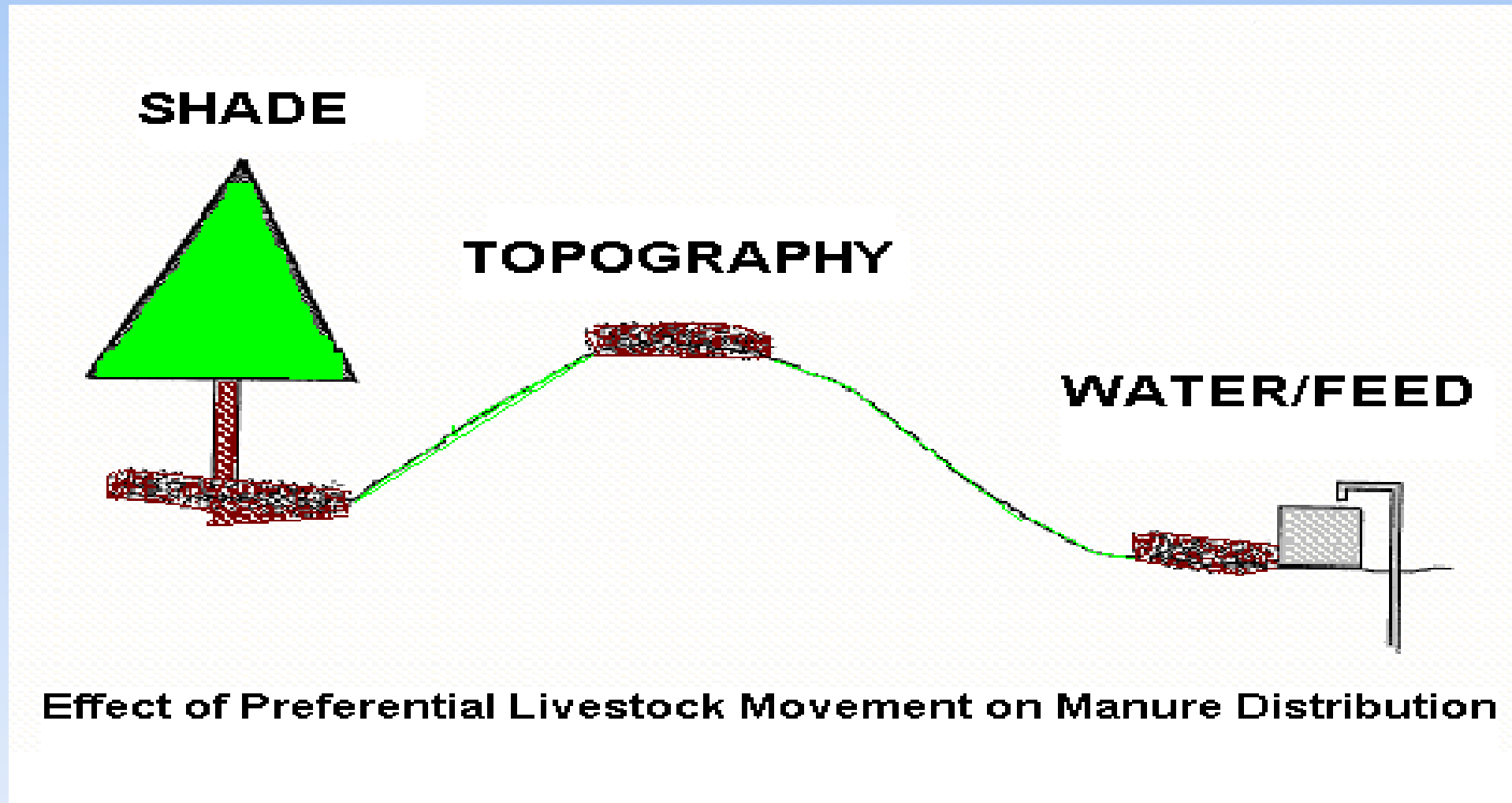


Nutrient Management on Pastures



Effect of Grazing: Concentrating nutrients - consume them from a large area and excrete them in a small area.

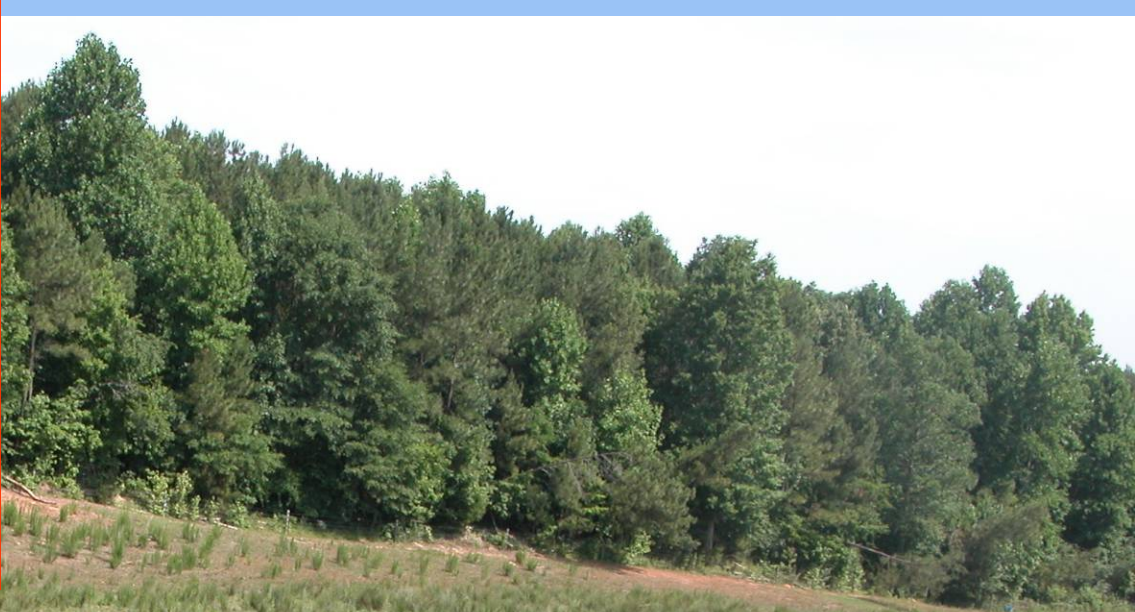
Nutrient Management on Pastures











Grazing Systems

- Continuous (Months)
- Prescribed (7-10 days)
- Intensive (1-3 days)
- Mob (>100,000 lb/ac – hours)

Nitrogen is the most limiting Mineral Nutrient in Pastures.

Nitrogen
Deficient

Dung Pat - Nitrogen
Sufficient

Continuous Grazing



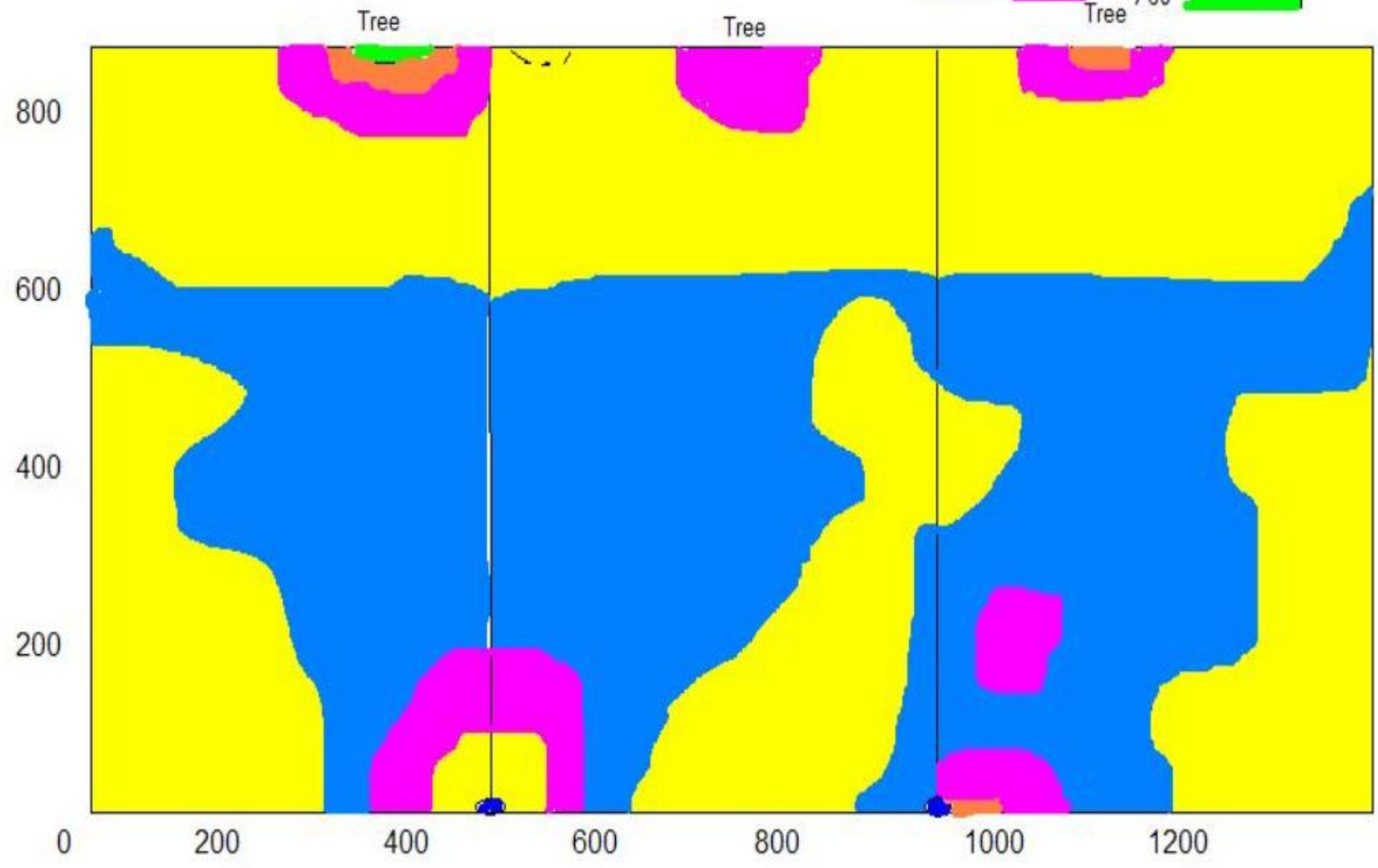
Paddock System

The Effect of Grazing Intensity on Manure Distribution in Pastures From James Gerrish et. al. at University of Missouri

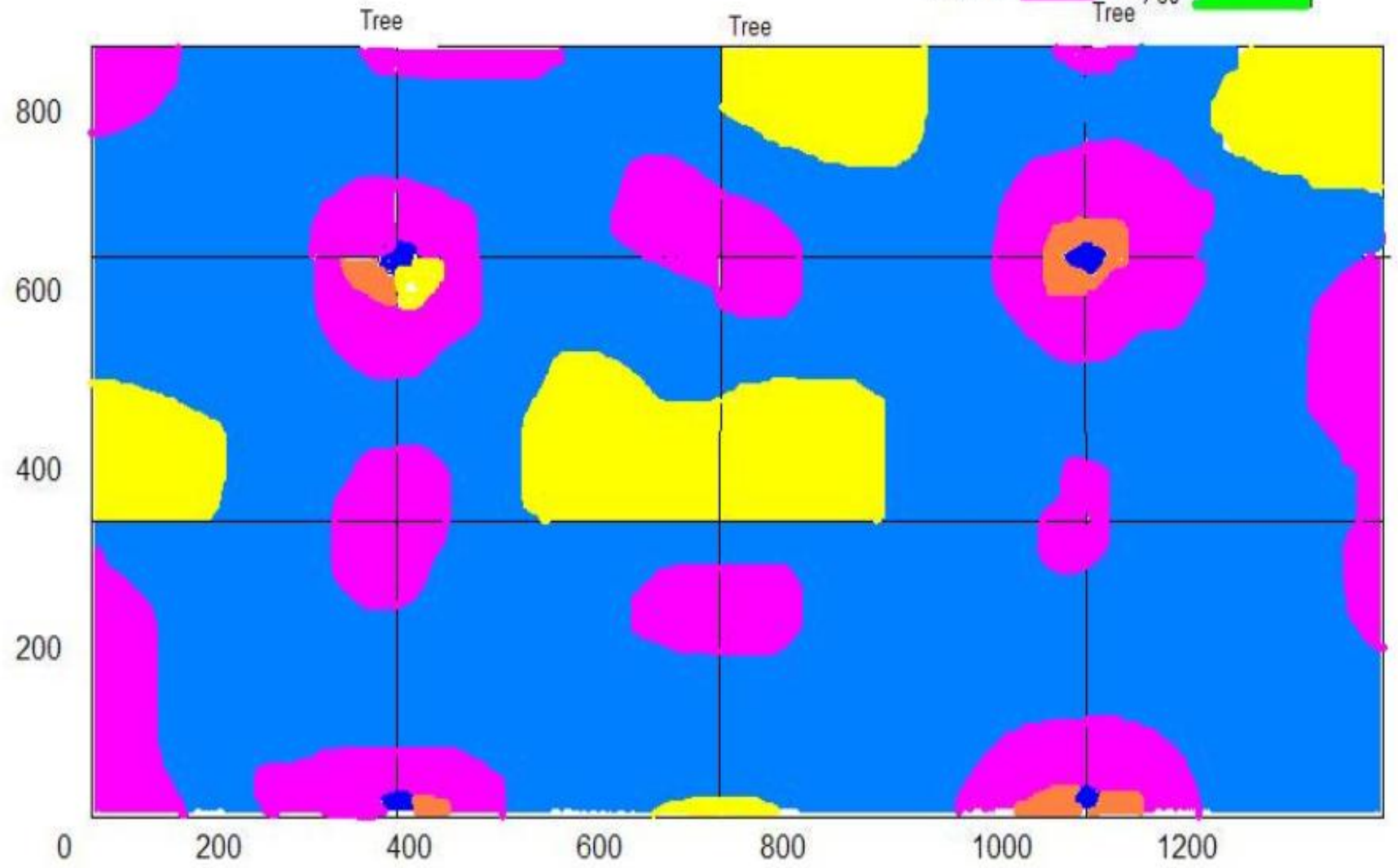
Rotation Frequency	Years to get 1 'pie' /sq.yd.
Continuous	27
14 Days	8
4 Days	4-5
2 Days	2



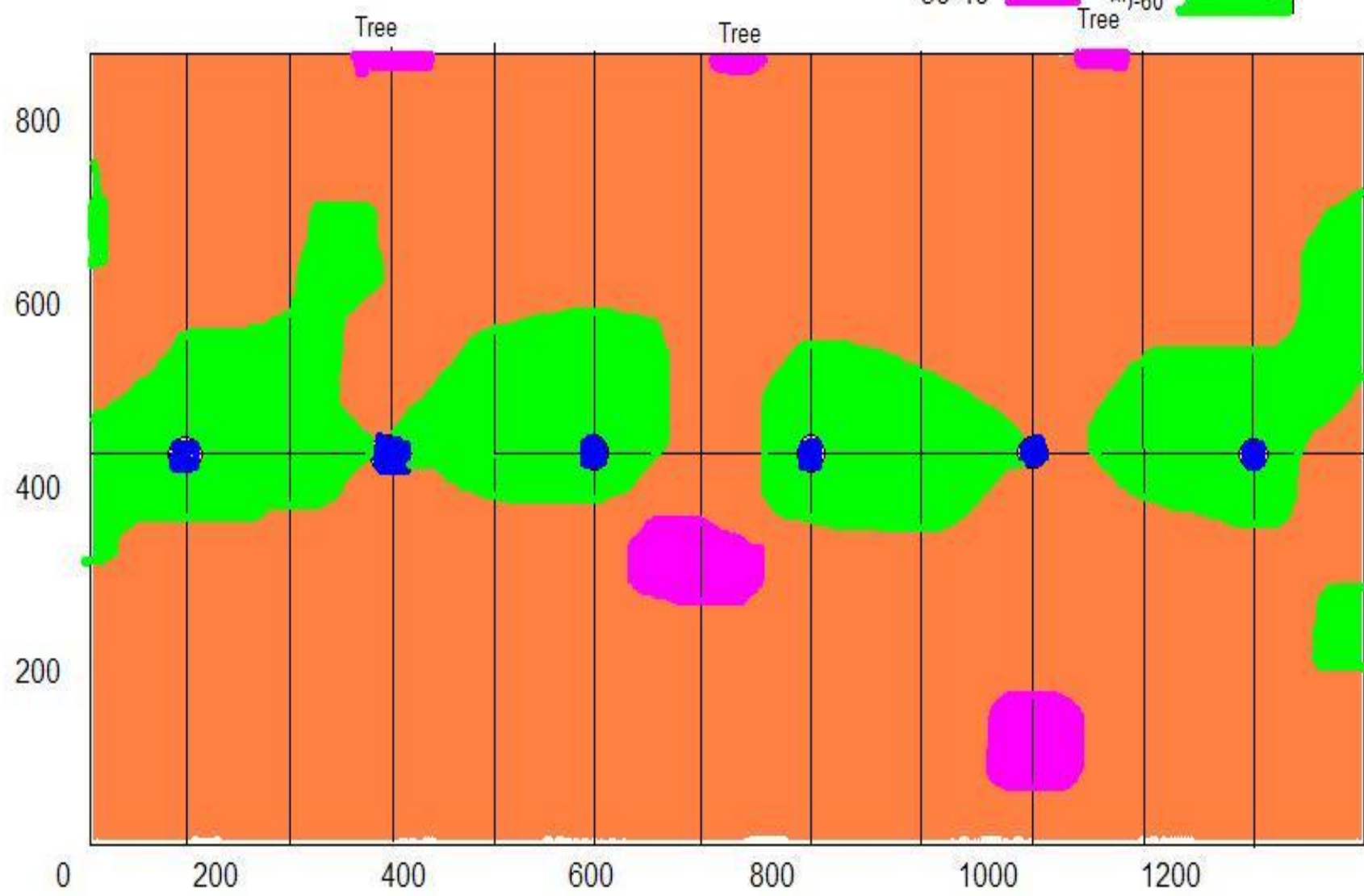
3 Paddock System



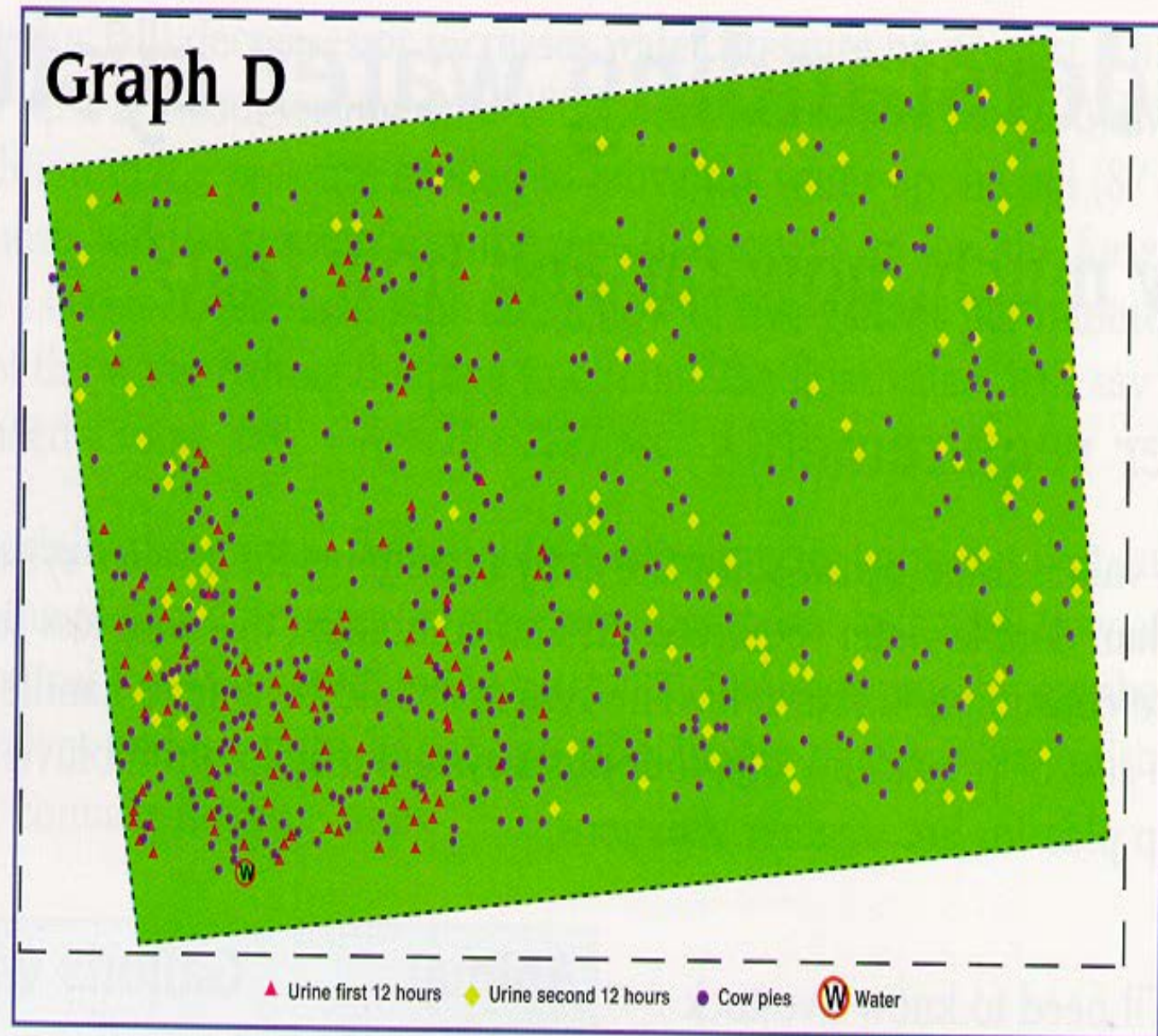
12 Paddock System



24 Paddock System



Cow pies and urine distribution during a 24-hour period in an intensively grazed system.



Source: Steven P. Washburn, 1997, Animal Science Dept. NCSU.



09/17/2009



Given there is adequate forage quantity, quality
and growth rate:

The faster the rotation frequency,

(With access to water, minerals for every paddock for each
rotation)

***The better the livestock waste nutrient distribution
will be.***

So Is That The Best We Can Do?

NO!

1. We can sample our manure falling on the pasture to have the best 'numbers' possible – Direct sampling, ex. NUTBAL
2. We can interseed legumes to help with nitrogen supply and yield.
3. In most U.S. (high rainfall) pastures, as nutrient distribution improves, production (yield) increases compared to continuous grazing 365/24/7.



Legumes and Soil Quality:

Fix nitrogen as a symbiotic host to Rhizobia bacteria

Increase organic matter

Create bigger soil aggregates

(Mean weight diameter of soil aggregates 20% higher under alfalfa over bare fallow, Rasse et al., 2000)

Improve soil porosity; hence water infiltration

(Saturated soil conductivity increased 57% under alfalfa over bare fallow, Rasse et al., 2000)

Increase mineralizable nitrogen and phosphorus



Nitrogen Fixation by Various Legume Species either Alone or in Association with a Grass

Seasonal Total of Nitrogen Fixation by Forage Legumes and Legume-Grass Mixtures

<u>Legume or Legume - Grass</u>	<u>Total N₂ Fixation (Pounds per Acre)^{1/}</u>
Alfalfa	70 - 300
Alfalfa - Orchardgrass	13 - 121
Alfalfa - Reed Canarygrass	73 - 226
Alsike Clover	119
Berseem Clover	55 - 210
Birdsfoot Trefoil	44 - 100
Birdsfoot Trefoil - Reed Canarygrass	27 - 116
Crimson Clover	94
Hairy Vetch	100
Ladino Clover	100 - 179
Lespedeza (Annual)	85
Red Clover	20 - 200
Red Clover - Reed Canarygrass	5 - 136
Subterranean Clover	52 - 163
Subterranean Clover - Soft Chess	19 - 92
Sweet Clover	119
White Clover	103 - 114
White Clover - Bahiagrass	> 270
White Clover - Bermudagrass	135
White Clover - Dallisgrass	143
White Clover - Tall Fescue	187

^{1/} Ranges given where available. **Single values are probable maximums or the averaged result of one experiment. Highly variable. Do not use as absolutes.**

Sources: Ball, D. M. et al., *Southern Forages*, 1991; Barnes, R. F. et al., *Forages*, 1995; Chessmore, R. A., *Profitable Pasture Management*, 1979; and Graffis, D. W. et al., *Approved Practices in Pasture Management*, 1985.

Take Home Message

1. Use A Managed Grazing System to improve nutrient distribution by small paddock & frequent rotation
2. Improve Yields by Natural Fertility – legumes
3. Keep movement records per paddock
4. Sample and Test Manure From Your Livestock for Nutrients available
5. Include manure deposited by grazing animals as part of the nutrient management plan (NMP)
6. Soil test on a regular basis
7. If available, measure ungrazed forage species nutrient uptake from your farm at the End of the Grazing Season

Get the Best Information of the Nutrient Cycle happening on Your Farm or Ranch

The End



Thank You