AMT Office Hours Manure

4/12/2024

Tom Butler, EPA

What we hope to go over

- What is manure in CAST?
- How does it end up applied to the land?

How do Ag Nutrients cycle through CAST?

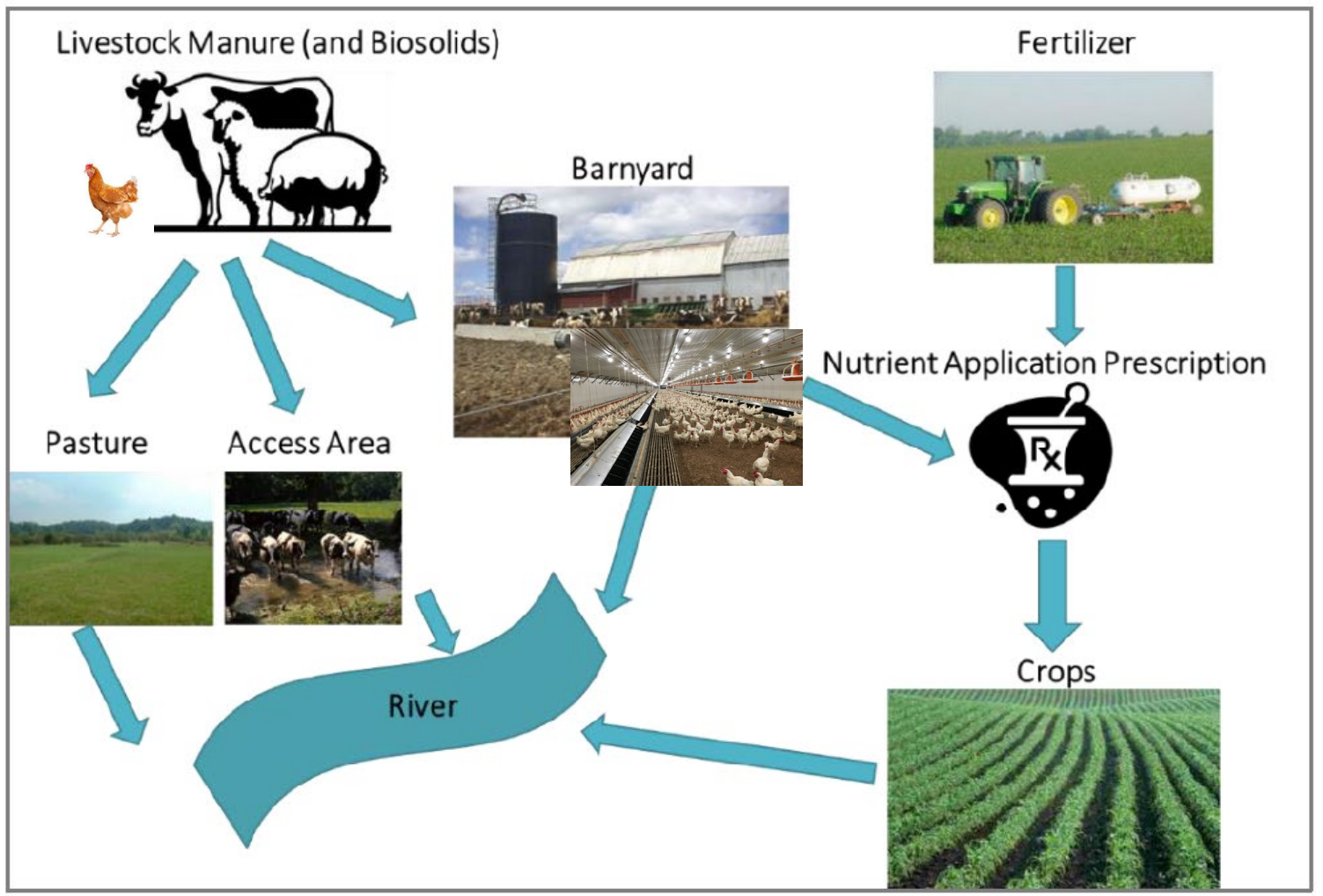


Figure 3-4 Conceptual diagram of nutrient fate through agricultural lands

Understanding manure and its nutrients

Lbs Manure Nitrogen from Beef cattle/Year
=
Beef animals
X
Lbs Dry Manure/animal/Year
X
Lbs of Total Nitrogen/Lb Dry Manure*

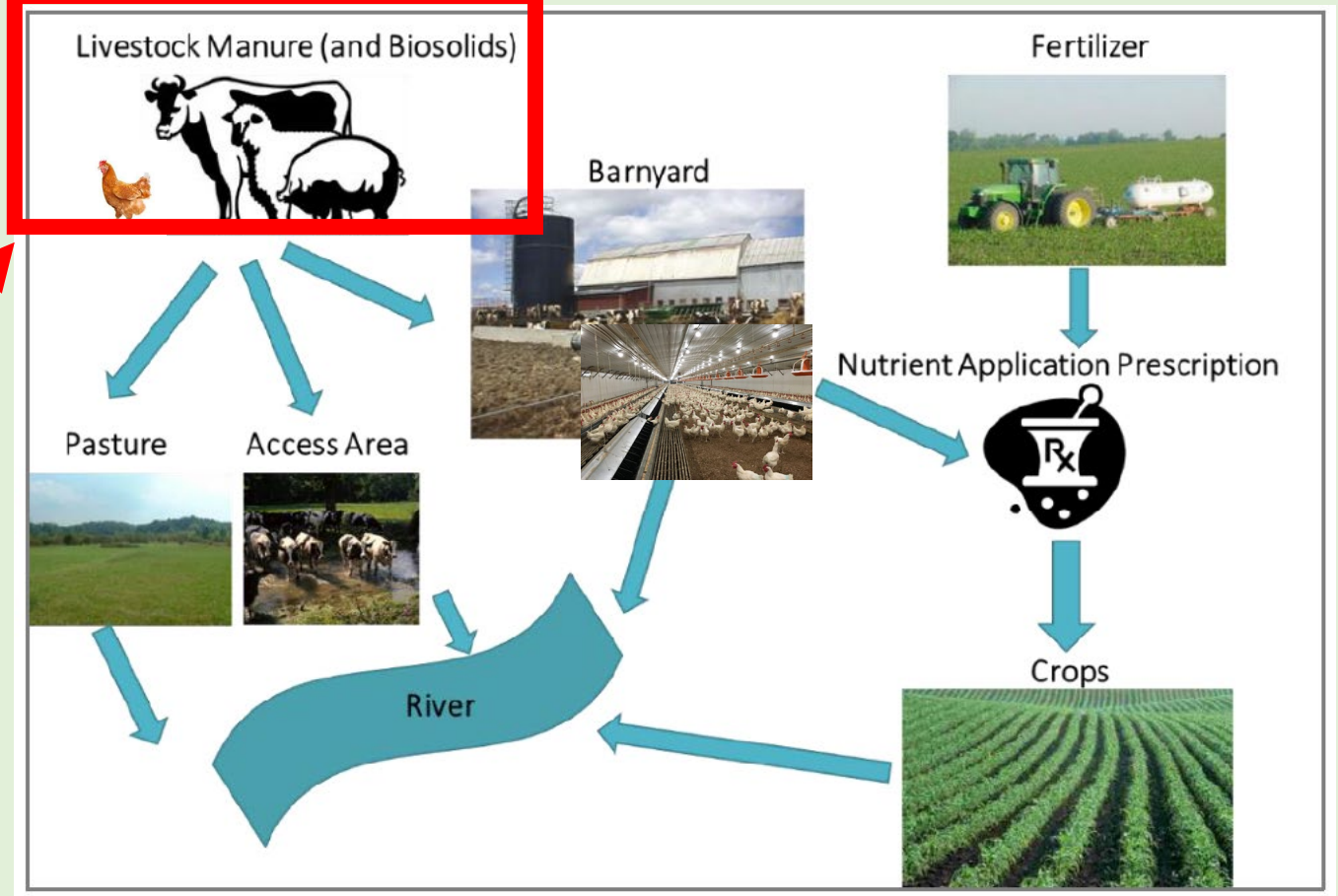
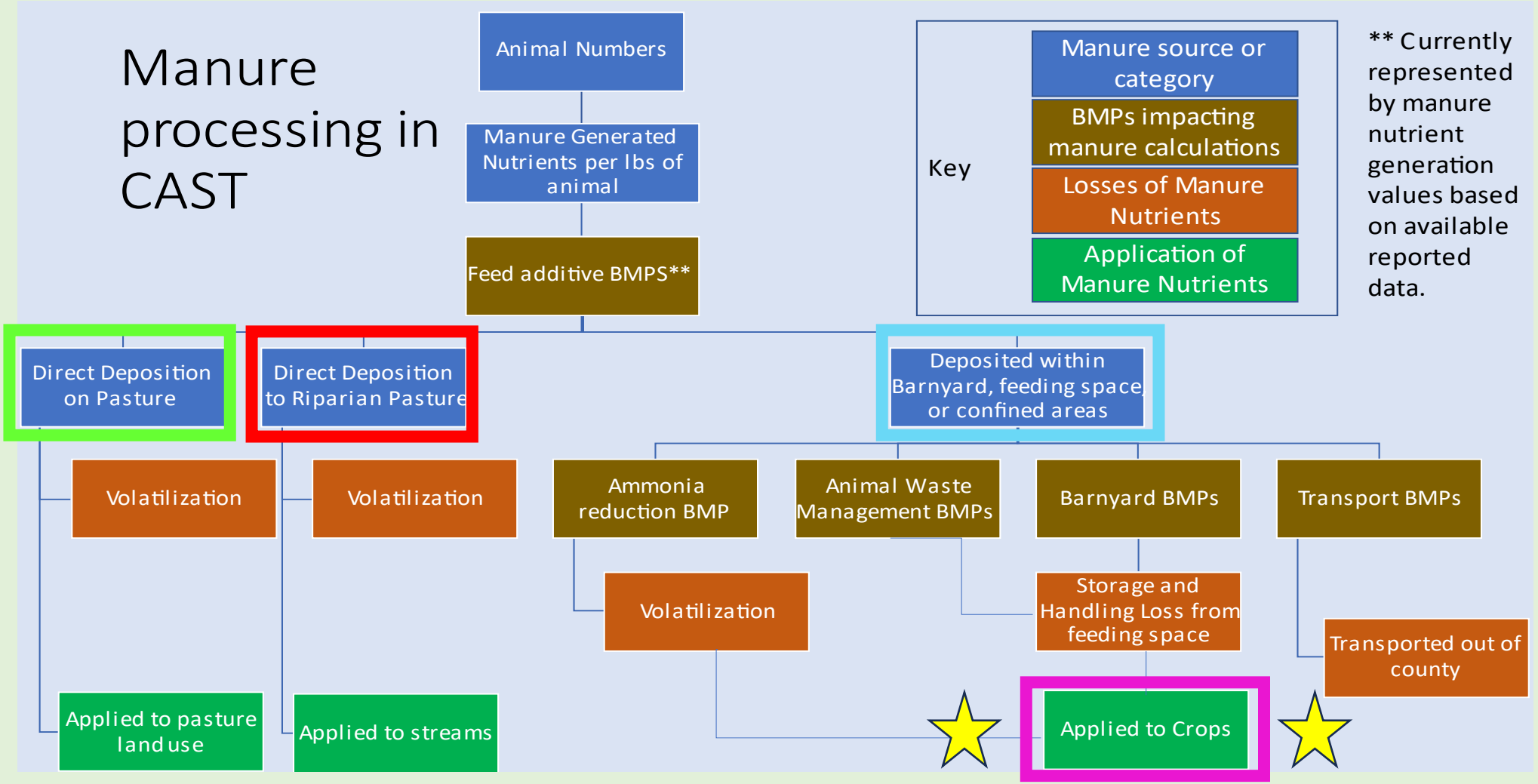


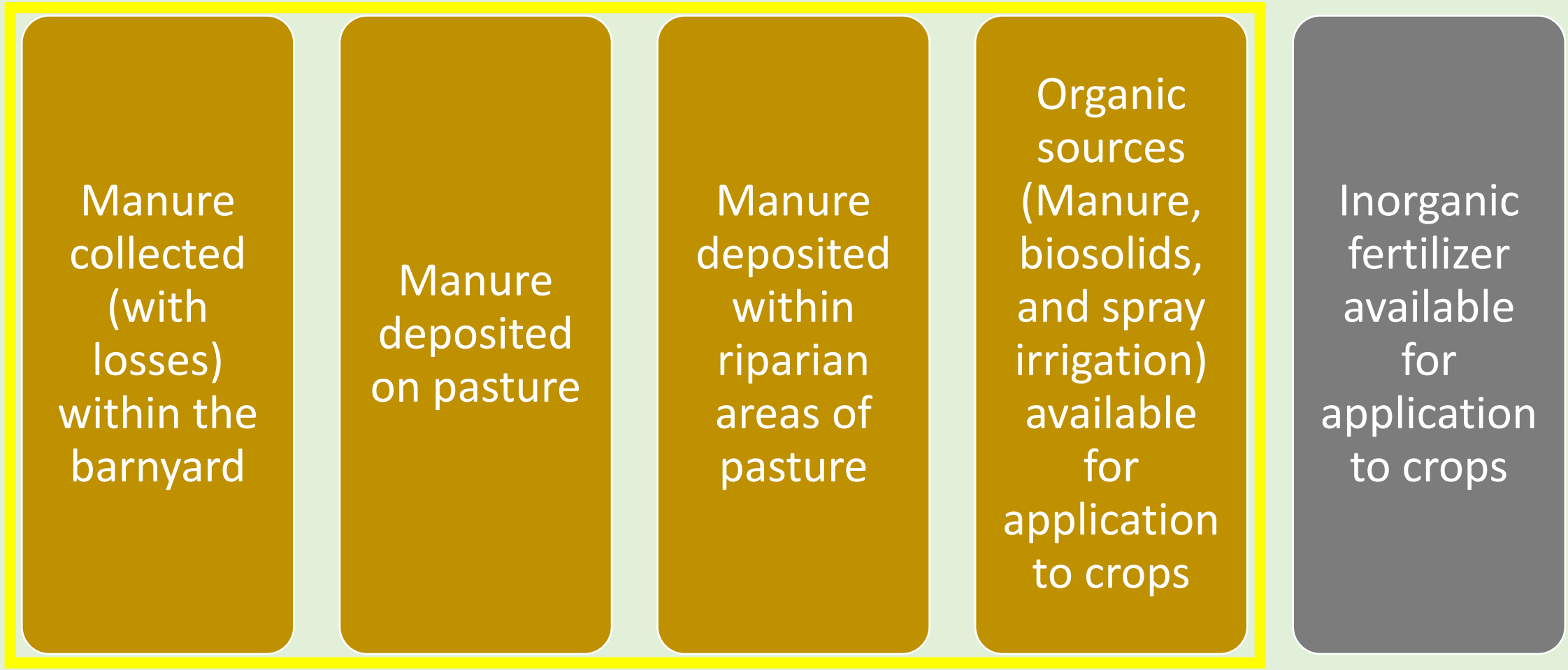
Figure 3-4 Conceptual diagram of nutrient fate through agricultural lands

Manure generation diagram:

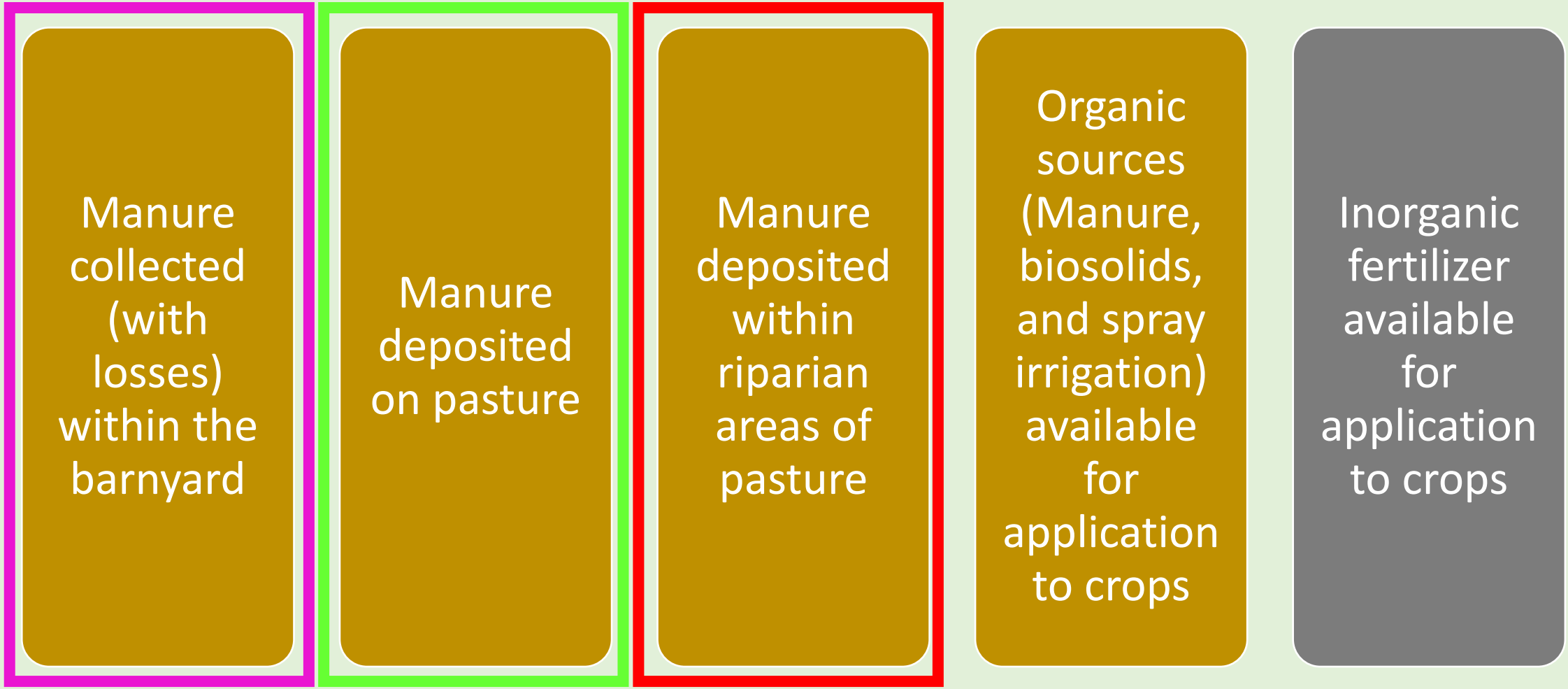


- Manure nutrients stay in their county of origin UNLESS they are transported

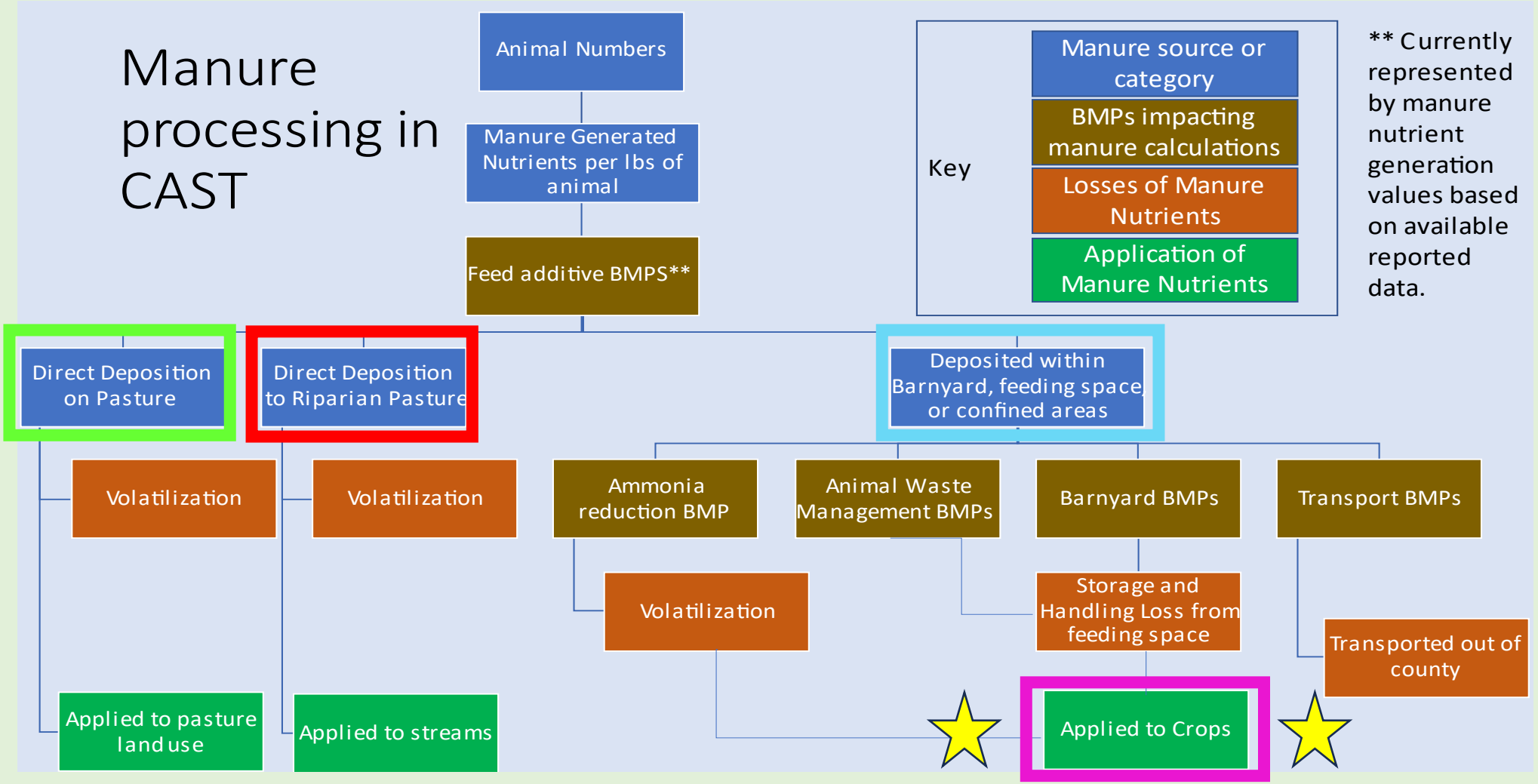
CAST Agriculture nutrient categories



CAST Agriculture nutrient categories



Manure generation diagram:



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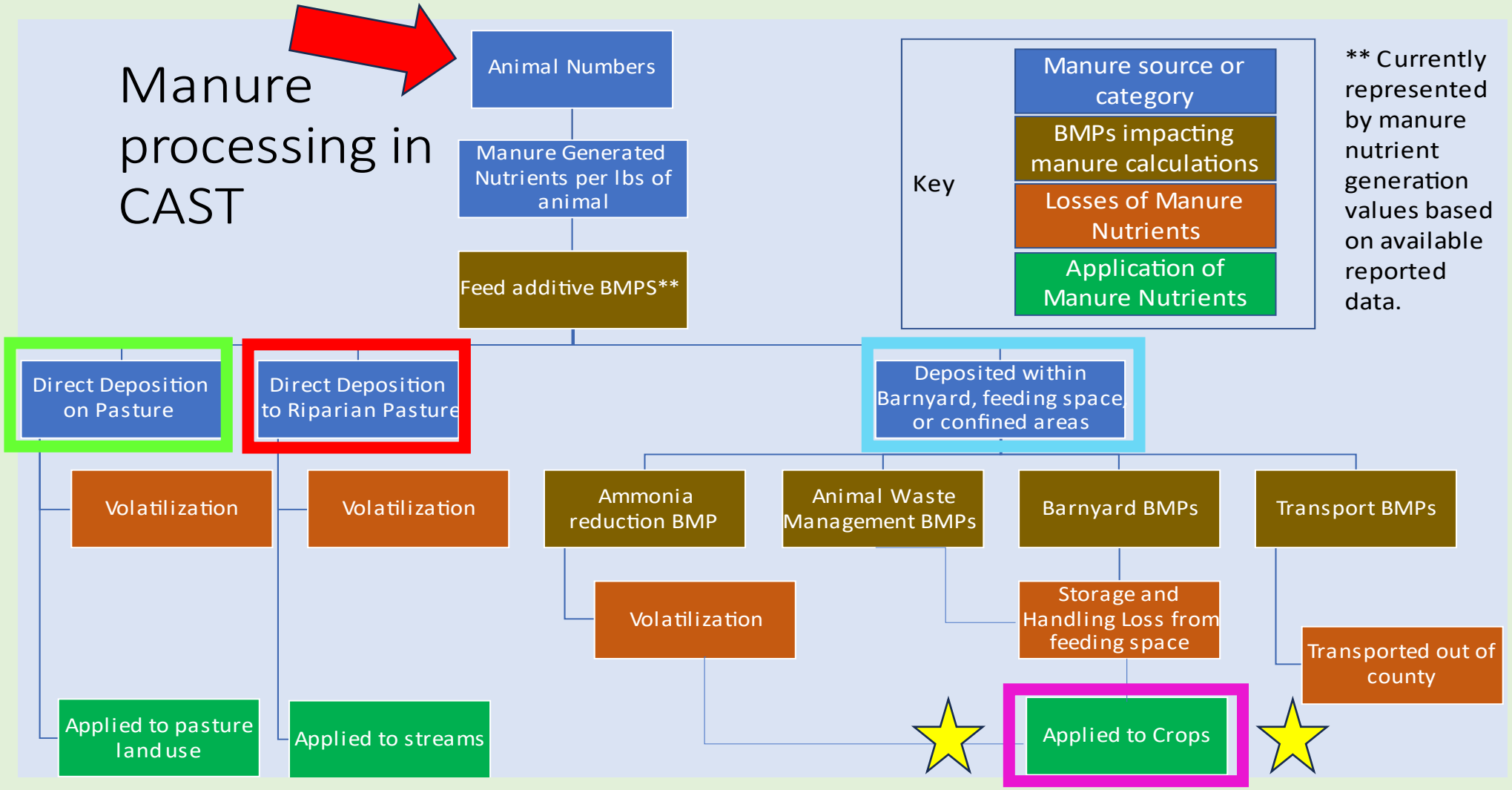
Manure generation diagram:

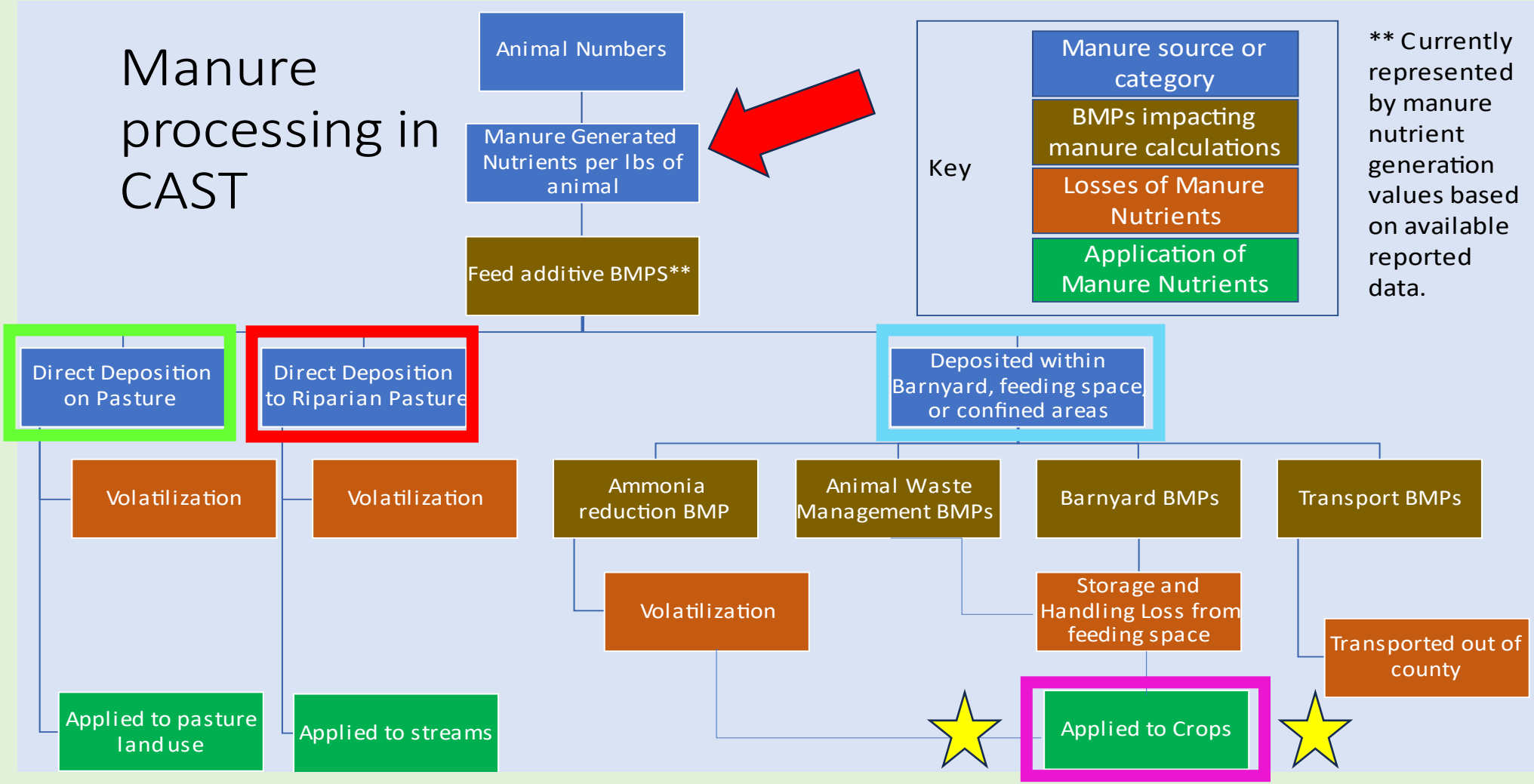


Animal populations

- County scale

Animal Type	Population data source
Beef	Five year Census of Ag
Diary	Five year Census of Ag
Other Cattle	Five year Census of Ag
Horses	State-sponsored horse censuses
Hogs for Breeding	Five year Census of Ag
Hogs for Slaughter	Five year Census of Ag
Sheep and Lambs	Five year Census of Ag
Goats	Five year Census of Ag
Pullets	Five year Census of Ag
Layers	Five year Census of Ag
Broilers	USDA-NASS's Poultry Production and Value surveys
Turkeys	USDA-NASS's Poultry Production and Value surveys

Manure generation diagram:



Manure dry weight and nutrient calculations

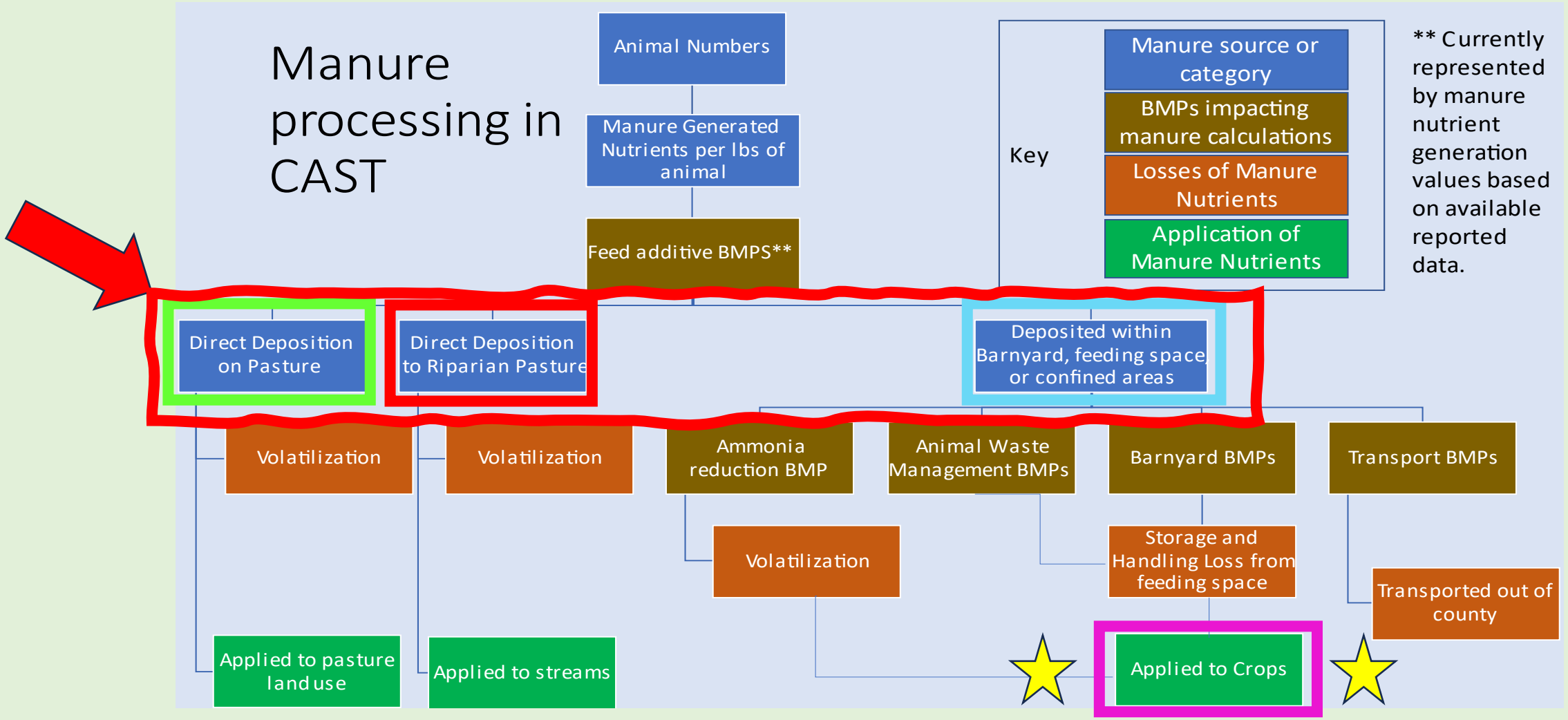
- Standardize manure by moisture
- Provide the total amount of nutrient

Table 3-4: Total nutrient manure characteristics for livestock

Animal Type	Manure Source	Lbs Dry Manure/Animal/Year	Lbs TN/Lb Dry Manure	LbsTP/Lb Dry Manure
Beef	Beef - Cow (confinement) from ASAE 2005 for manure values	5,475.00	0.028788	0.006467
Dairy	Lactating Cow, Dry Cow and Heifer from ASAE 2005 for manure values	4,404.33	0.042221	0.006764
Other Cattle	Estimated based upon weighted average combination of Beef and Dairy from Census of Agriculture; See Appendix D	1,605.07	0.035504	0.006616
Horses	Average of Horse- Sedentary and Horse - Intense Exercise from ASAE 2005 for manure values	3,102.50	0.031672	0.005941
Hogs for Breeding	Swine Characterization Report; See Appendix E	220.62	.294653	Varies
Hogs for Slaughter	Swine Characterization Report; See Appendix E	97.09	0.106841	Varies
Sheep and Lambs	ASAE 2003 for manure values	240.9	0.038182	0.007909
Goats	ASAE 2003 for manure values	680.91	0.034615	0.008462
Pullets	PLS Report; See Appendix A	12.95	Varies	Varies
Layers	PLS Report; See Appendix A	17.89	Varies	Varies
Broilers	PLS Report; See Appendix A	Varies	Varies	Varies
Turkeys	Turkey Characterization Report; See Appendix F	7.62	Varies	Varies

Lbs Manure Nitrogen from Beef cattle/Year
=
Beef animals
X
Lbs Dry Manure/animal/Year
X
Lbs of Total Nitrogen/Lb Dry Manure*

Manure generation diagram:



Manure nutrients are split into categories

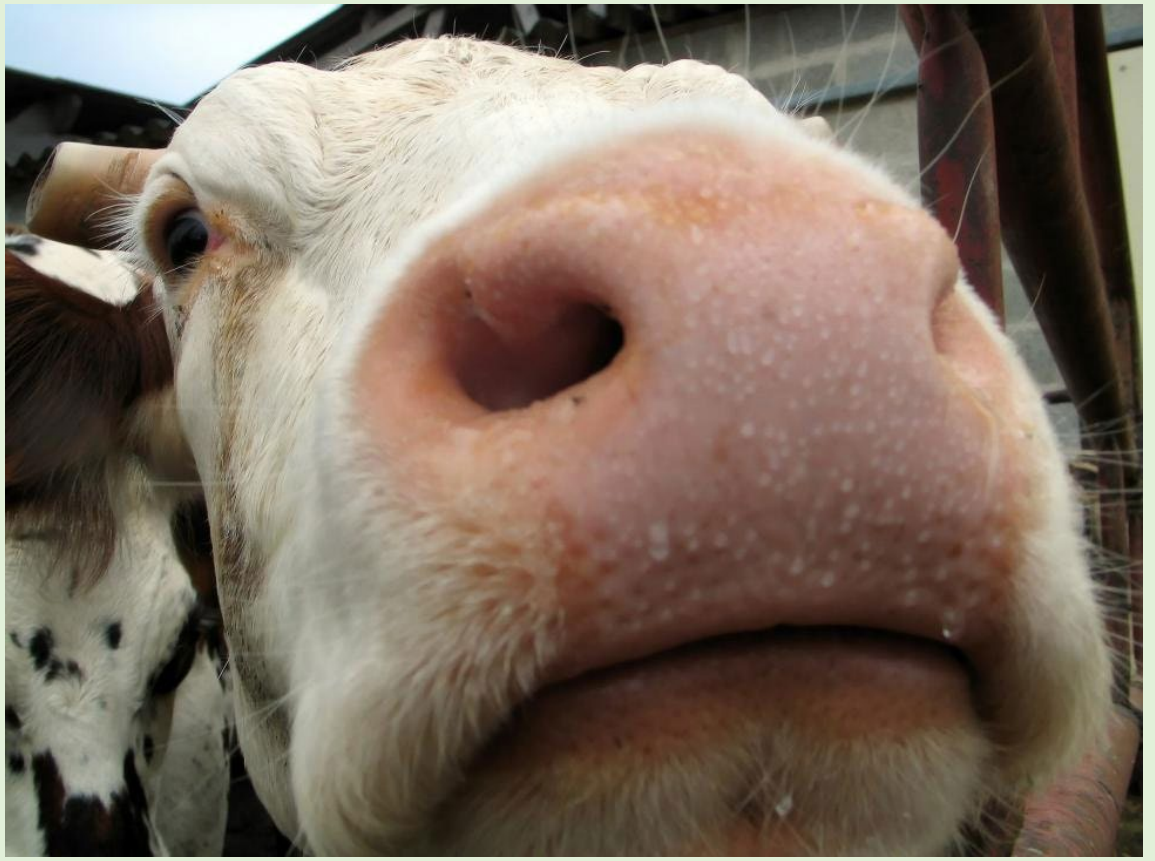
- State provided
- Can change for each county

Table 3-5: Beef percent manure deposited by area in West Virginia growth region 1

Growth Region	Animal Type	Month	Barnyard Percent	Pasture Percent	Access Area Percent
WV_1	beef	1	6	91	3
WV_1	beef	2	6	91	3
WV_1	beef	3	0	96	4
WV_1	beef	4	0	94	6
WV_1	beef	5	0	94	6
WV_1	beef	6	0	90	10
WV_1	beef	7	0	90	10
WV_1	beef	8	0	90	10
WV_1	beef	9	0	94	6
WV_1	beef	10	0	96	4
WV_1	beef	11	0	96	4
WV_1	beef	12	6	91	3

A quick manure sniff test:

- Ran CAST 23 scenarios:
  - Zero BMPs (no action)
  - BMPs implemented to date (2022 progress)
- Compared results for Total Manure Nitrogen:
  1. Direct deposition in riparian zones
  2. Direct deposition in pasture
  3. Losses from stored manure
  4. Remaining portion of stored manure
- NOTE* ALL results must still apply further losses to determine the Plant Available Nitrogen.



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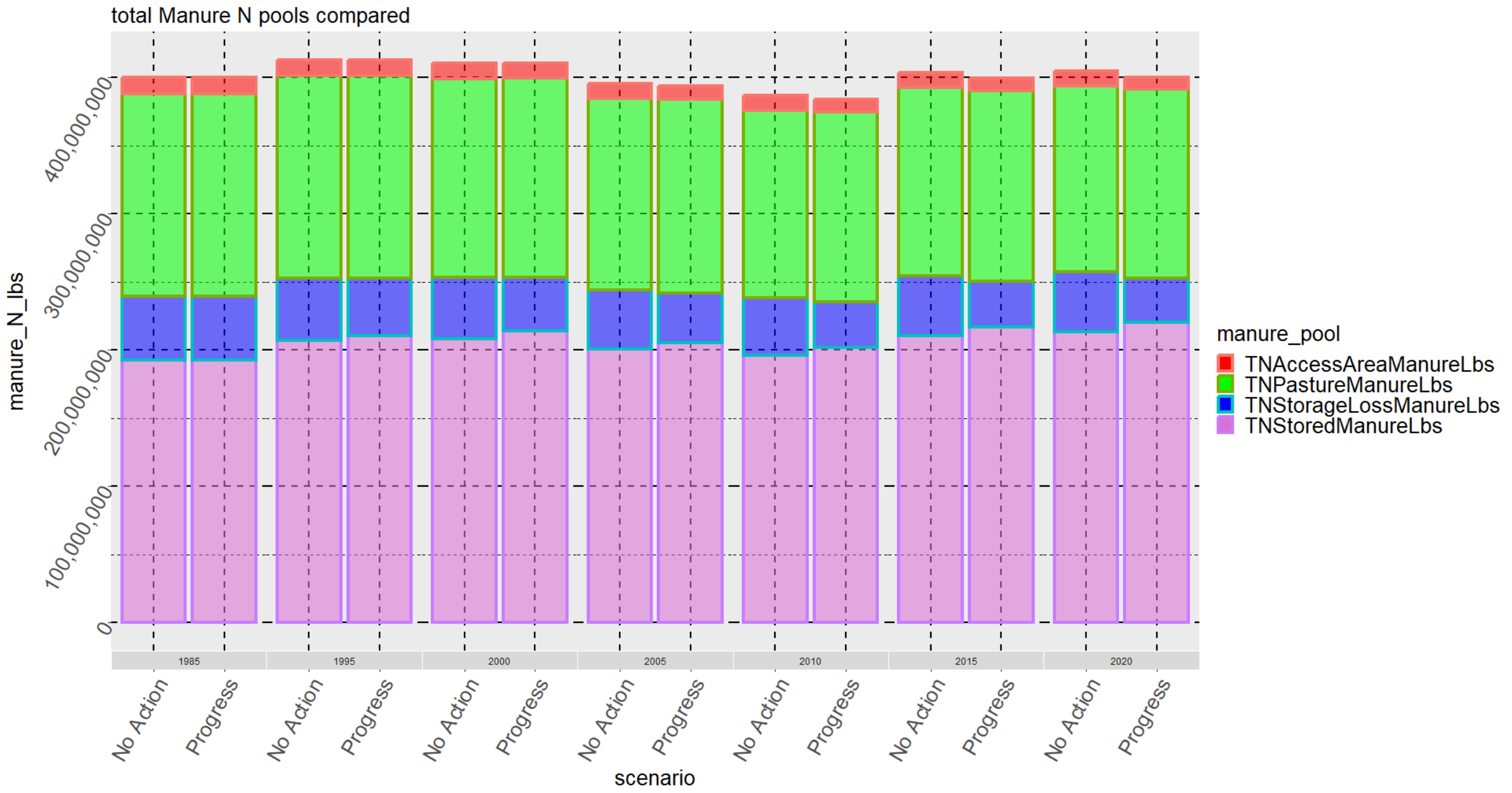
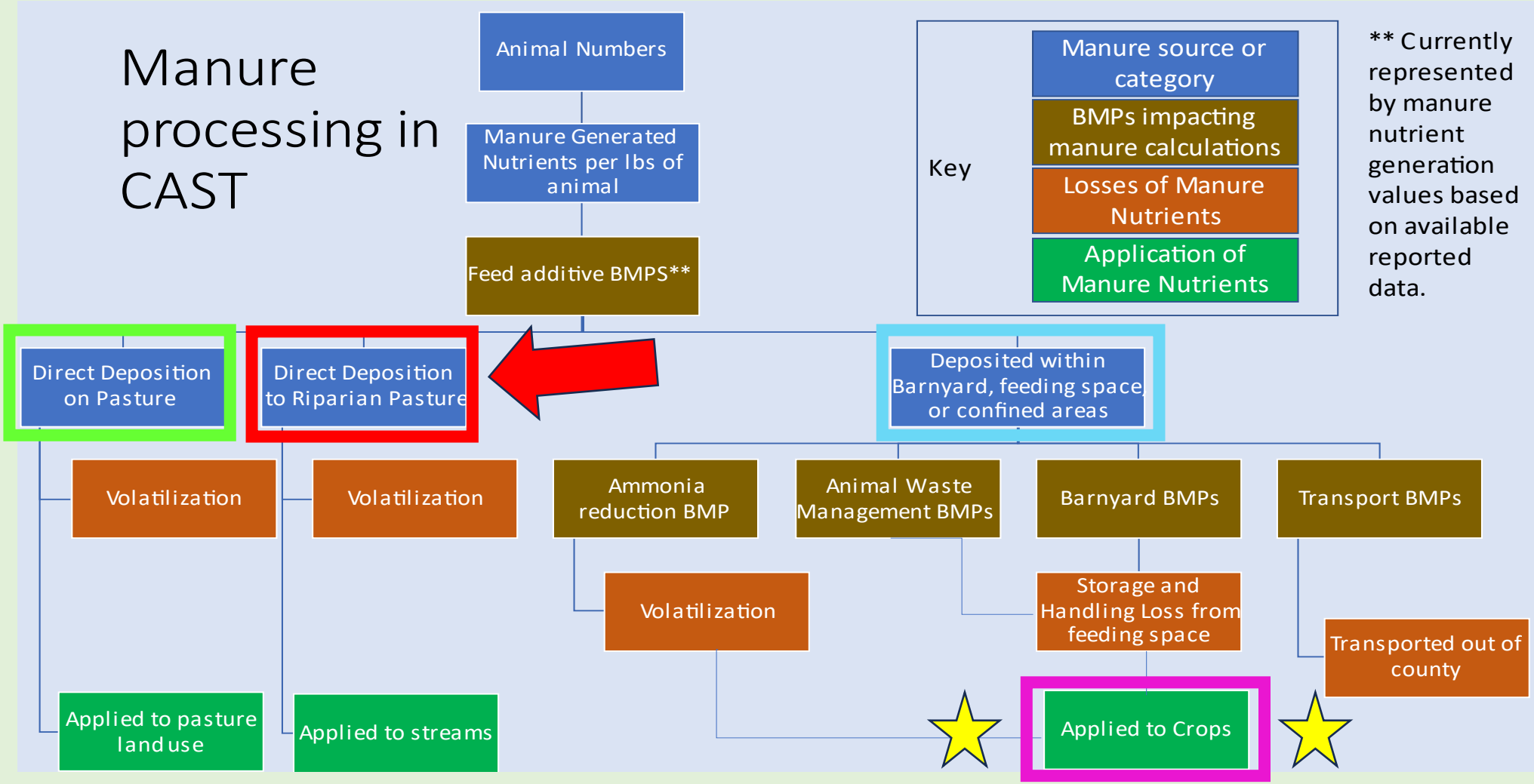

total Manure N pools compared
manure_N_lbs
400,000,000
300,000,000
200,000,000
100,000,000
0
1985
1995
2000
2005
2010
2015
2020
No Action
Progress
scenario
manure_pool
TNAccessAreaManureLbs
TNPastureManureLbs
TNStorageLossManureLbs
TNStoredManureLbs

Manure generation diagram:



Where nutrient losses occur in each pool?

Riparian

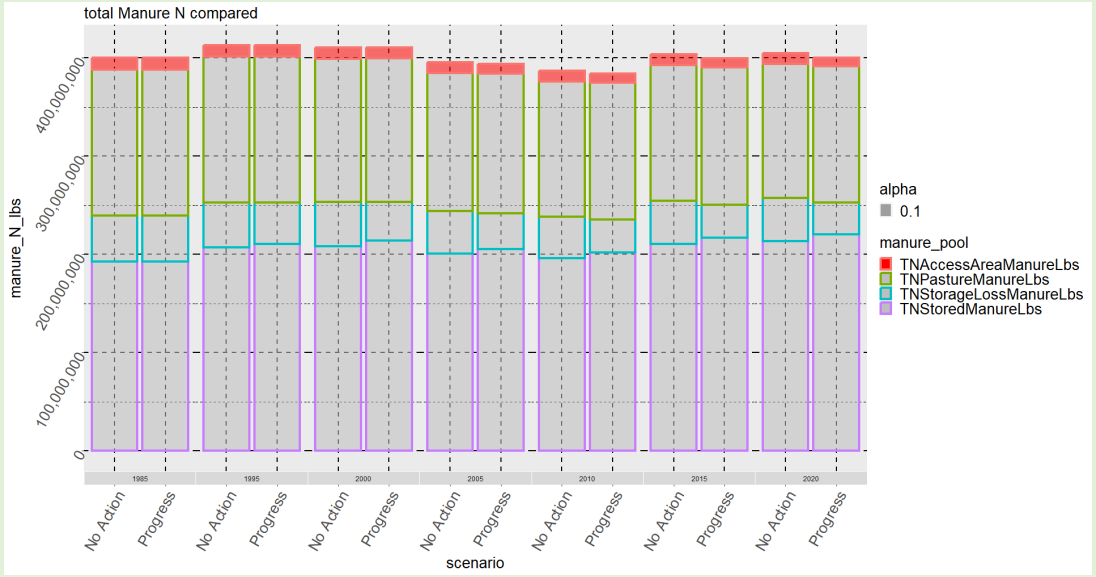
- Volatilization

Pasture

- Volatilization

Confined

- Volatilization
- Storage and handling
- Transported across county lines



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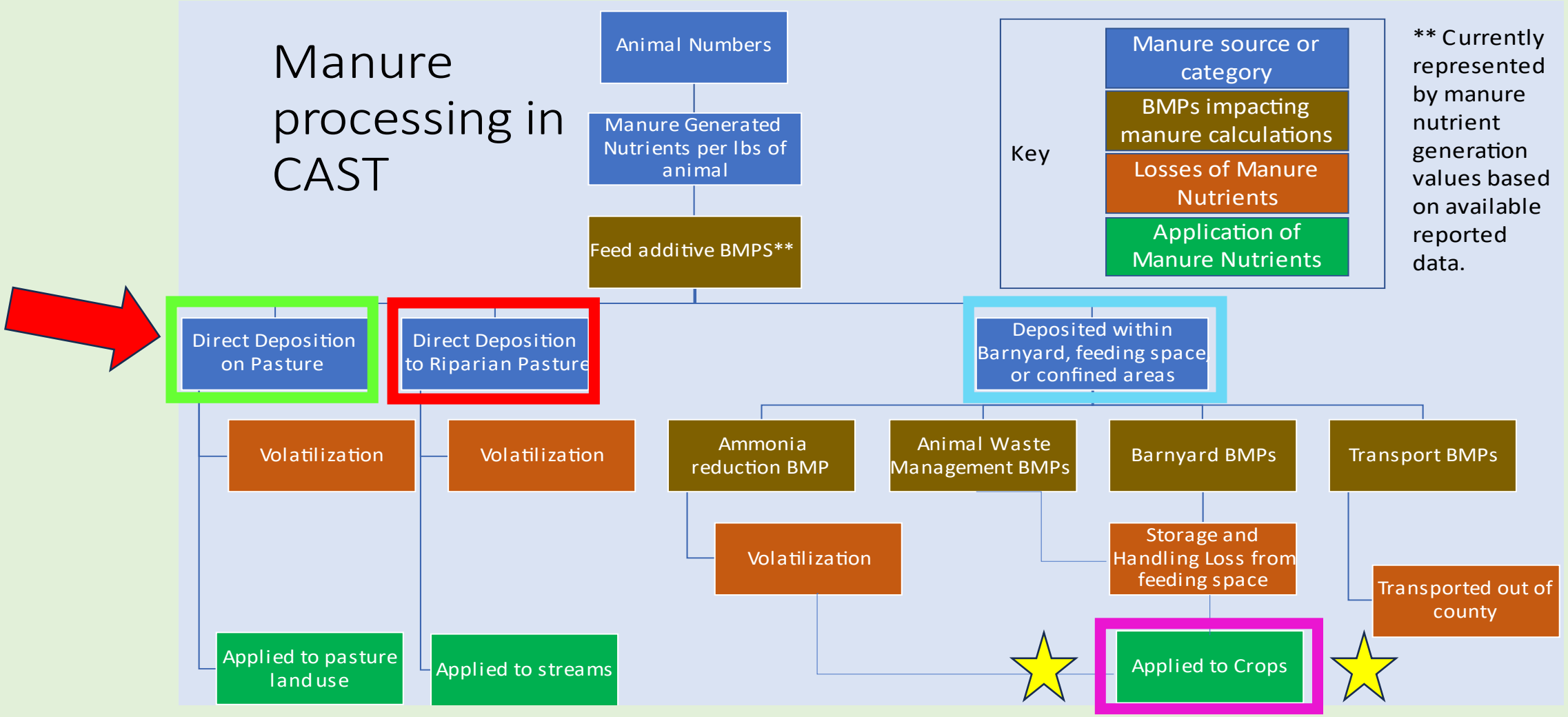

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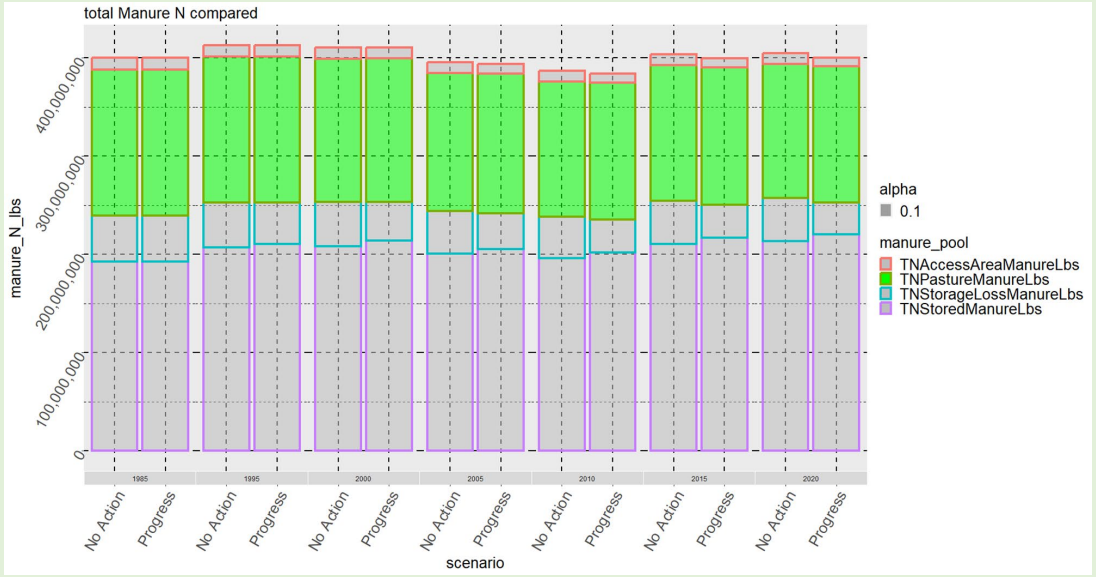

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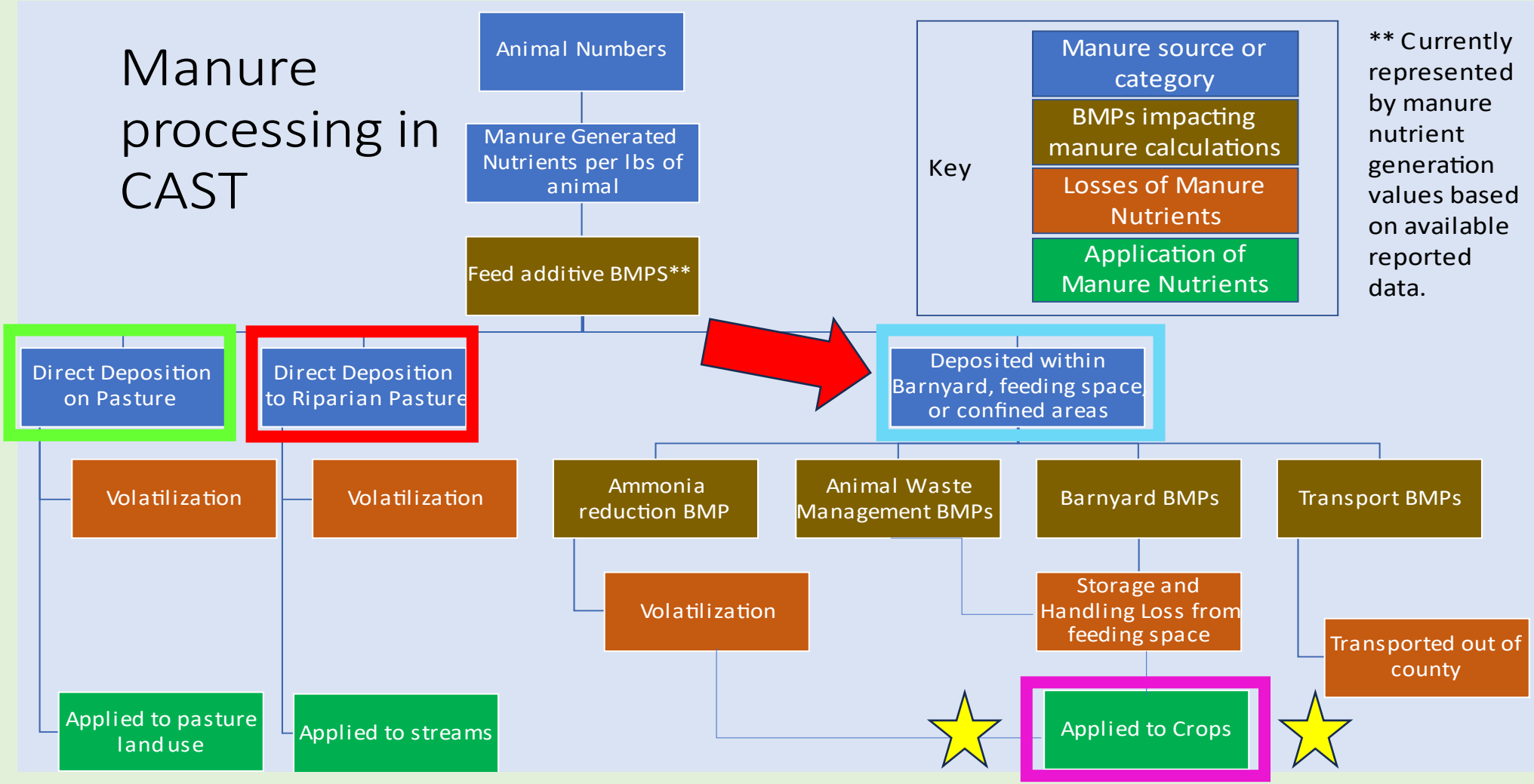
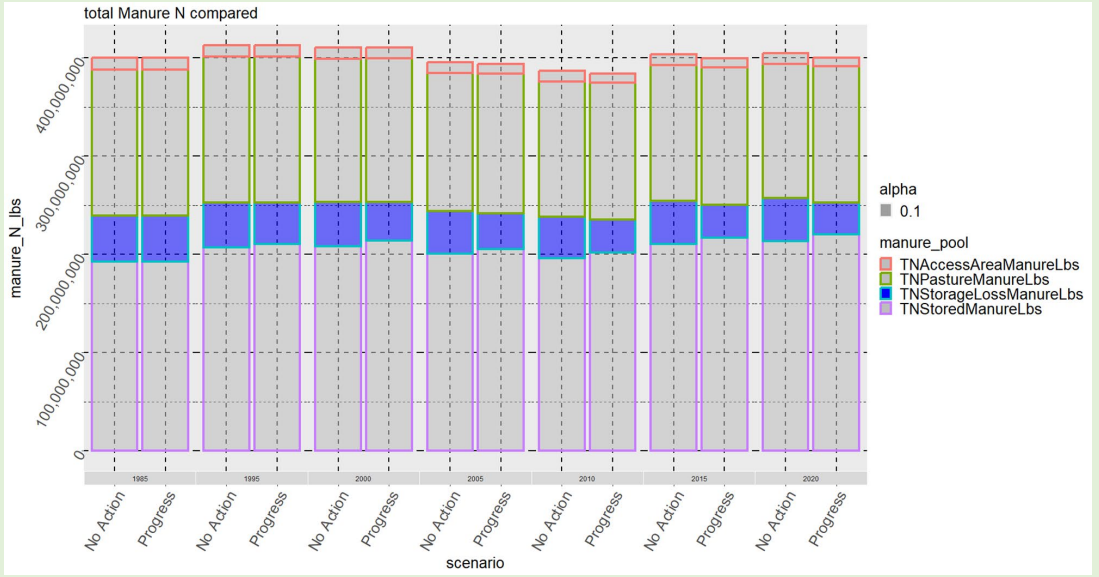


Manure Storage Losses

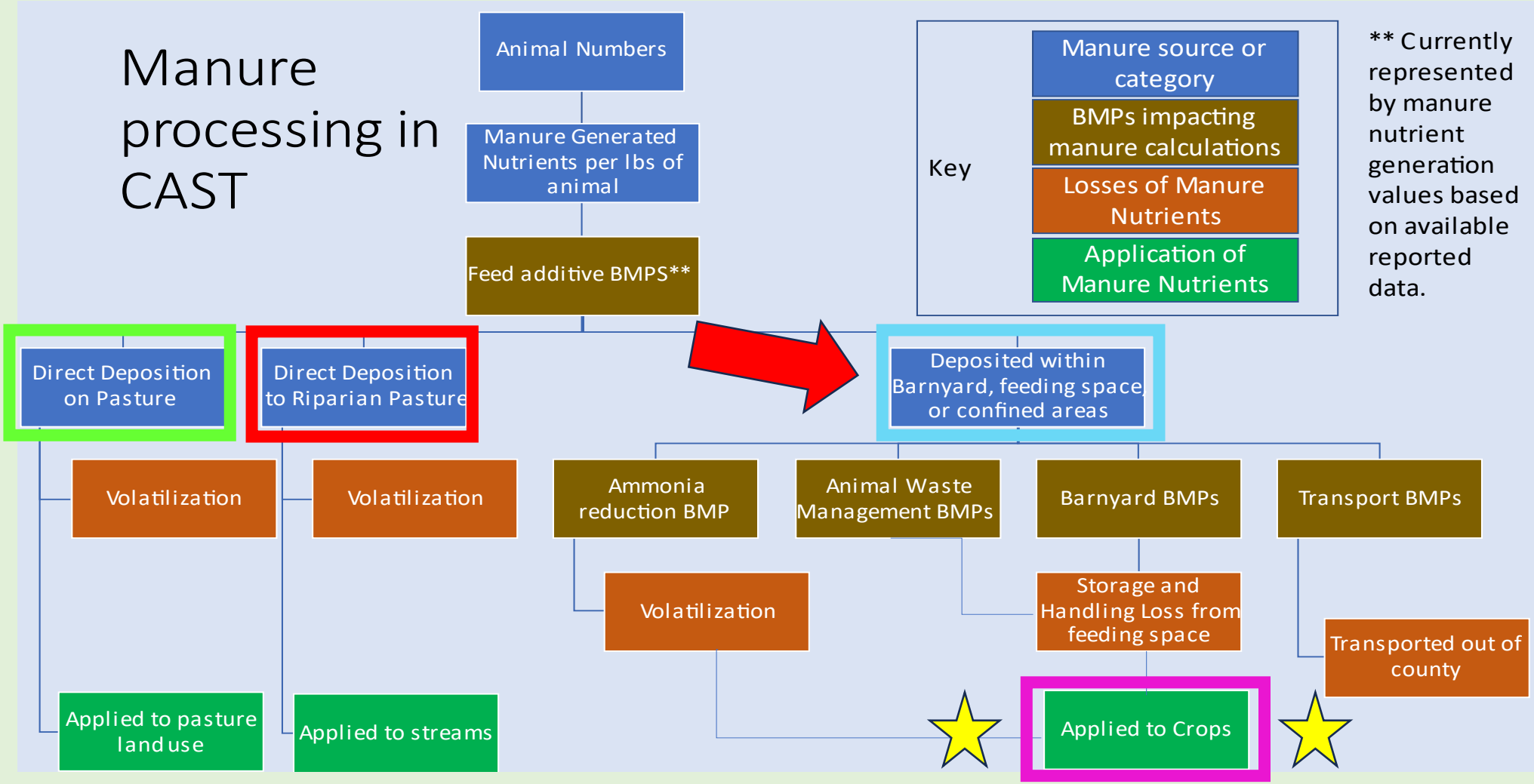
- Animal Waste Management System expert panel report provided values

Table 3-7: Recoverability of Manure with and Without AWMS (Hawkins, et al. 2016)

Animals	% Recoverable without AWMS	% Recoverable with AWMS
Beef	60	99
Dairy	75	95
Other Cattle	60	99
Hogs for Slaughter	90	99
Hogs for Breeding	90	99
Broilers	90	99
Layers	90	99
Turkeys	90	99
Pullets	90	99
Sheep	95	98
Horses	95	98
Goats	95	98



Manure generation diagram:



Where nutrient losses occur in each pool?

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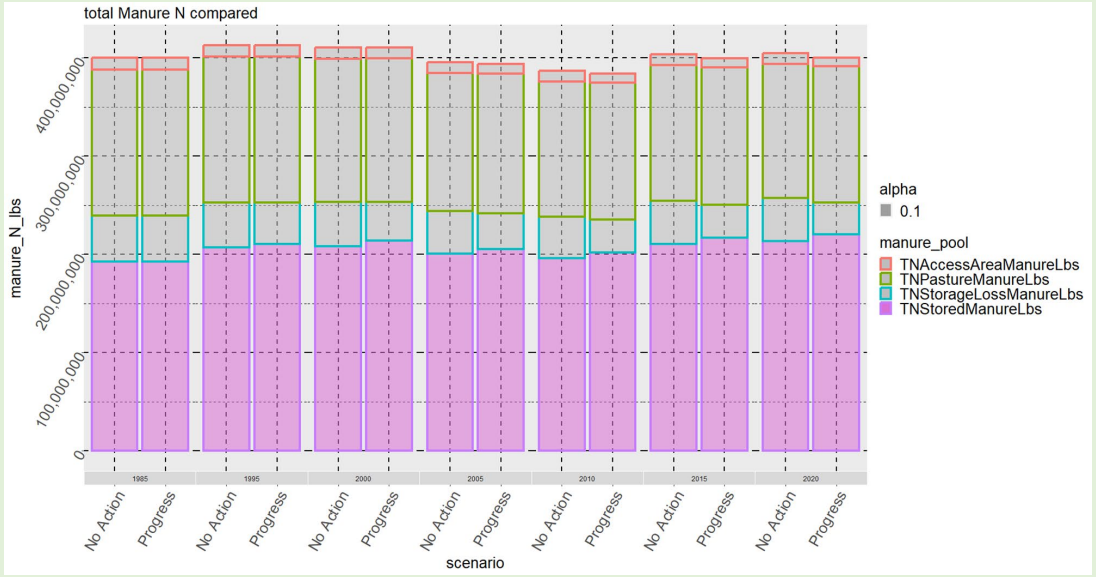

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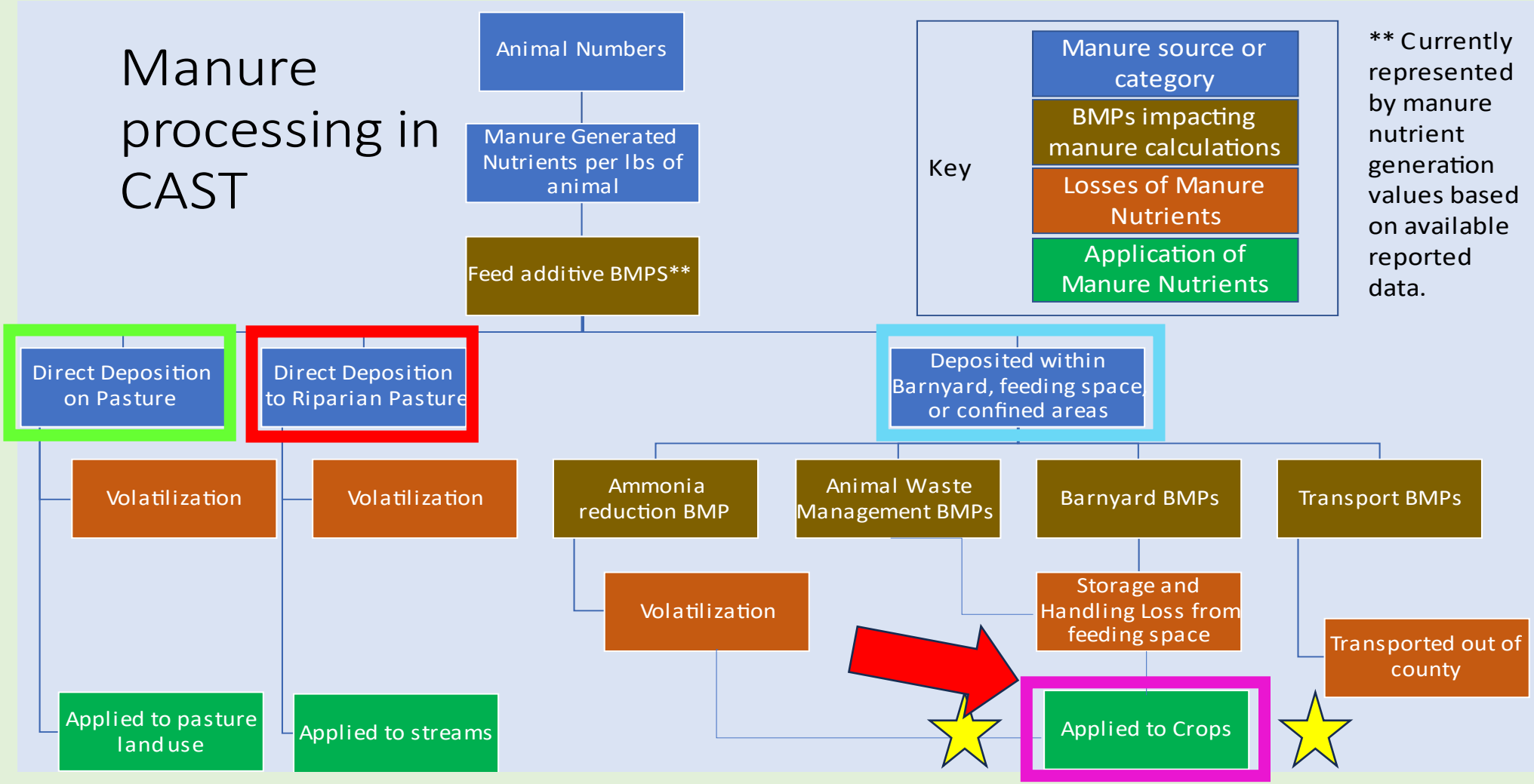


How does manure get used?

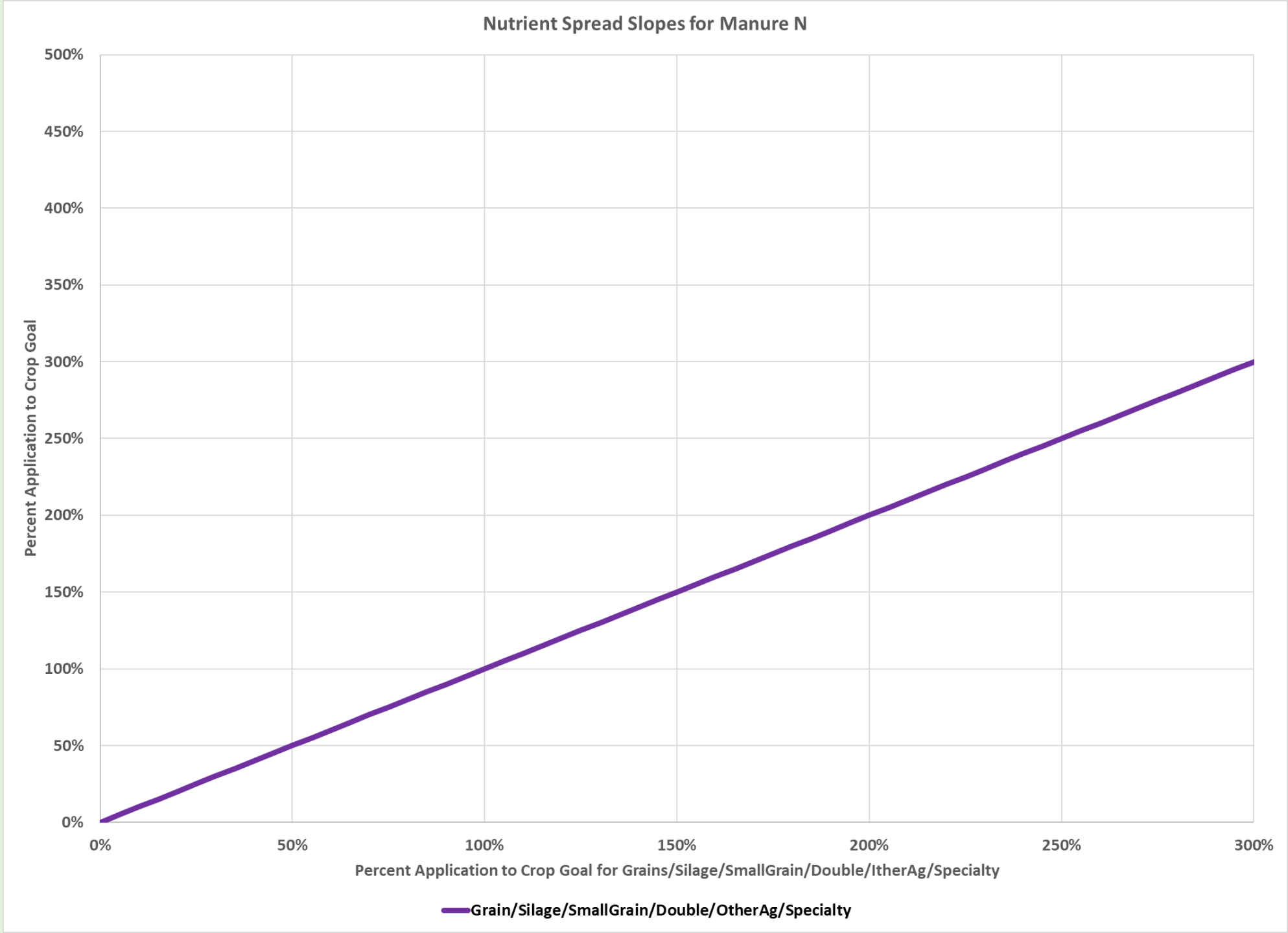
- 14 total Land Uses
- **11 are ELIGIBLE to receive nutrients from manure**
  - **NOTE* not all the crops in each Land Use are manure eligible (e.g. Strawberries in Specialty)**

Chesapeake Bay Average			
Land class	Land Use	Loading Rate Ratio	Loading Rate (pounds per acre per year)
Cropland	Double Cropped Land	0.79	30.9
	Full Season Soybeans	0.71	27.7
	Grain with Manure	1.4	54.7
	Grain without Manure: **Reference land use**	1	39.1
	Other Agronomic Crops	0.45	17.6
	Silage with Manure	1.62	63.3
	Silage without Manure	1.16	45.3
	Small Grains and Grains	0.84	32.8
	Specialty Crop High	1.34	52.4
	Specialty Crop Low	0.31	12.1
Pasture	Ag Open Space	0.43	5.1
	Legume Hay	0.74	8.7
	Other Hay	1.04	12.3
	Pasture: **Reference Land Use**	1	11.8

How do applications work?

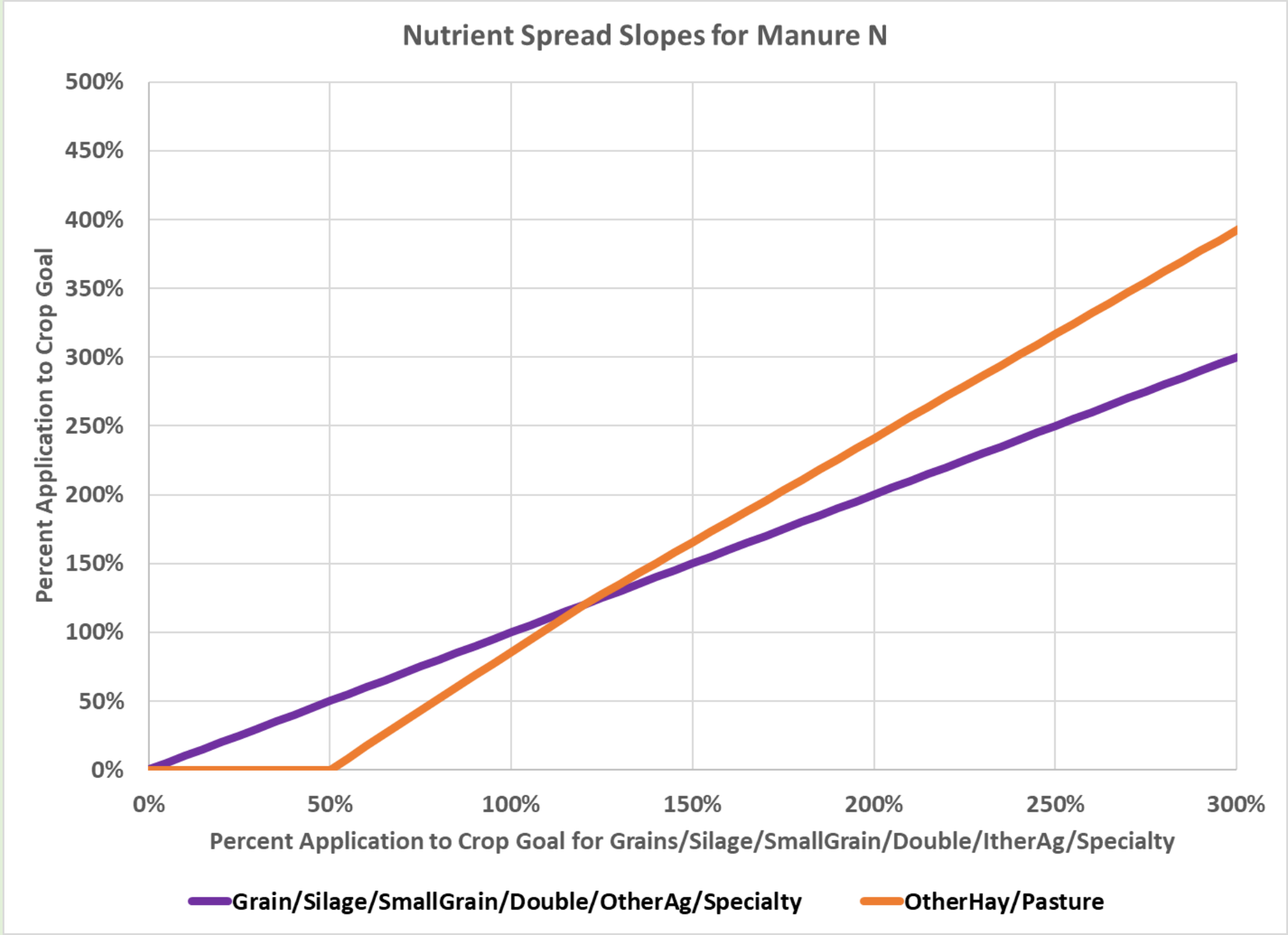
Group 1

- Start with:
  - Grain
  - Silage
  - Small Grains
  - Double cropped
  - Other crops
  - Specialty (high and low)
- Go until each of these crops has 50% of its need met.



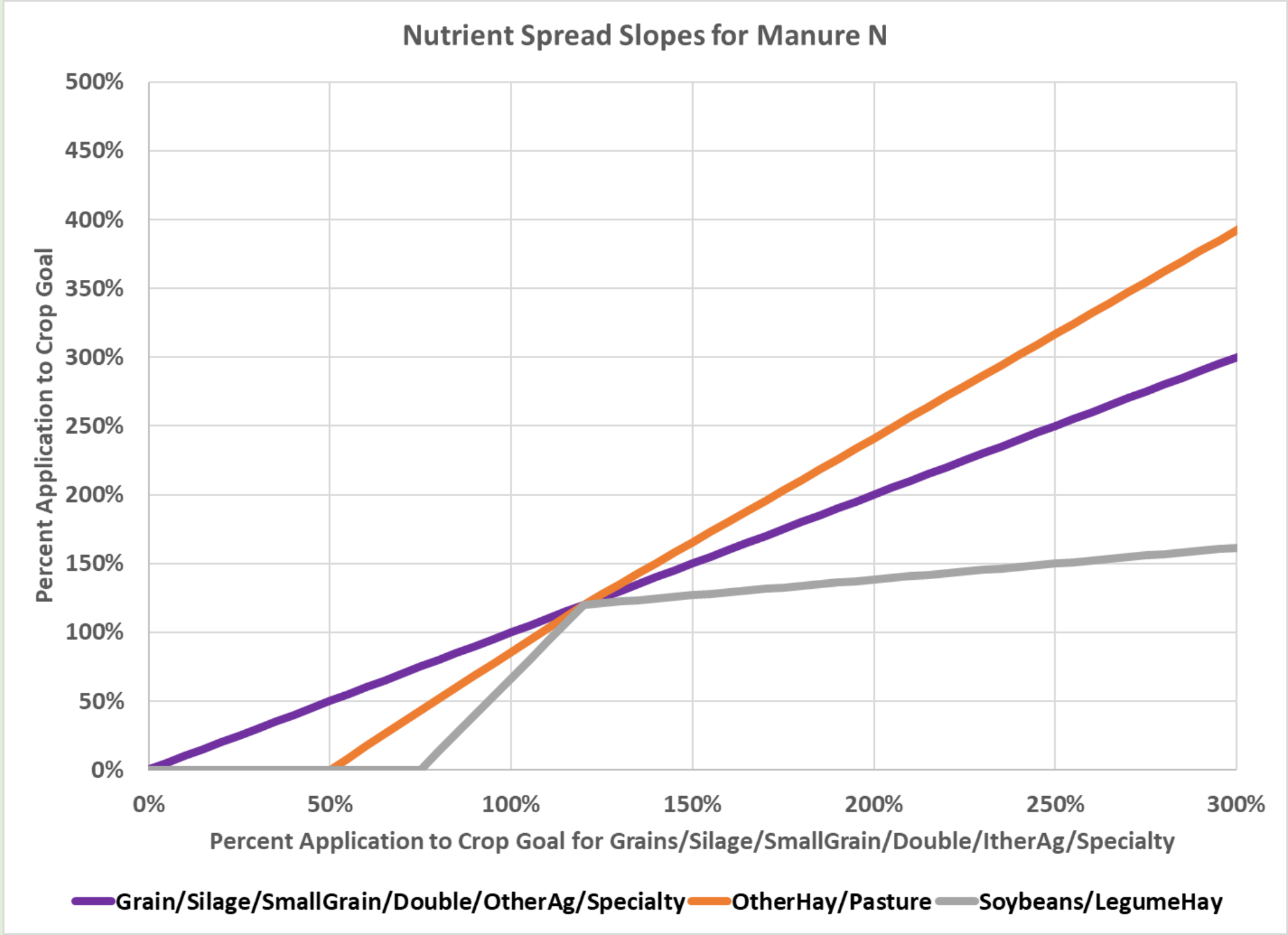
Group 2

- We will KEEP applying to Group 1
- Begin applying to:
  - Other Hay
  - Pasture
- Go until we hit 75% of crop need for Group 1



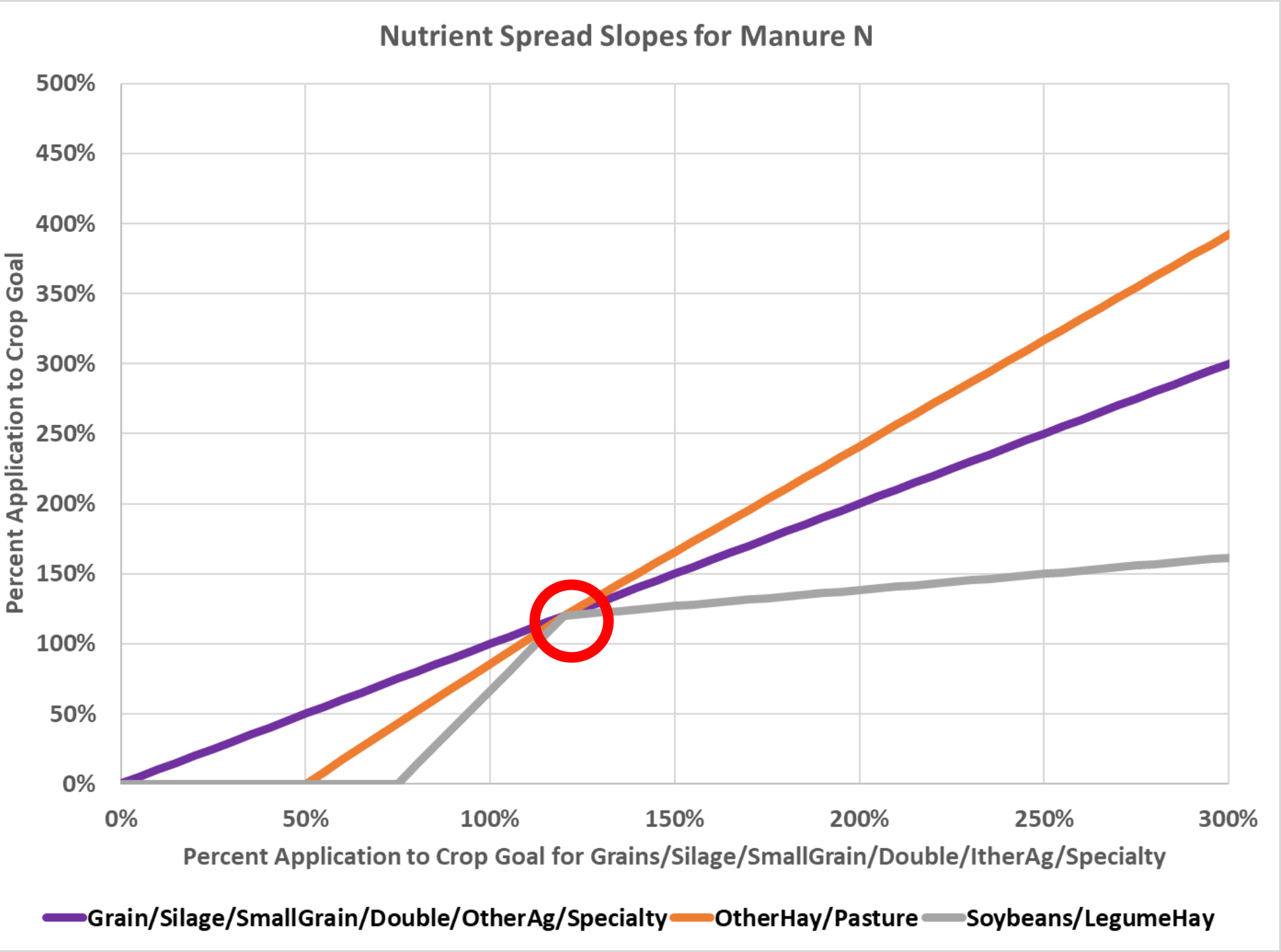
Group 3

- We will KEEP applying to Groups 1 AND 2
- Begin applying to:
  - Soybeans
  - Legume Hay



NOTES:

- 120% of crop need is the assumed max for nutrient application
- Volatilization occurs on the field
- Not all manure nutrients are Plant Available



How can manure influence a Land Use?

- 14 total Land Uses
- **11 are ELIGIBLE to receive nutrients from manure**

Chesapeake Bay Average			
Land class	Land Use	Loading Rate Ratio	Loading Rate (pounds per acre per year)
Cropland	Double Cropped Land	0.79	30.9
	Full Season Soybeans	0.71	27.7
	Grain with Manure	1.4	54.7
	Grain without Manure: **Reference land use**	1	39.1
	Other Agronomic Crops	0.45	17.6
	Silage with Manure	1.62	63.3
	Silage without Manure	1.16	45.3
	Small Grains and Grains	0.84	32.8
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	Legume Hay	0.74	8.7
	Other Hay	1.04	12.3
	Pasture: **Reference Land Use**	1	11.8

Animal populations

- Down to the county scale

Animal Type	Population data source	Type of data
Beef	Five year Census of Ag	NASS Census inventory
Diary	Five year Census of Ag	NASS Census inventory
Other Cattle	Five year Census of Ag	NASS Census inventory
Horses	State-sponsored horse censuses	State equine surveys
Hogs for Breeding	Five year Census of Ag	NASS Census sales
Hogs for Slaughter	Five year Census of Ag	NASS Census sales
Sheep and Lambs	Five year Census of Ag	NASS Census inventory
Goats	Five year Census of Ag	NASS Census inventory
Pullets	Five year Census of Ag	NASS Census inventory
Layers	Five year Census of Ag	NASS Census inventory
Broilers	USDA-NASS's Poultry Production and Value surveys	NASS Poultry production
Turkeys	USDA-NASS's Poultry Production and Value surveys	NASS Poultry production

Calculating manure acres

Silage

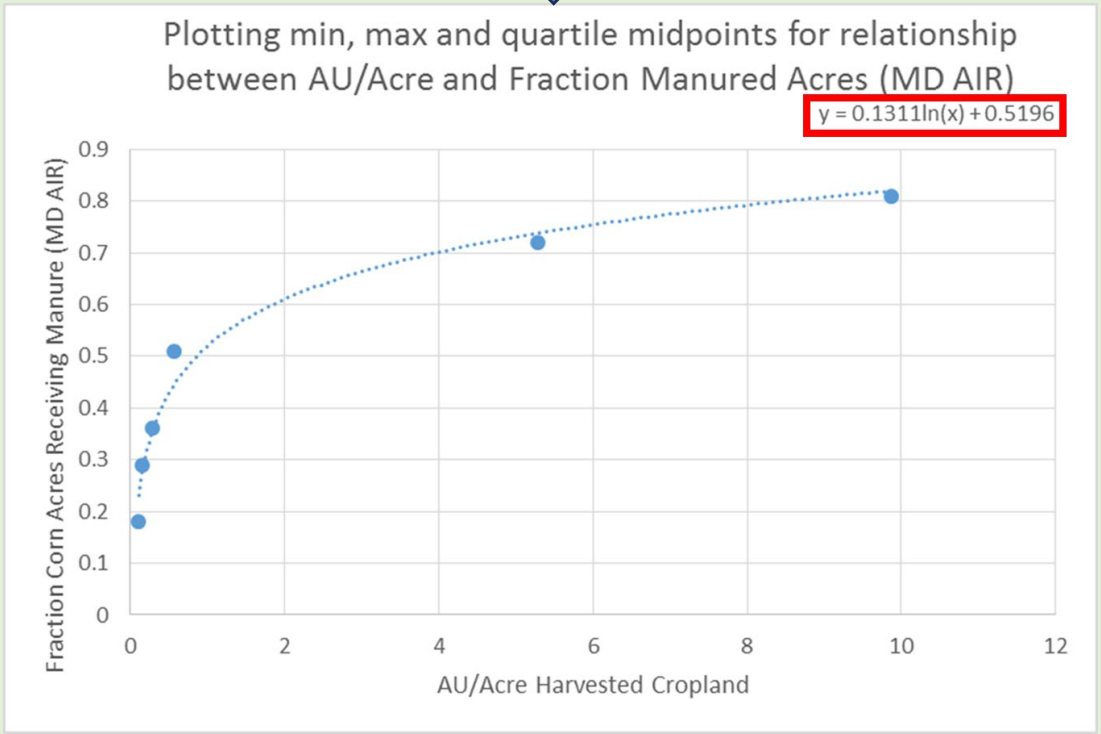
- 85 percent of corn and sorghum for silage acres received manure

Grain

- Fraction receiving manure is constrained to be between 0.18 and 0.81.

Grain with Manure

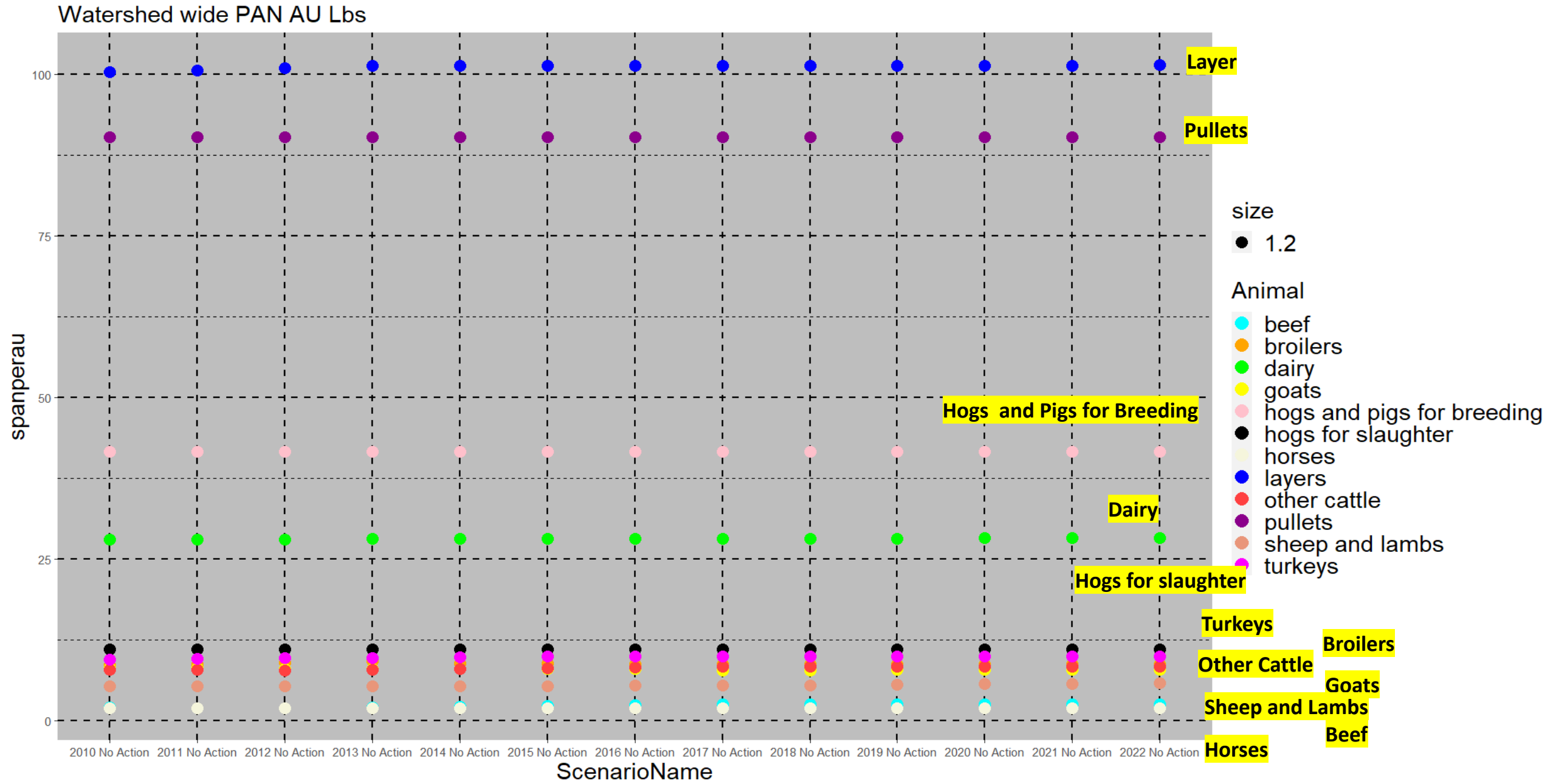
Grain without Manure: **Reference land use**

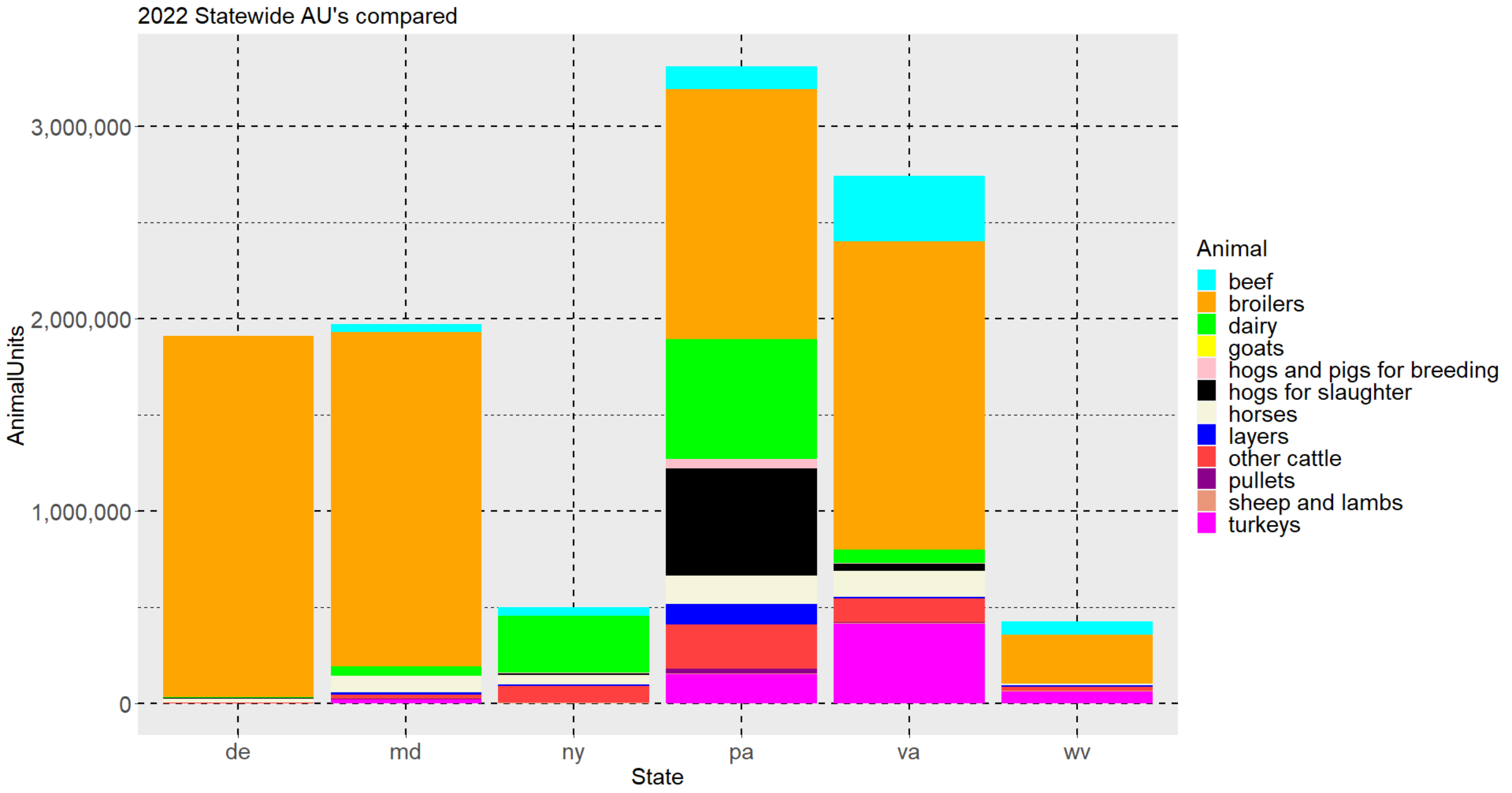


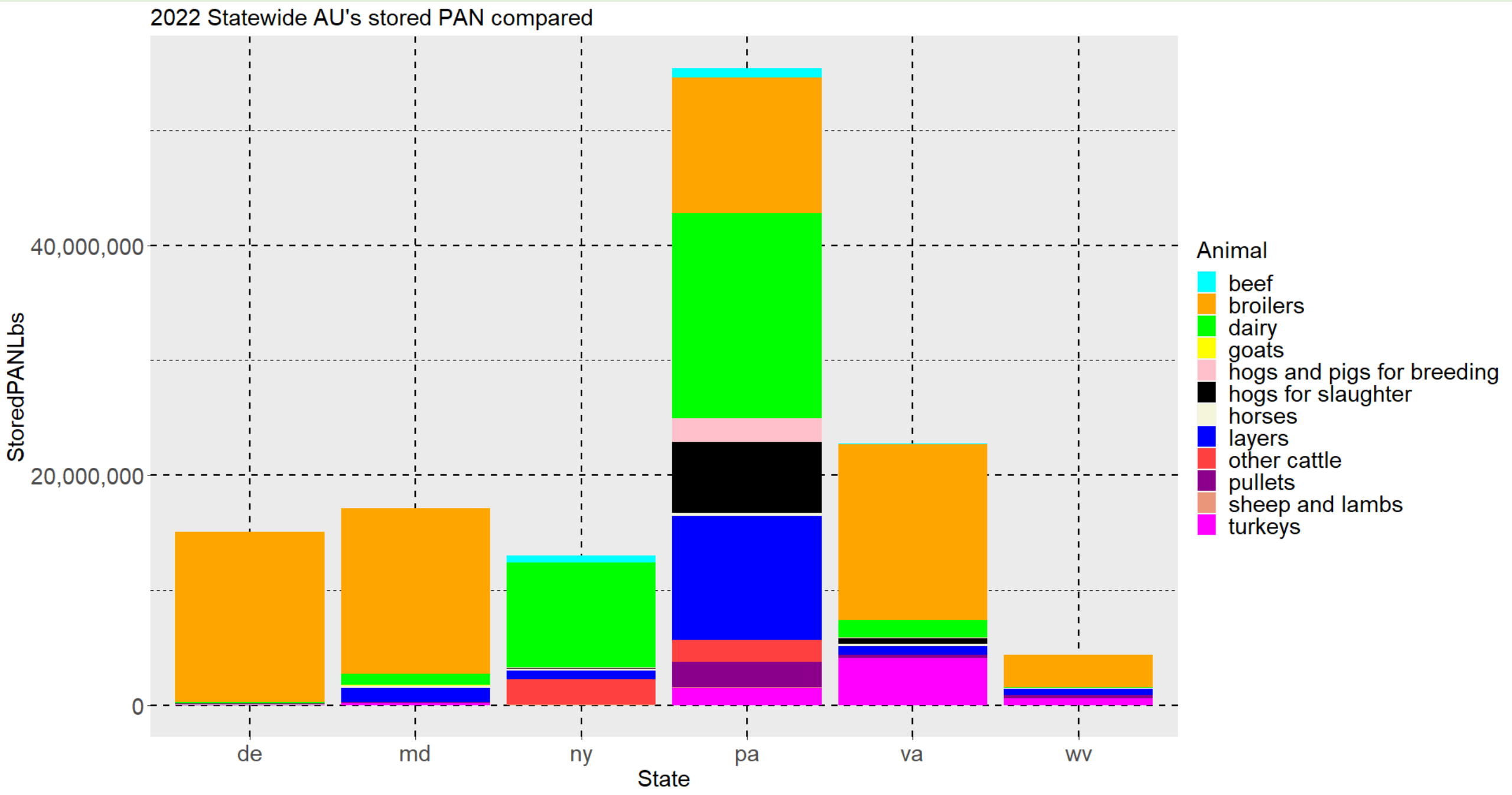
What this looks like across the watershed

- No action scenario
- 2022
- For each state
  - Animal Units (AU) – 1AU= 1000lbs of animal
  - Plant Available Nitrogen (PAN)
    - Amount of Nitrogen which a plant can use from a fertilizer source
      - Never 100% for manure
    - Differs between species of livestock
      - Beef cattle behave differently then egg laying chickens
    - Time in confinement does matter

Plant Available N in stored manure per AU by animal type:




2022 Statewide AU's compared
3,000,000
2,000,000
1,000,000
0
AnimalUnits
de
md
ny
pa
va
wv
State
Animal
beef
broilers
dairy
goats
hogs and pigs for breeding
hogs for slaughter
horses
layers
other cattle
pullets
sheep and lambs
turkeys


2022 Statewide AU's stored PAN compared
StoredPANLbs
40,000,000
20,000,000
0
de
md
ny
pa
va
wv
State
Animal
beef
broilers
dairy
goats
hogs and pigs for breeding
hogs for slaughter
horses
layers
other cattle
pullets
sheep and lambs
turkeys

Summary

- **Manure acres** are necessary for two specific Land Uses
  - Grain
  - Silage
- **Manure nutrient generation** is still necessary for all Land Uses which are eligible to receive manure.
- **Stored manure** is applied to the land where additional losses occur.
- **How it is applied** differs between Land Uses.
- **Each eligible acre** will receive manure based on several factors:
  - The type of crop grown on the acre.
  - The amount of nutrient required to feed the recorded crop yield.
  - The amount of manure nutrients available.

Questions?