Phase 6 Scenario Builder 101

Presentation to WQGIT

9/28/15

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Ag Modeling Subcommittee Chair

AMS/Scenario Builder Time Frame

- Pending WQGIT approval, Scenario Builder modifications approved by the AgWG on 9/16/15 will be used in October 2015 Phase 6 calibration runs
- AMS will reconvene starting in January, 2016 to evaluate output from calibration runs
- AgWG is encouraged to review the calibration runs beginning in January, 2016, and provide comments/questions/recommendations to the AMS
- By March, revised AMS recommendations presented for AgWG approval
- CBPO staff will work with AMS to incorporate any changes through the summer of 2016





Load for a land use in a segment =

Estimated Average Load + Sensitivity * Δ Inputs

*

BMPs

*

Watershed Delivery Variance

*

Stream Delivery

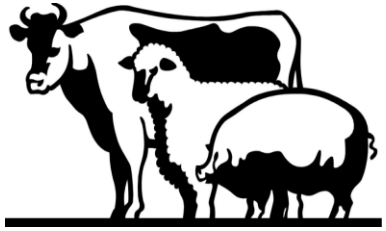
*

River Delivery

Phase 6

Phase 6 Scenario Builder Conceptual Model

Livestock Manure (and Biosolids)



Barnyard

Fertilizer

Nutrient Application Prescription

Pasture

Access Area

River

Crops

Image Credits
https://utextension.tennessee.edu/lincoln/4-H/Pages/Livestock-Skillathons-%28Beef,-Sheep-and-Swine%29.aspx
Rebelwoodsranch.com
Seaburst.com
http://pubs.ext.vt.edu/442/442-308/442-308.html
http://nh.water.usgs.gov/project/champlain_bmp/ag.htm

Estimating Livestock Manure N and P Production

Data Needed:

- Animal or bird population
- Estimates of manure produced per animal
- Estimates of manure total N and P concentrations
- Estimates of rate of N and P mineralization from organic form

Equation to Estimate Manure per Animal Type

= Population X Lbs of manure per animal X Lbs of N or P per Lb manure

Estimating Livestock Population

Data Sources:

- USDA-NASS 5-Yr Ag Census Inventory – All Livestock (helps inform distribution of turkeys and broilers to county)
- USDA-NASS 5-Yr Sales Numbers – For Hogs for Slaughter and Pullets
- NASS Annual Poultry Production – For Broilers and Turkeys
- Industry and state data where available

Approach varies with livestock type and level of available data

Population for Broilers and Turkeys =

(Statewide Birds Produced) X (Countywide Ag Census Inventory/Statewide Ag Census Inventory)

Population for Hogs for Slaughter and Pullets

(Ag Census County Inventory X 1/Production Cycles) + ((Ag Census County Animals Sold/Production Cycles) X (Production Cycles – 1/Production Cycles)

Population for Other Livestock and Layers =

Ag Census County Inventory

Manure Production per Animal and Total Nutrient Concentrations

Data source:

- Dairy, Beef, Hogs, and horses: ASABE, 2005[1]
- Sheep and goats: ASABE, 2003
- Poultry litter estimates vary by year and are explained in detail in the PLS report

[1]State provided data utilized when available

Nutrient Concentrations and Mineralization

- SB Phase 5 assumptions retained:
  - manure ammonium-N to organic N ratio
  - fraction of organic-N mineralized (plant available) in the year of application
  - 100% of total P available in year of application

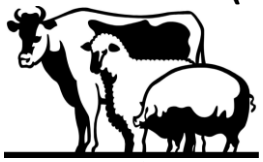
- Maximum ammonia-N loss assumed (no or delayed incorporation)

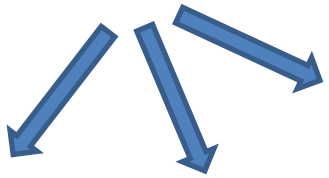
County-by-county farm fertilizer availability

- Estimate watershed-wide farm fertilizer sales from APFCO data (farm use adjusted from total fertilizer sales)
- Estimate watershed-wide fertilizer expenditures from Ag Census (adjusted for use within watershed)
- Average the two fertilizer use estimates
- Determine crop nutrient needs for each county
- Subtract available nutrients from manure in each county and determine county's crop need as a fraction of watershed-wide fertilizer sales

Distributing Manure to Pasture, Access Areas and Barnyard

Livestock Manure (and Biosolids)





Barnyard

Pasture

Access Area

Data Needed:

- Confined Area, Pasture, and Access Area fractions provided by states (estimated by month)
- Multiply total manure produced by fraction in each month to determine how much is available to direct deposition, access area and barnyard

Barnyard Storage and Handling Loss

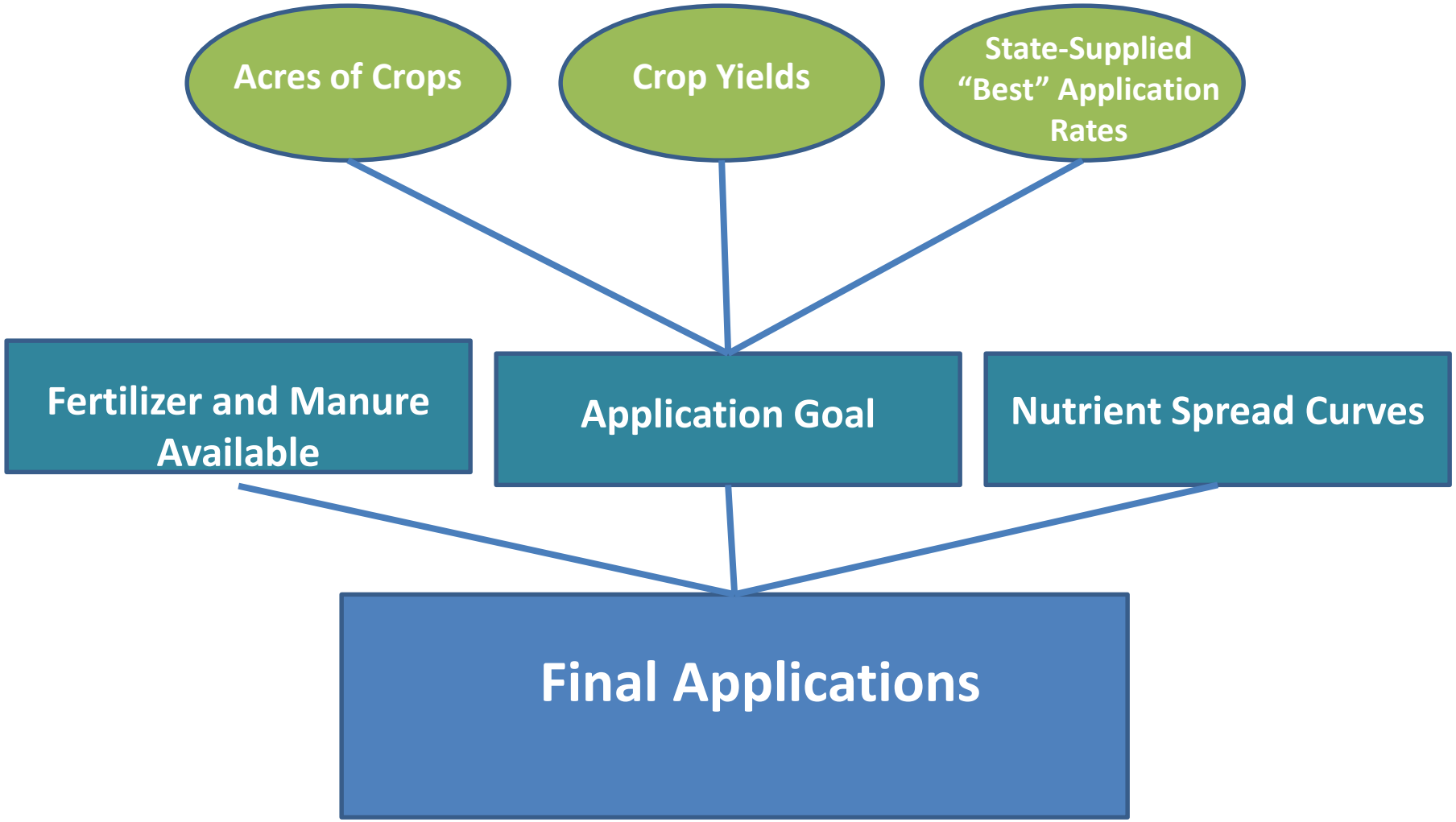
- Storage and Handling Loss factor determines the pre-BMP and volatilization nutrient load from animal feeding operations. (Source: USDA-NRCS, 2003. Costs Associated with Development and Implementation of Comprehensive Nutrient Management Plans. June, 2003)
- Volatilization, BMPs, and further nutrient retention between the operation and the simulated stream further reduce these loads.

Acres of feeding operation

- Average area needed to produce one animal (acres/animal) (Source: ASABE)
- Total animals produced (as described previously)

Baseline manure production estimates do not include animal waste management systems or manure transport. Waste management systems will increase retention of manure and the amount available for land application

“Prescribing” Applications to Crops



Application Goal

Data Needs:

- Ag Census acres of crops (or projected acres)
- State-supplied applications per yield unit
- State-supplied application per month
- NASS annual crop survey yearly yields for major crops (including corn, soybeans, wheat, oats, barley, and alfalfa hay)
- Ag Census yields for other crops

Yield goal for application target = Best 3 out of available 5 yields x 1.1

Application/Yield unit from LGA recommendations

Equation:

N or P applied = Acres X Application/Yield Unit X Yield goal X Fraction Applied in Month

Crops to LU

Land Use Name	Manure Eligible
Ag Open Space	N
Full Season Soybeans	Y
Grain with Manure	Y
Grain without Manure	N
Legume Hay	Y
Silage with Manure	Y
Silage without Manure	N
Small Grains and Grains	Y
Small Grains and Soybeans	Y
Specialty Crop High	Y
Specialty Crop Low	Y
Other Agronomic Crops	Y
Other Hay	Y
Pasture	Y
Farmstead	NA
Permitted Feeding Space	NA
Non-Permitted Feeding Space	NA

CropName	Phase6 MajorLanduse
Cotton Harvested Area	Other Agronomic crops
Dry edible beans, excluding limas Harvested Area	Other Agronomic crops
Peanuts for nuts Harvested Area	Other Agronomic crops
Sod harvested Area	Other Agronomic crops
Sod harvested Protected Area	Other Agronomic crops
Sweet Corn Harvested Area	Other Agronomic crops
tobacco Harvested Area	Other Agronomic crops

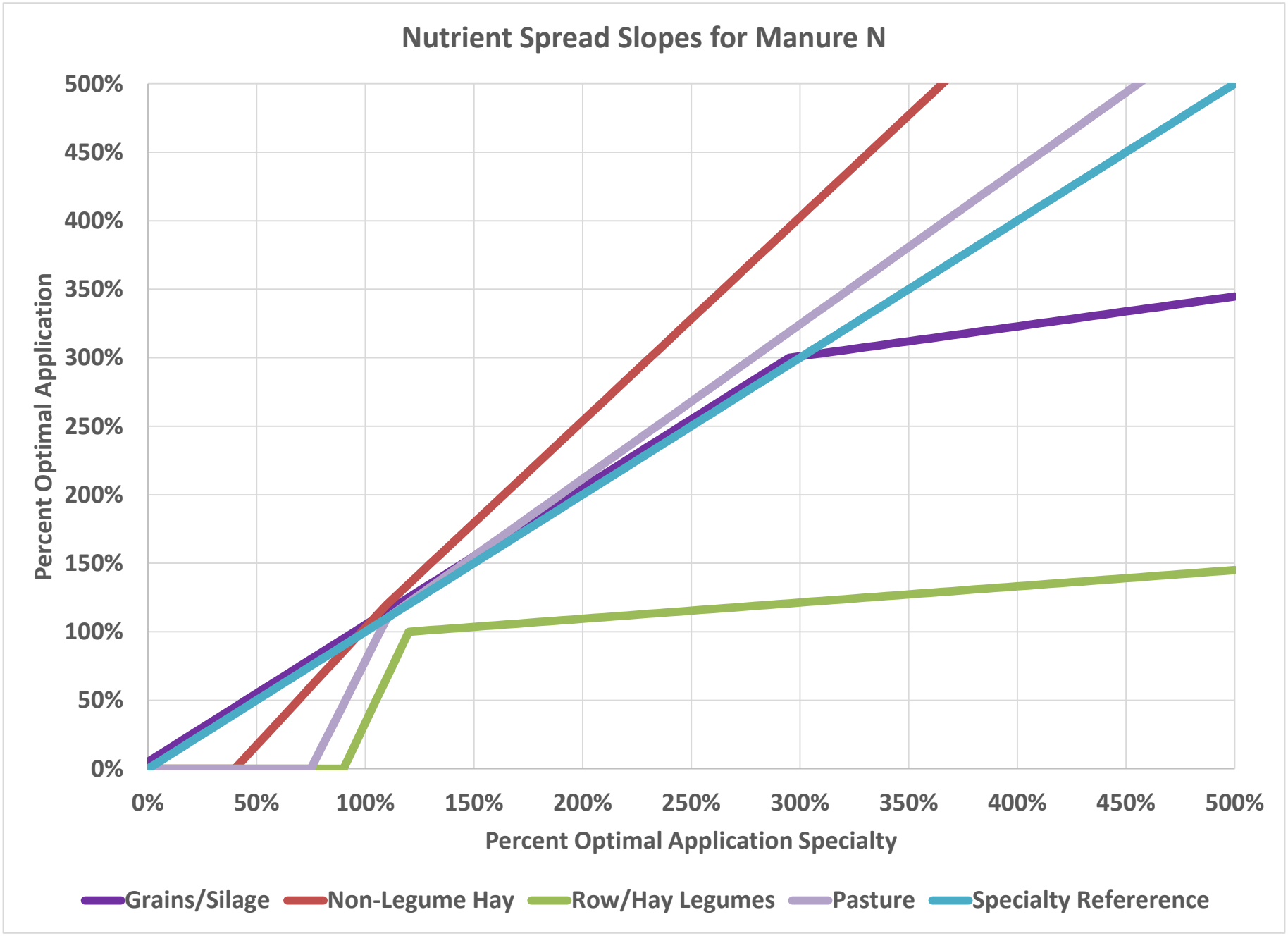
- Applications are made directly to crops, BUT crops are lumped into land uses.
- Overall application on a single land use represents application on multiple crops.

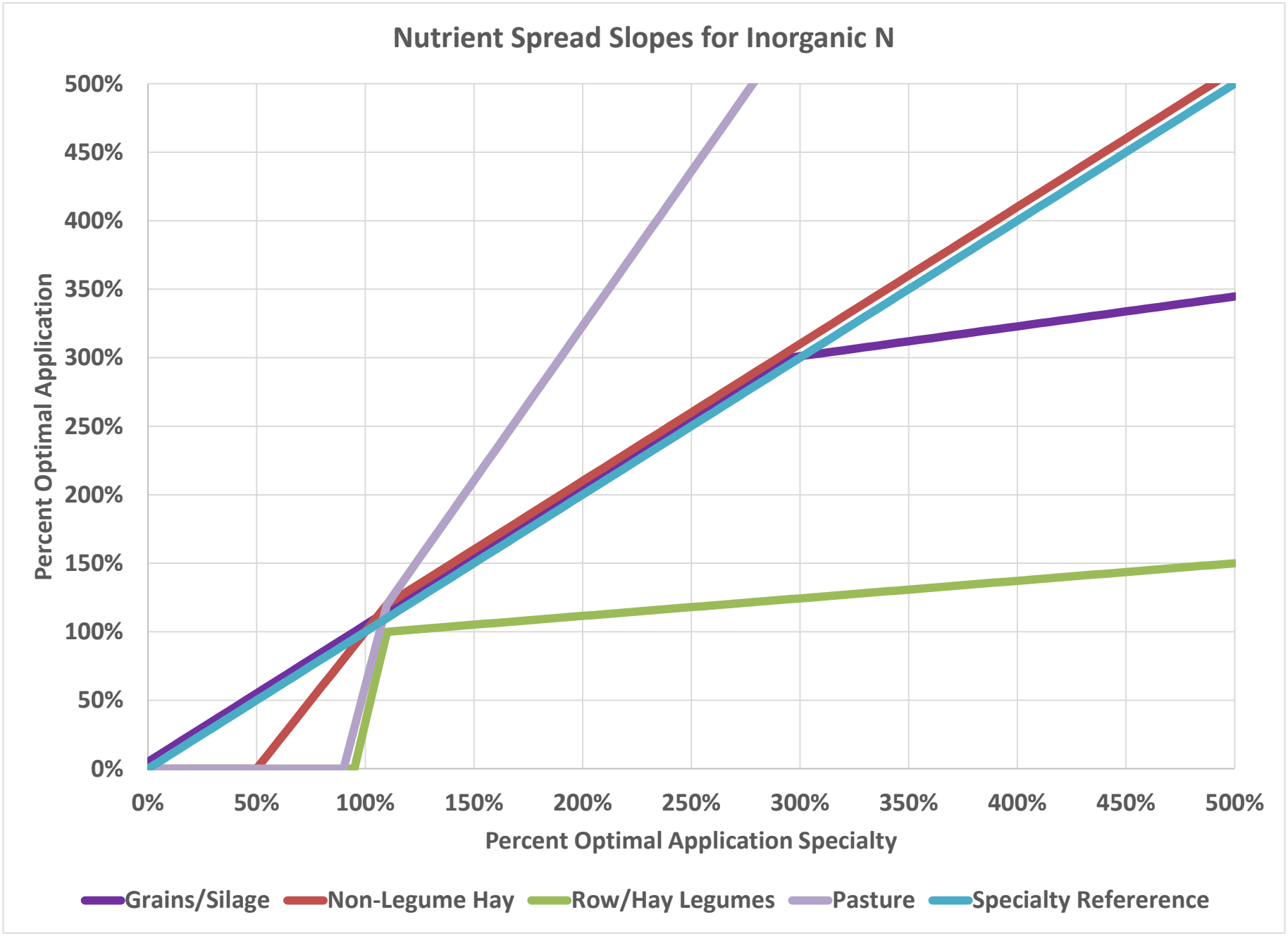
Acres of Manure Eligibility

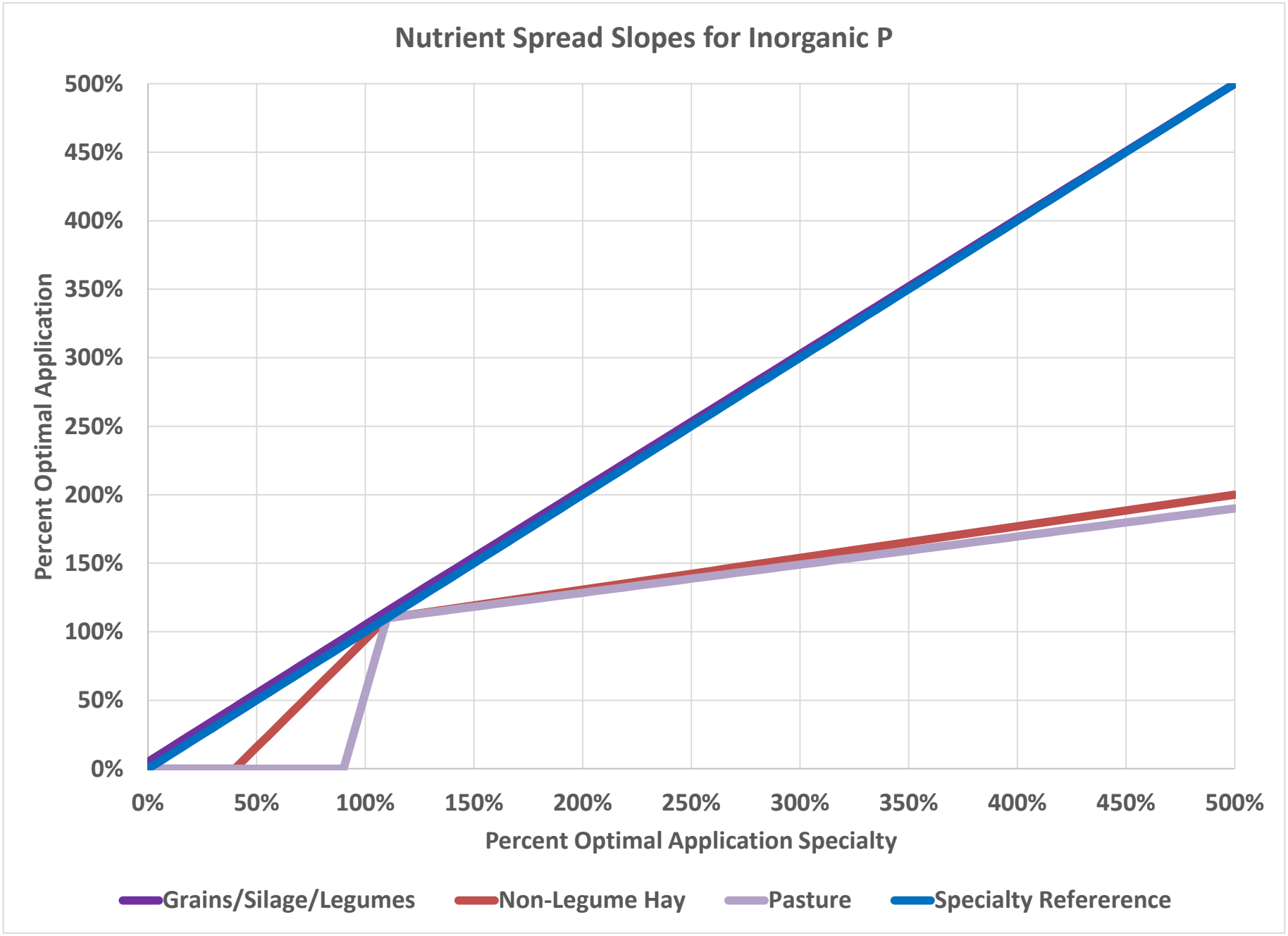
- Grain with Manure and Silage with Manure are two land uses that are created by multiplying their constituent crops by a manure fraction found in the Ag Census for that county.
- **Manure Fraction = Acres Receiving Manure/ (Harvested Cropland Acres + Pasture Acres – Soybeans Harvested Acres)**
- Values are only available for 2007 and 2012.
- The 2007 value is assumed to be constant back to 1985.
- Future values are assumed to be constant with 2012 until a new Ag Census is released.
- Estimation manured acreage compared well with data reported in Maryland AIR reports for selected counties
- Where available, state supplied data could replace estimated acreage

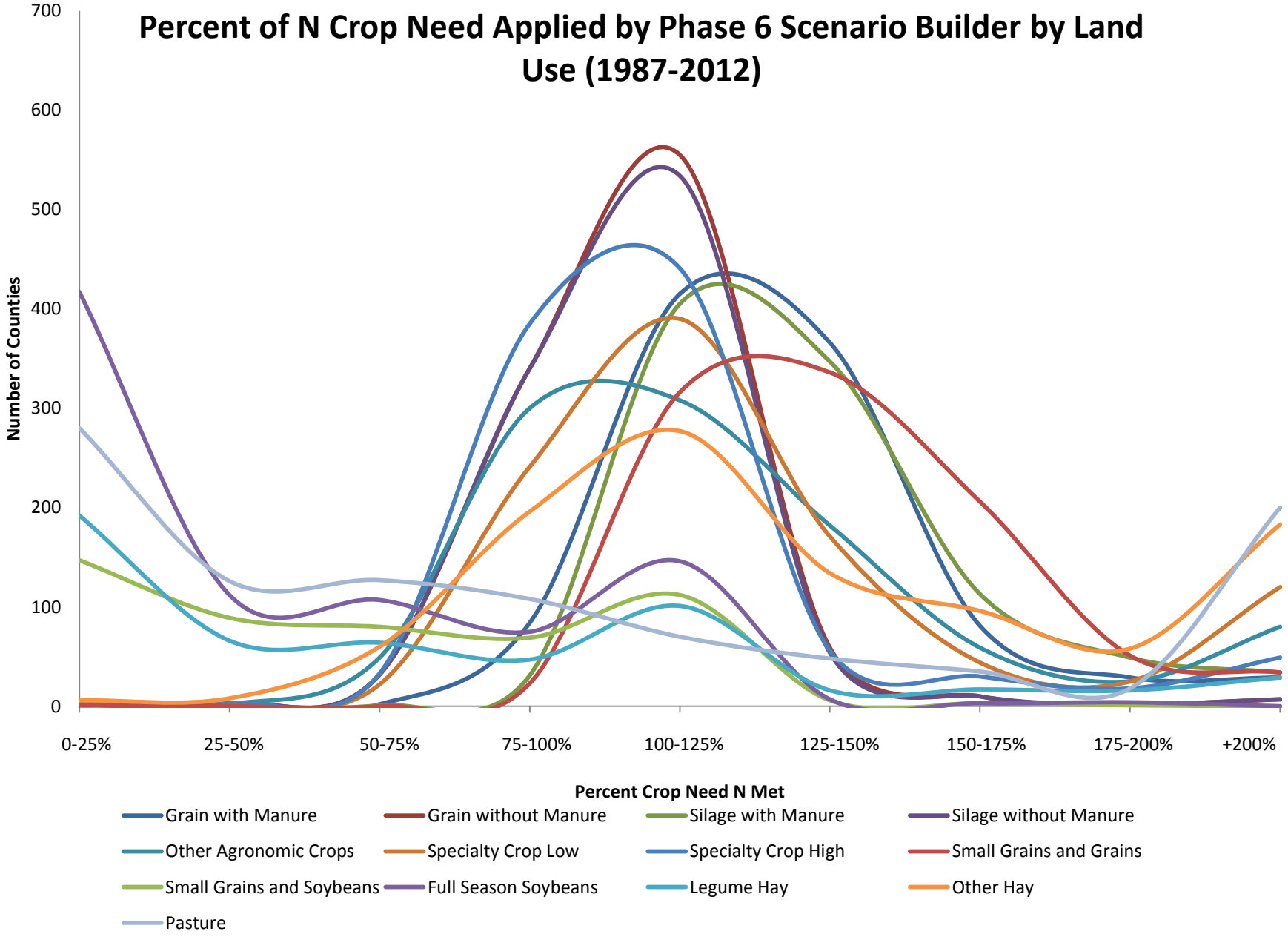
Nutrient spread procedure

- First priority is manure application to corn
- Hay and pasture only being receiving N when corn and small grain requirement is nearly fulfilled
- Application above crop requirement if county has excess nutrients (manure transport accounted for later)


Nutrient Spread Slopes for Manure N
Percent Optimal Application
500%
450%
400%
350%
300%
250%
200%
150%
100%
50%
0%
0%
50%
100%
150%
200%
250%
300%
350%
400%
450%
500%
Percent Optimal Application Specialty
Grains/Silage
Non-Legume Hay
Row/Hay Legumes
Pasture
Specialty Refererence


Nutrient Spread Slopes for Inorganic N
Percent Optimal Application
500%
450%
400%
350%
300%
250%
200%
150%
100%
50%
0%
0%
50%
100%
150%
200%
250%
300%
350%
400%
450%
500%
Percent Optimal Application Specialty
Grains/Silage
Non-Legume Hay
Row/Hay Legumes
Pasture
Specialty Refererence


Nutrient Spread Slopes for Inorganic P
Percent Optimal Application
500%
450%
400%
350%
300%
250%
200%
150%
100%
50%
0%
0%
50%
100%
150%
200%
250%
300%
350%
400%
450%
500%
Percent Optimal Application Specialty
Grains/Silage/Legumes
Non-Legume Hay
Pasture
Specialty Refererence


Percent of N Crop Need Applied by Phase 6 Scenario Builder by Land Use (1987-2012)
Number of Counties
700
600
500
400
300
200
100
0
0-25%
25-50%
50-75%
75-100%
100-125%
125-150%
150-175%
175-200%
+200%
Percent Crop Need N Met
Grain with Manure
Grain without Manure
Silage with Manure
Silage without Manure
Other Agronomic Crops
Specialty Crop Low
Specialty Crop High
Small Grains and Grains
Small Grains and Soybeans
Full Season Soybeans
Legume Hay
Other Hay
Pasture