Crop Yields in CAST

8/11/2023

What is the goal?

Best method of simulating nutrient applications

Requires us to know:

- Yield trends over time
- How a farmer views yields in relation to nutrient applications

Why do we need Crop Yields?

Fertilizer applications are influenced by the expected yield

Average yields drive long term loads

Annual yields help with the Dynamic Model

How do yields relate to nutrient applications?

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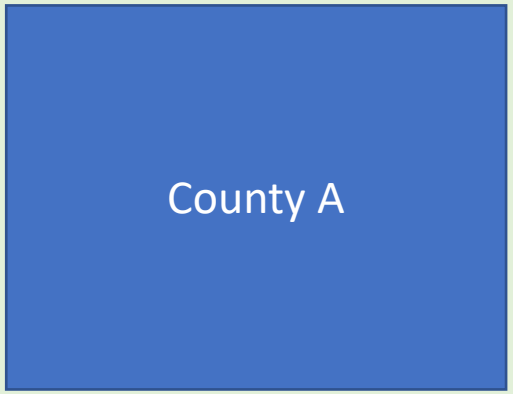

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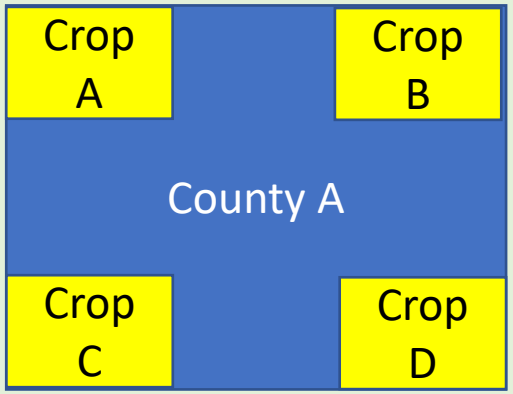

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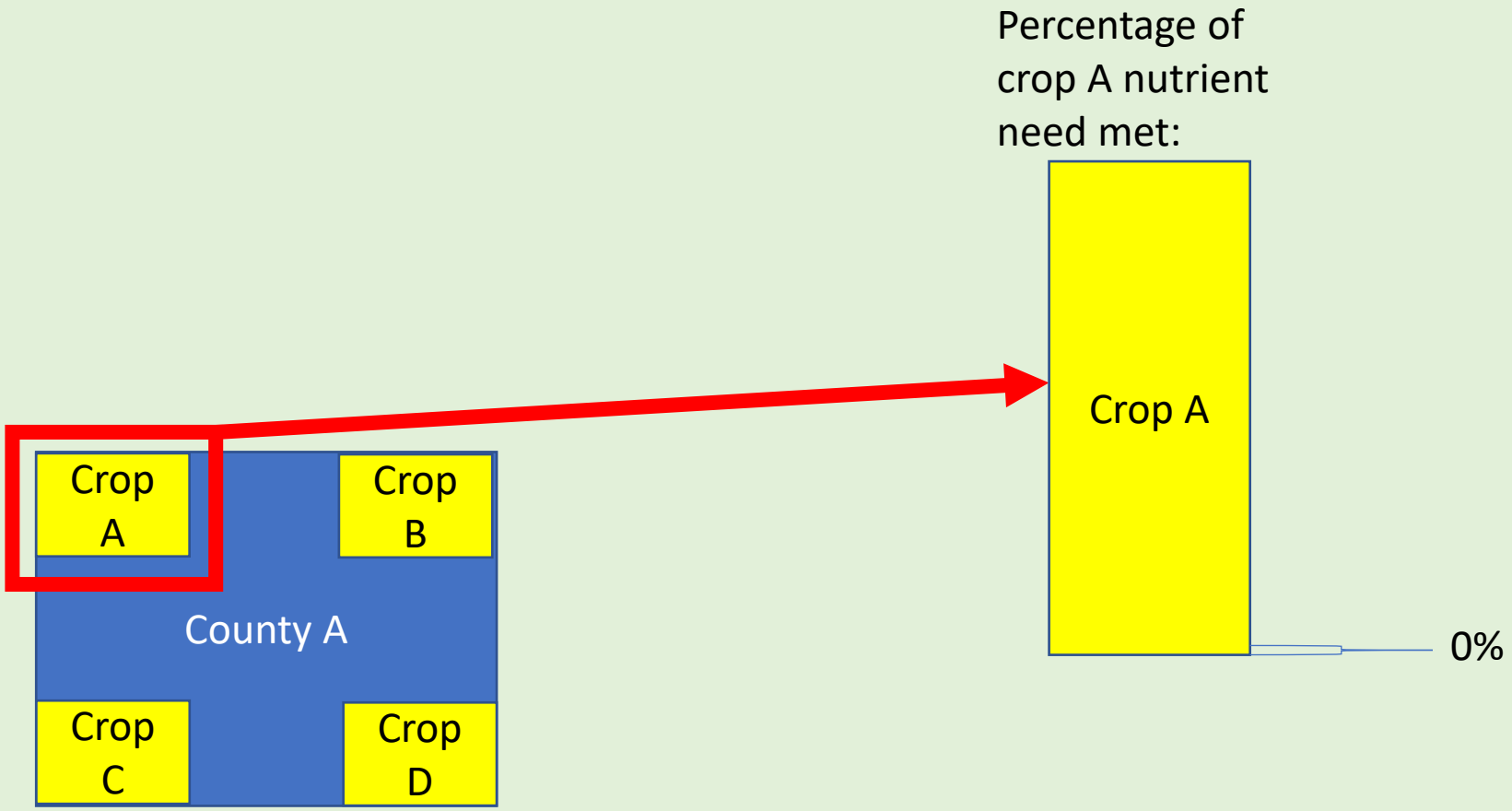
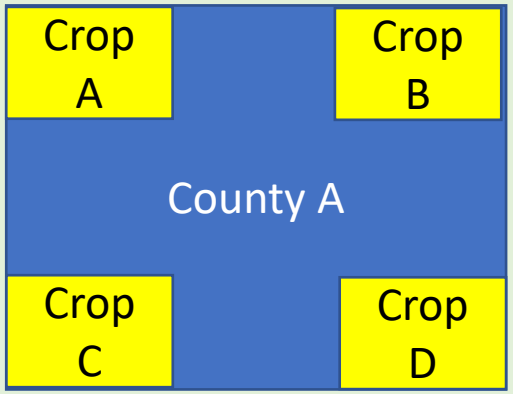
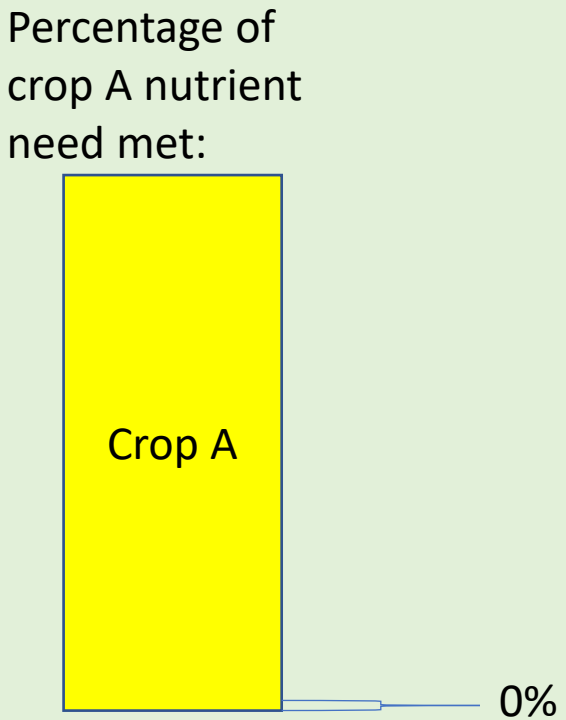


Nutrient application visualization

County A organic nutrient stock (biosolids, manure)





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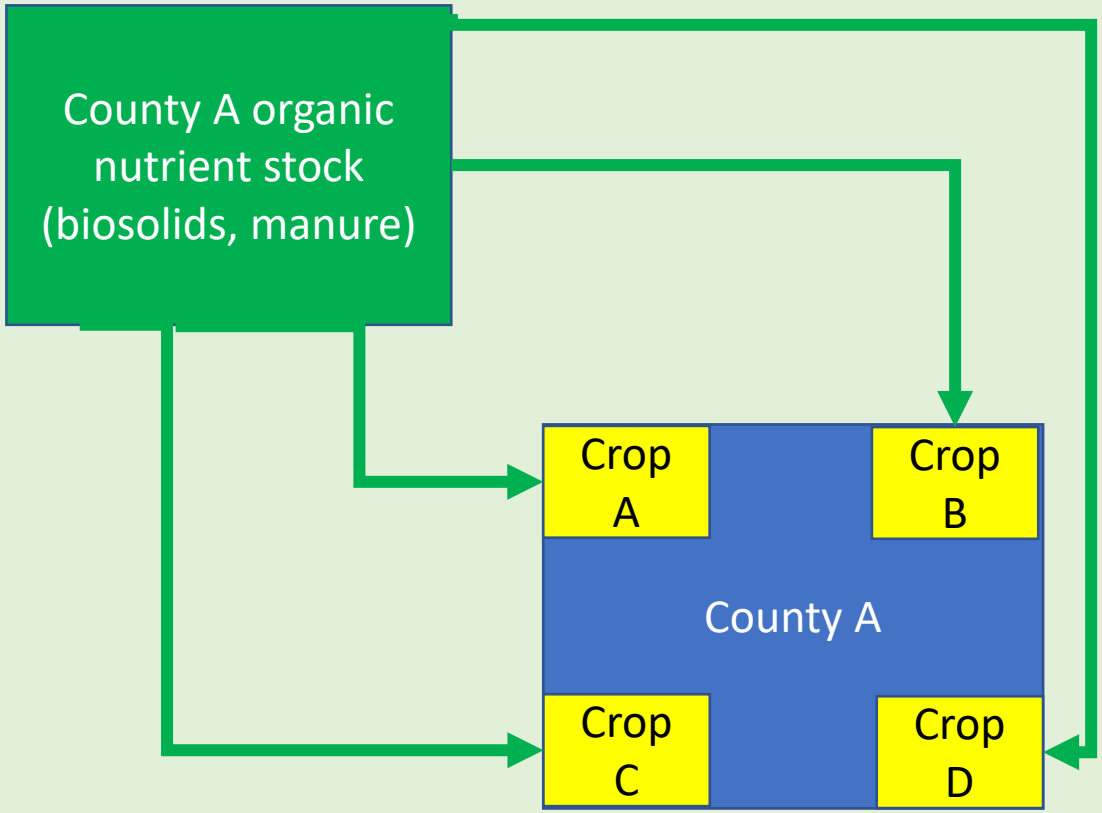

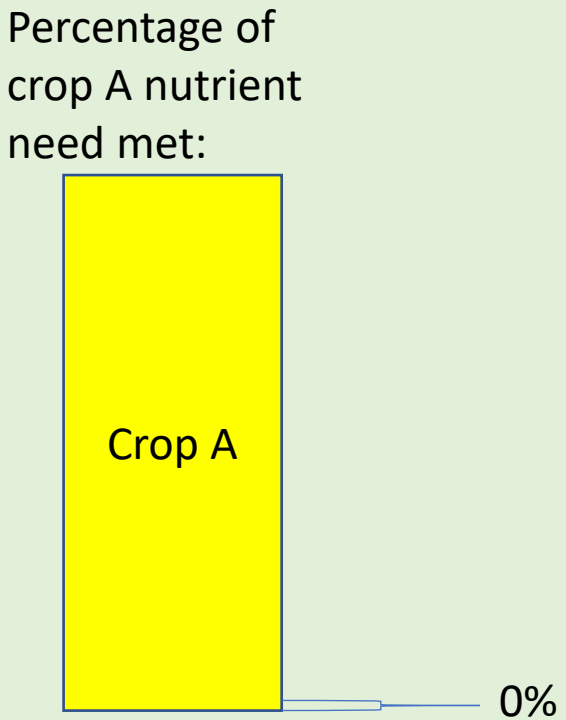

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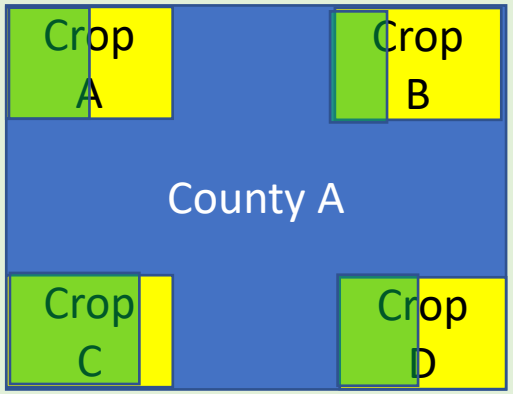
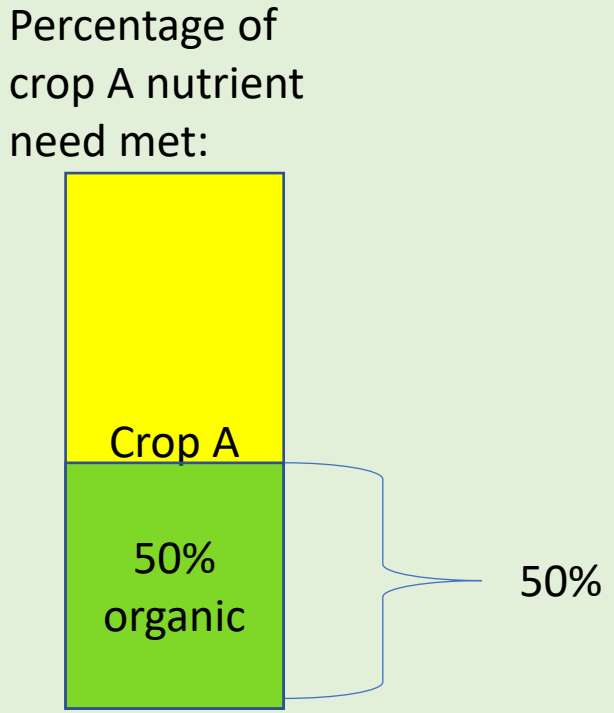
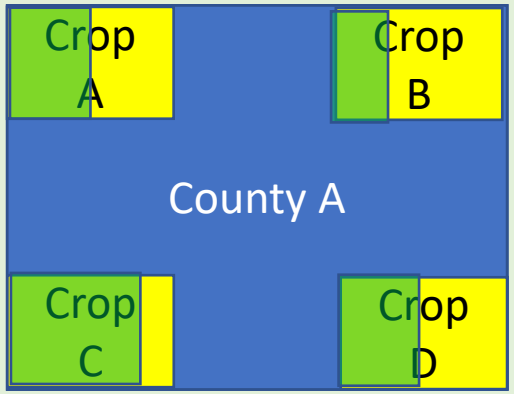


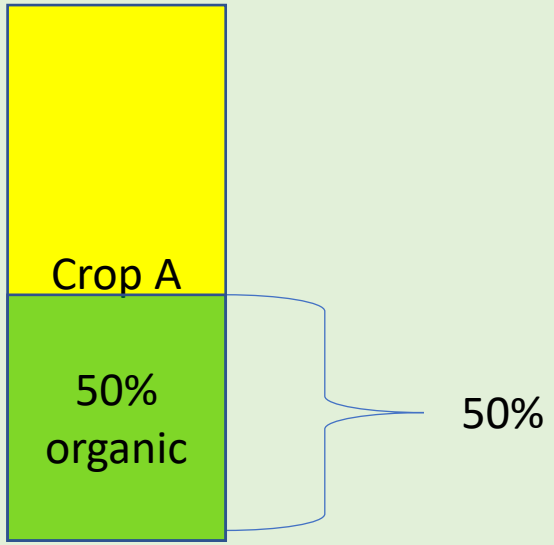


Nutrient application visualization

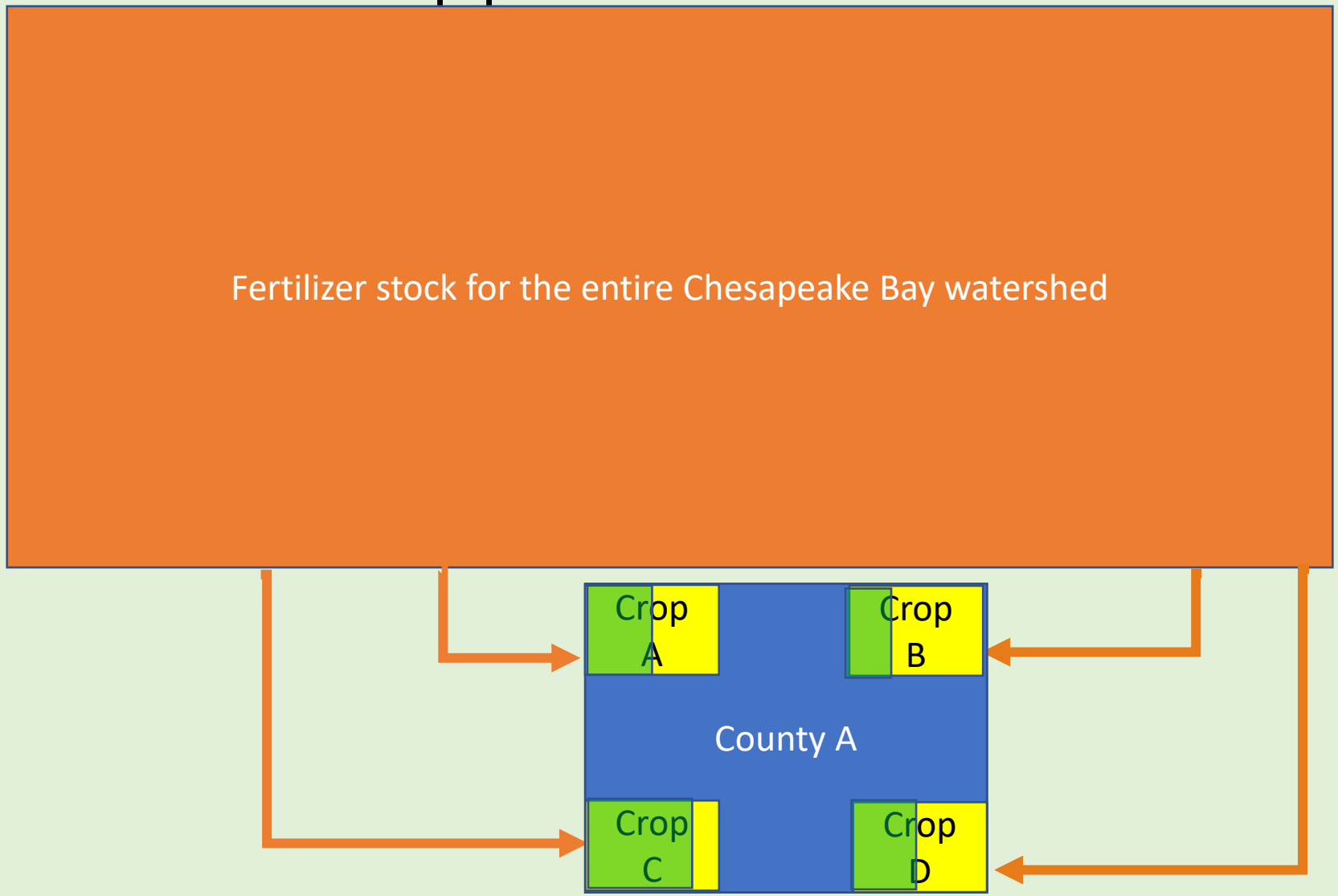
Fertilizer stock for the entire Chesapeake Bay watershed



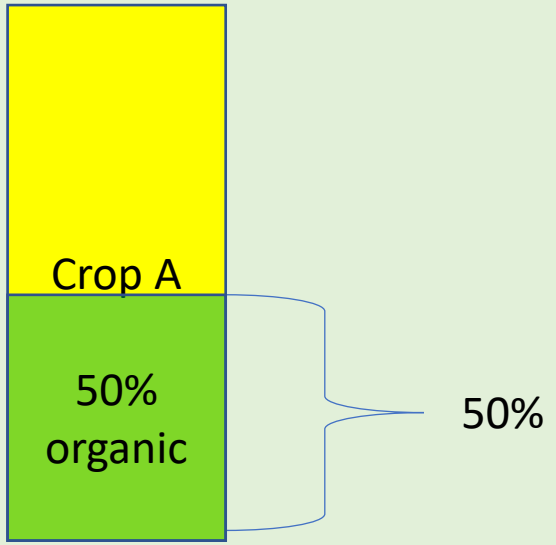
Percentage of crop need met:



Nutrient application visualization

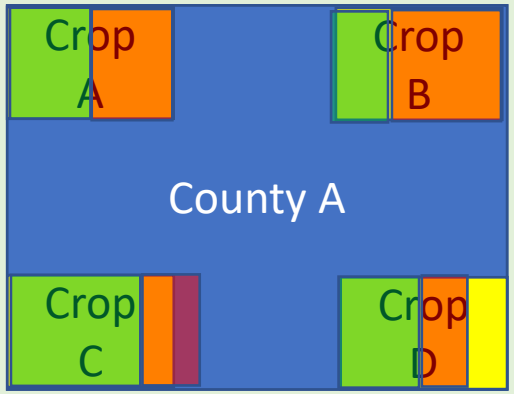


Percentage of crop A nutrient need met:



Nutrient application visualization

- This calculation can only be done when we have actual fertilizer data
- Provides an application ratio of crop need (organic nutrients to inorganic nutrients (50/50))
- This ratio is used to apply nutrients for all subsequent years
- Varying yields impact applications



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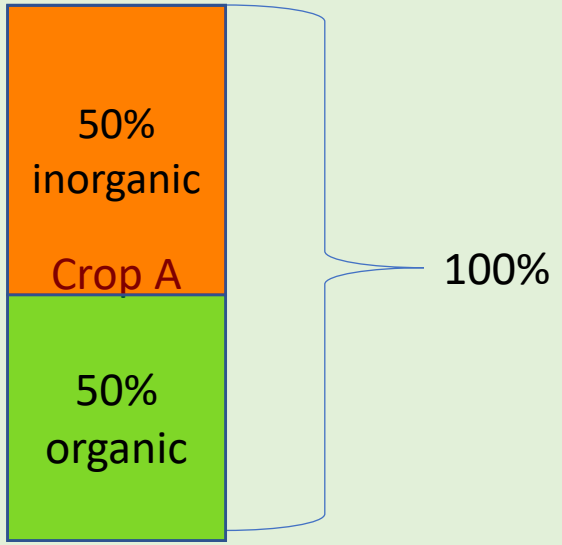
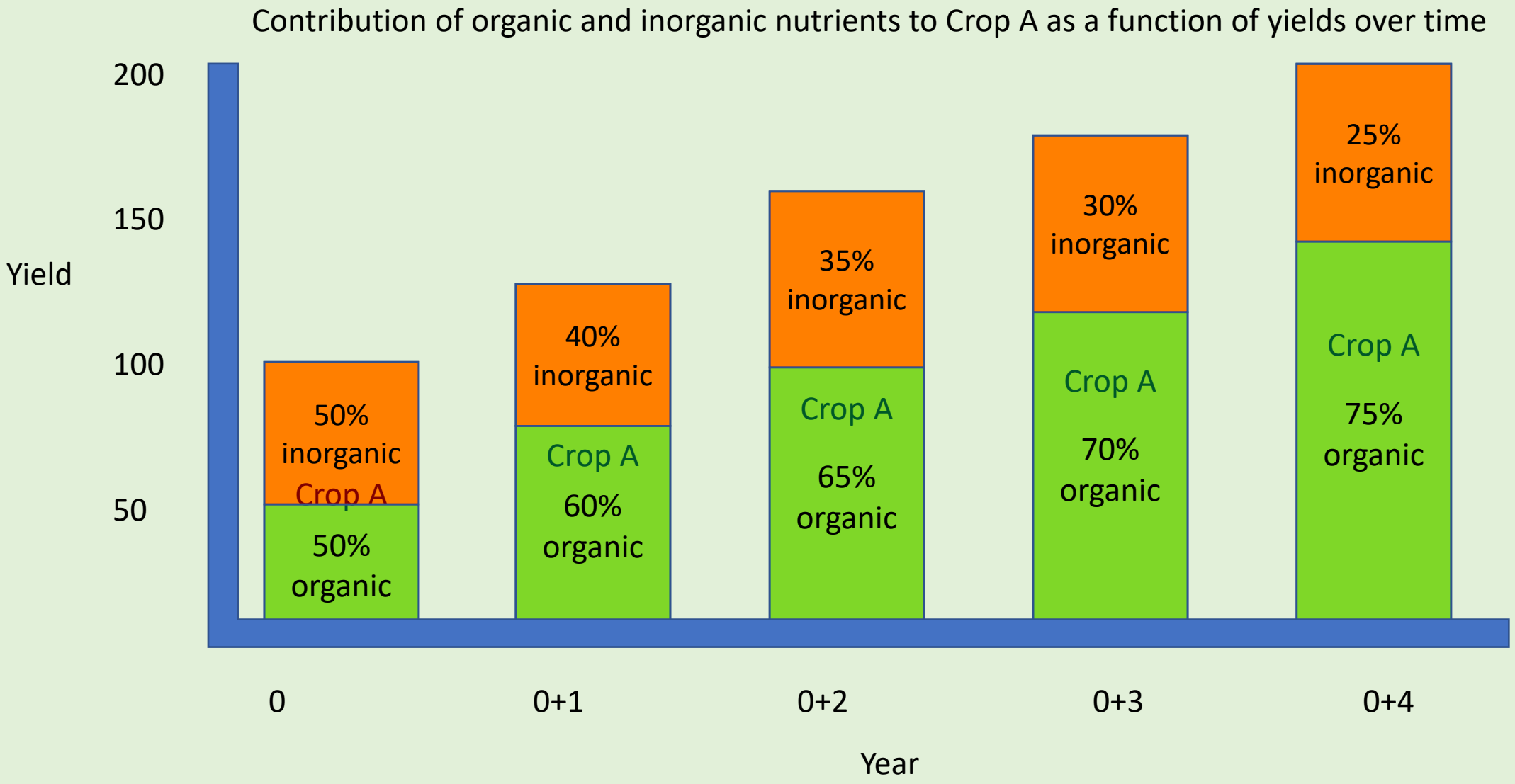


Applications and crop yield data example: 100% of crop need is met



- ALL meet 100% of crop need.
- Percentage of organic and inorganic can vary

What are the foundational Yield data?

Census of Agriculture	•Every Five years •11 crops
Annual Surveys	•Every year •7 crops

What Yield data are used in CAST?

Annual Surveys

- corn for grain
- soybeans for beans
- barley for grain
- alfalfa hay
- corn for silage or greenchop
- wheat for grain
- oats for grain

Ag census

- alfalfa hay
- barley for grain
- buckwheat
- corn for grain
- corn for silage or greenchop
- oats for grain
- rye for grain
- sorghum for grain
- sorghum for silage or greenchop
- soybeans for beans
- wheat for grain

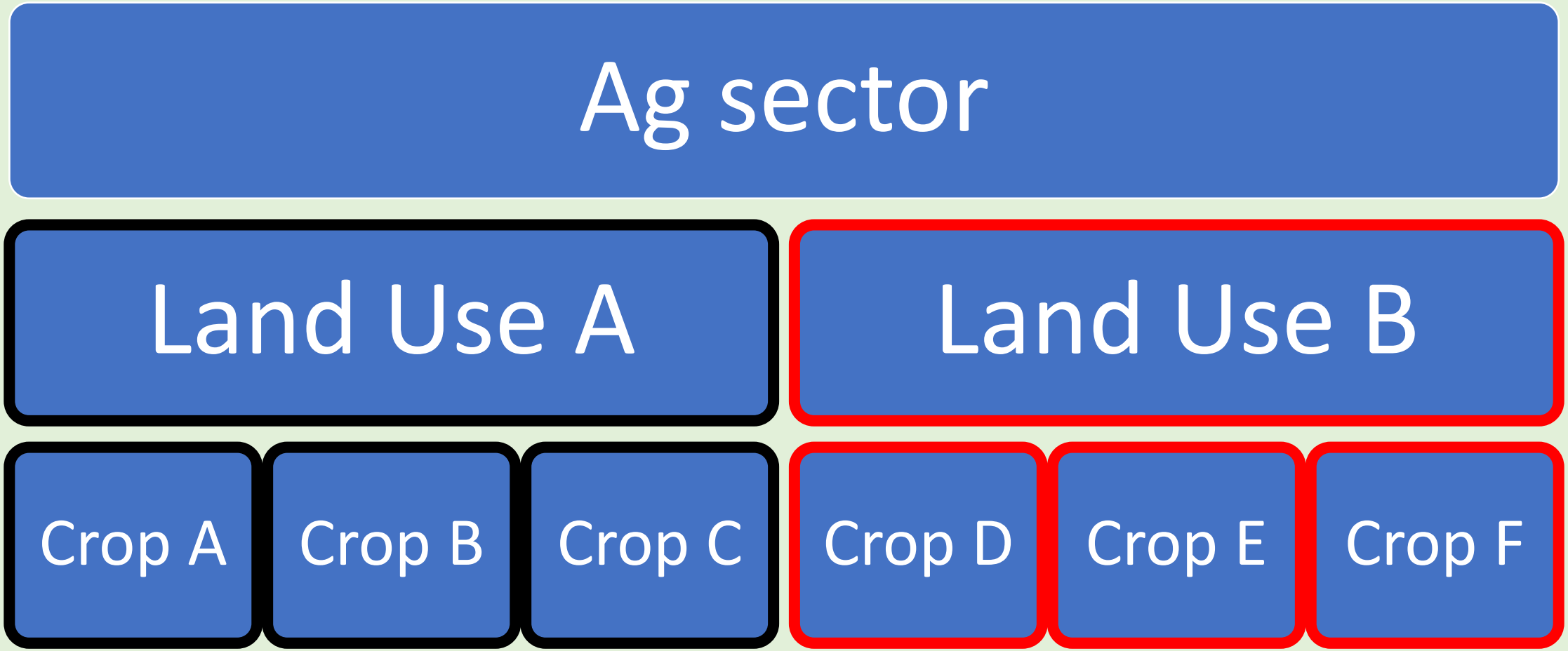
NOTE* annual survey coverage is based on crops reported to all states

How are these data used in CAST?

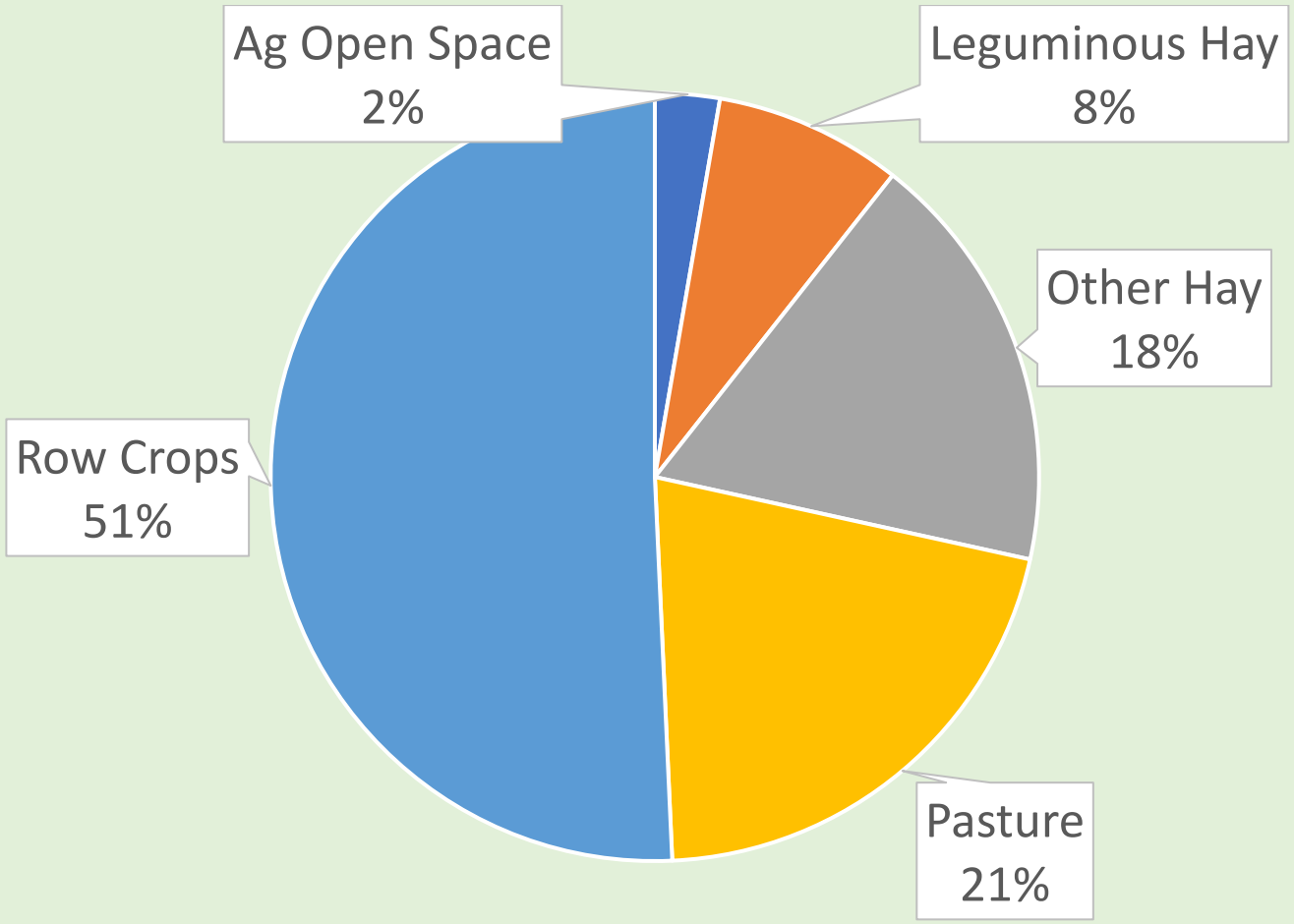
- Yields draw nutrient applications
- Two ways of applying nutrients lbs/acre or lbs/yield unit

Unit	Number of crops in CAST	Application method	% of Crop Acres Covered	% of Plant Available N	Update process
Acres (constant)	90	Application per acre	56	27	Process with the Land Use Workgroup
Yield (variable)	11	Application per yield unit	44	73	NASS data (Bushels, tons, etc.)

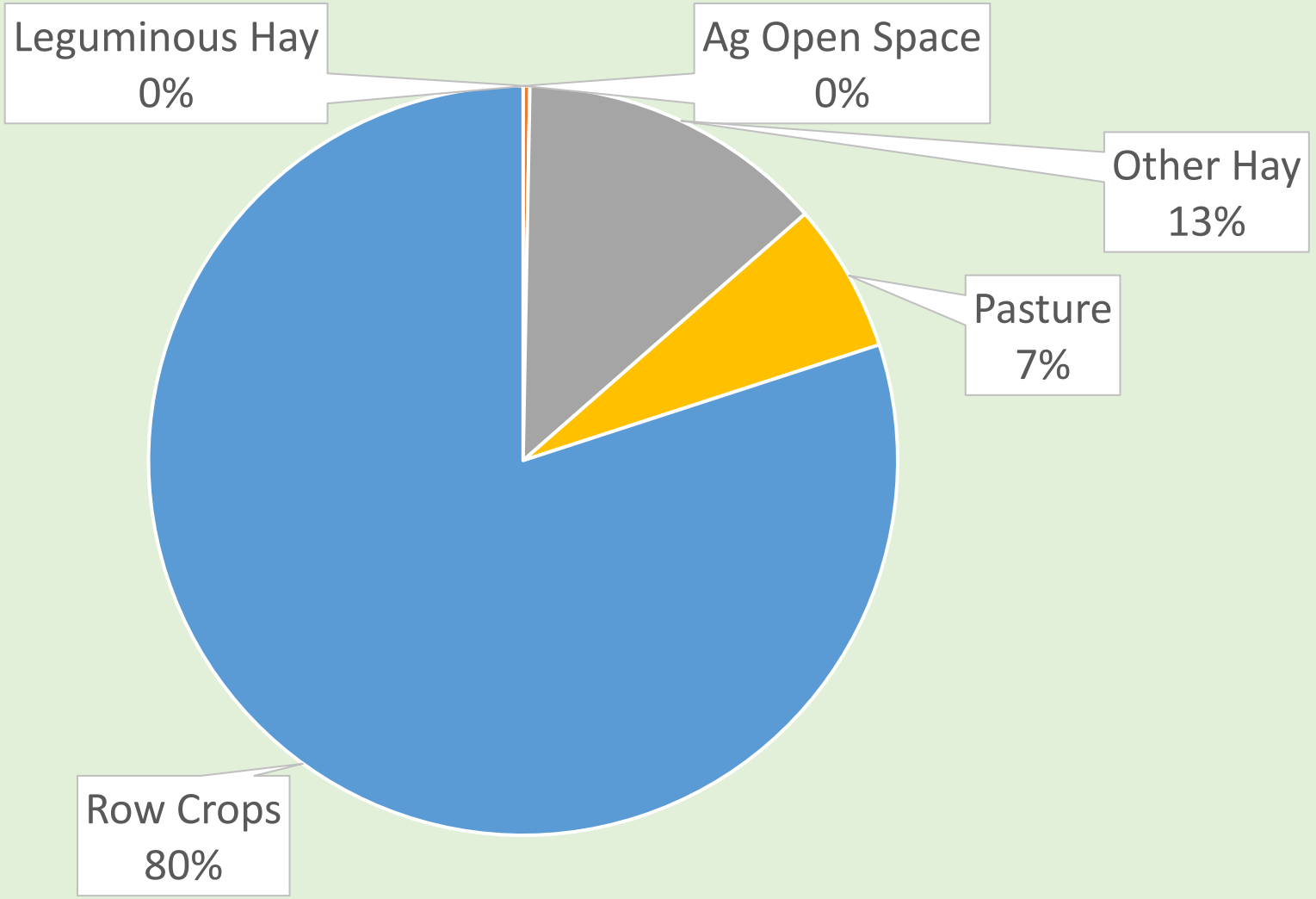
How do we currently look at Yields in CAST?



Contribution of each Land use to total crop acres



Contribution of each Land use to Plant Available N



A quick note on pasture

We do not have yield unit data

Per acre applications are prescribed

- 15lbs/acre – N
- 4 lbs/acre - P
- Already below NM application rate (no additional credit)

A deeper dive into these Yields

Calculated the percentage of

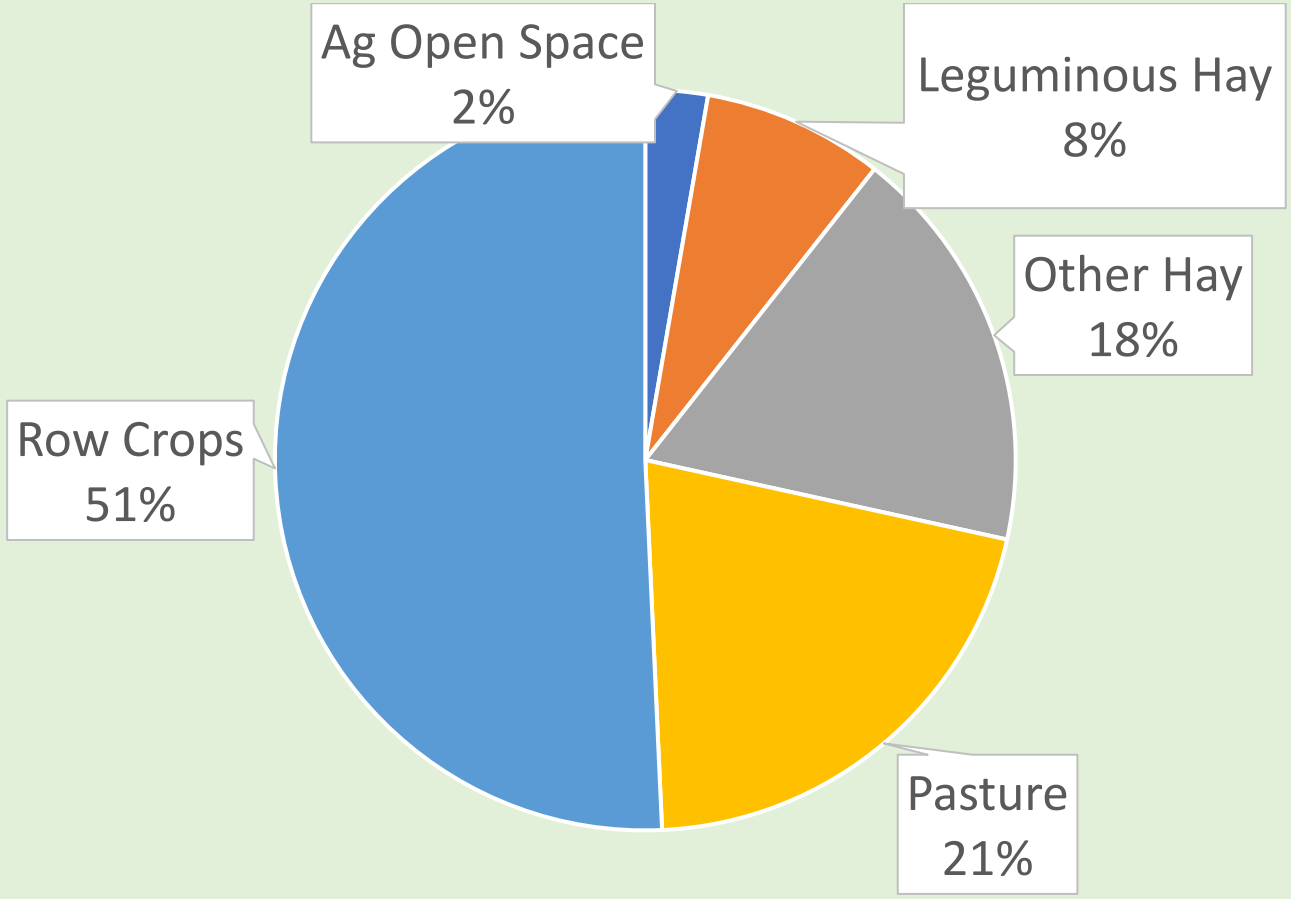
- Plant Available Nitrogen
- Cropland Acres

Land uses

Based on our current crops with yield units

Ag Land use contributions to agriculture acres

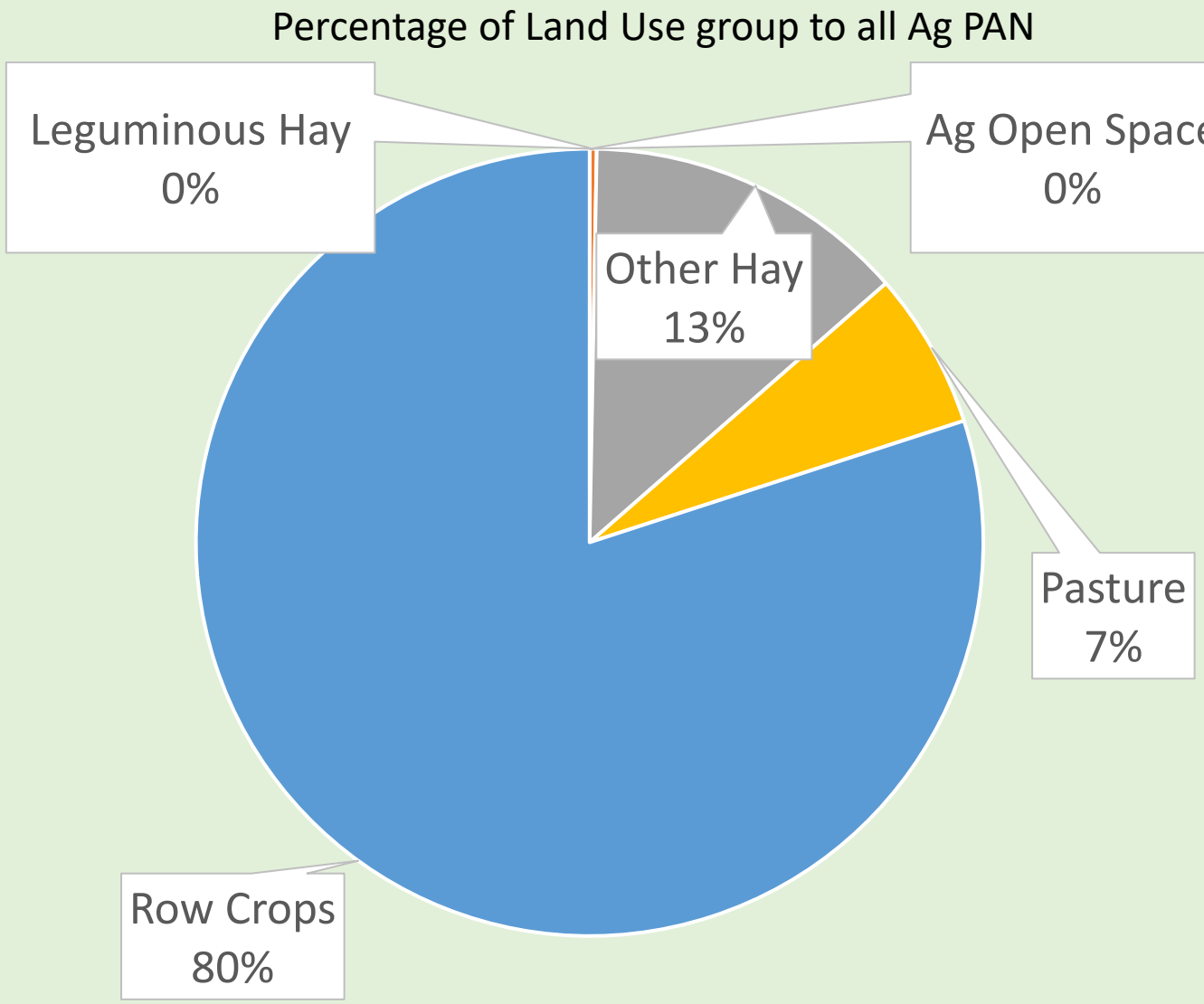
Percentage of Land Use group for all ag acres



Fraction of ag acres the current 11 crops with yield units contribute to each land use

Land Use	Fraction of Acres
Row Crops	78%
Leguminous Ha	55%
Other Hay	0%
Pasture	0%
Ag Open Space	0%

Plant Available Nitrogen (PAN) contribution to agriculture



Fraction of ag acres the current 11 crops with yield units contribute to each land use

Land Use	Fraction of PAN
Row Crops	91%
Leguminous Hay	98%
Other Hay	0%
Pasture	0%
Ag Open Space	0%

Things to think about?

- We have crops that have applications determined in two ways
- What is the best way to apply nutrients?
- Are we currently missing crops with yield data?
- If we apply based on yields, how do we get the yield a farmer would base their applications on?

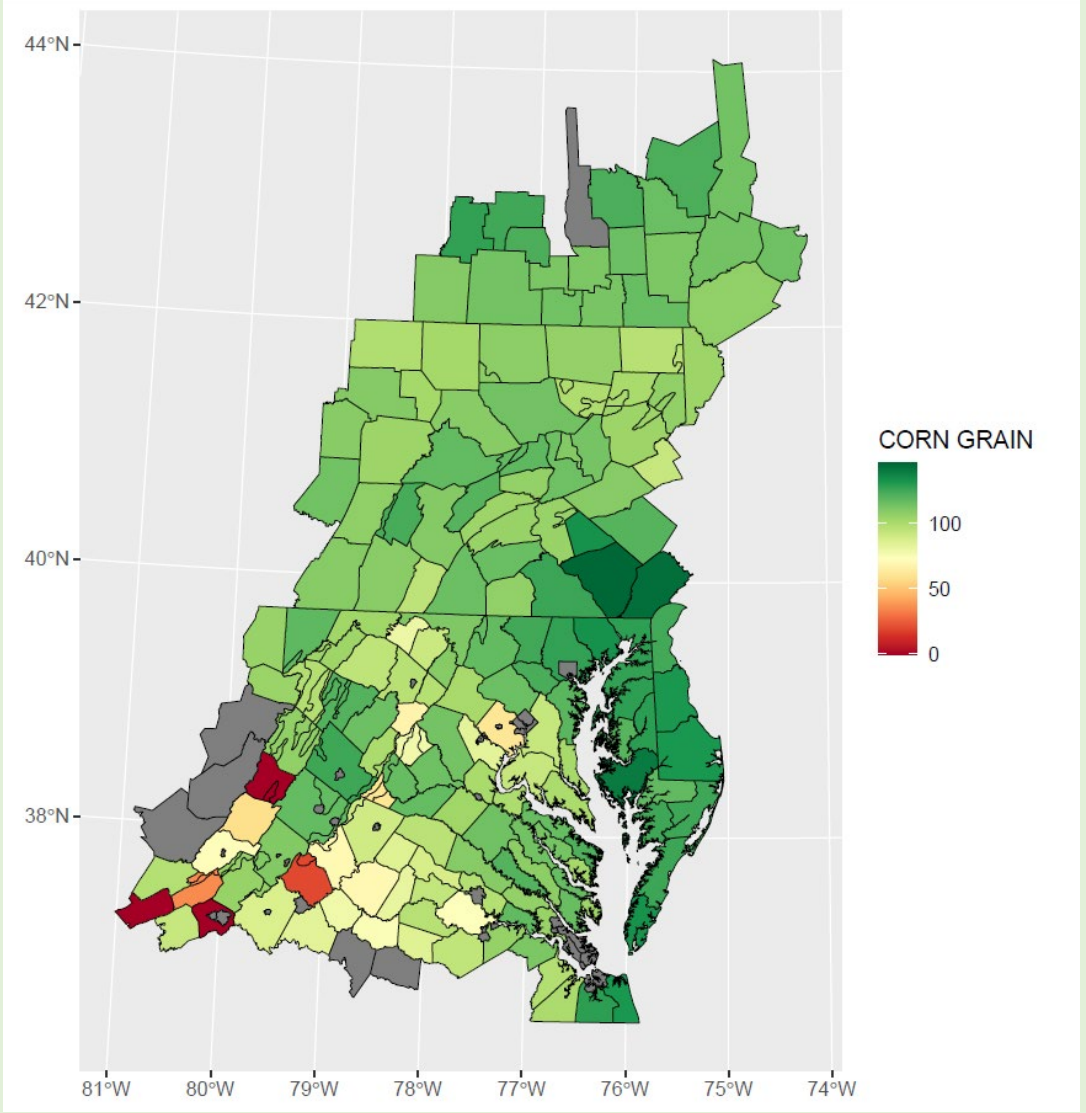
One possible way to improve yield trends:

Statistical framework

- CAST is looking at long term average change
- We have good coverage of the major crops now
- We want to better predict how yields change across time
- This can be expanded to account for smaller crops with less data

Statistical framework

- Fill in gaps
- Utilize surrounding data
- Multiple data streams
  - NASS data
  - Soil maps
  - Precipitation
- Improve yield trends over time



Questions?

Discussion Questions

- What is the best way to simulate nutrient applications?
  - Lbs per Yield unit?
    - Corn for Grain
  - Lbs per Acre?
    - Other Hay
- What is the best way to way to simulate nutrient applications with the acre - only yields?
  - Prescribed applications by acre?
    - Pasture
  - Yield data from alternate sources?
    - Industry
  - Yields from other regions?
- How do we simulate farmer behavior for nutrient applications based on yield units?
- How might a statistical framework improve yield trends?
  - Spatial relations
  - Multiple data streams
    - Precipitation
    - Soil maps

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Nutrient management and Applications example: 120% of crop need

Contribution of organic and inorganic nutrients to Crop A as a function of nutrient management implementation over time