CAST: a county-scale example of agricultural nutrient calculations

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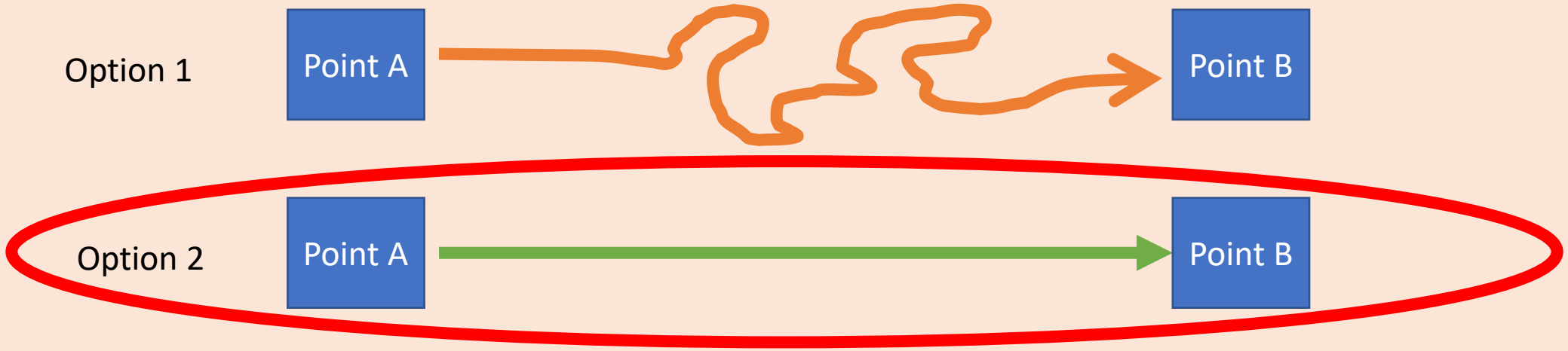
Outline

- Refresh CAST
- What are we doing with CAST?
- Understanding CAST with county data

What Is CAST?

- Keep It Simple Silly
  - Human change to loads
  - Aim to get the end loads right



What is CAST?

Phase 7 CAST Structure

(Average Load +Δ Inputs * Sensitivity)

*

Land Use Acres

*

BMPs

*

Land to Water

Direct Loads

*

Stream to Bay

Delivered N or P Load for a Load Source Within a Segment

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Delivered N or P Load for a Load Source Within a Segment

Understanding CAST data

Average load	• average loading rate from the watershed across a multi-year period
Change in input	• difference between local and watershed average values
Sensitivity	• Modeling WG sets the change in export for change in applications

What does inputs refer to?

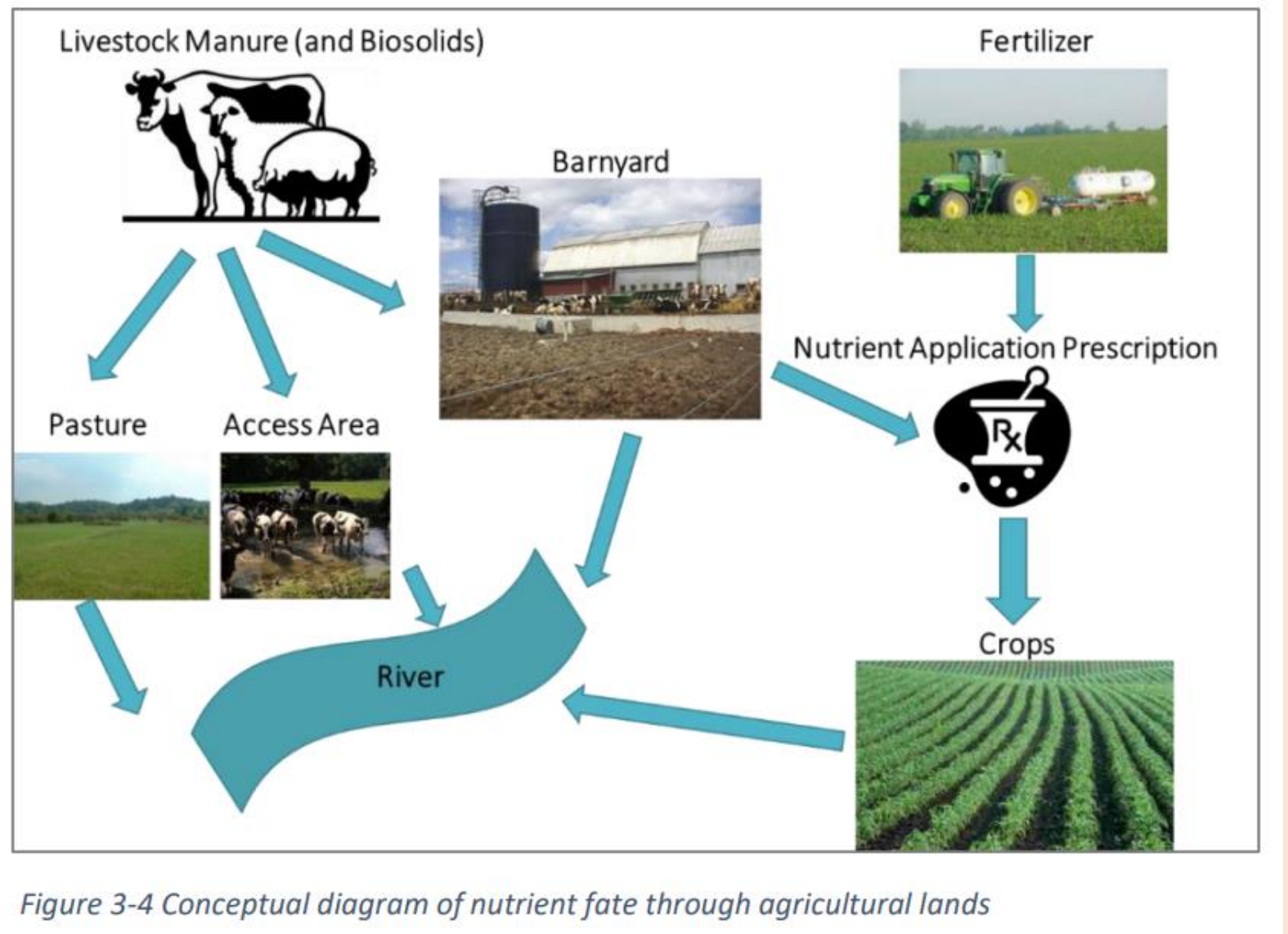
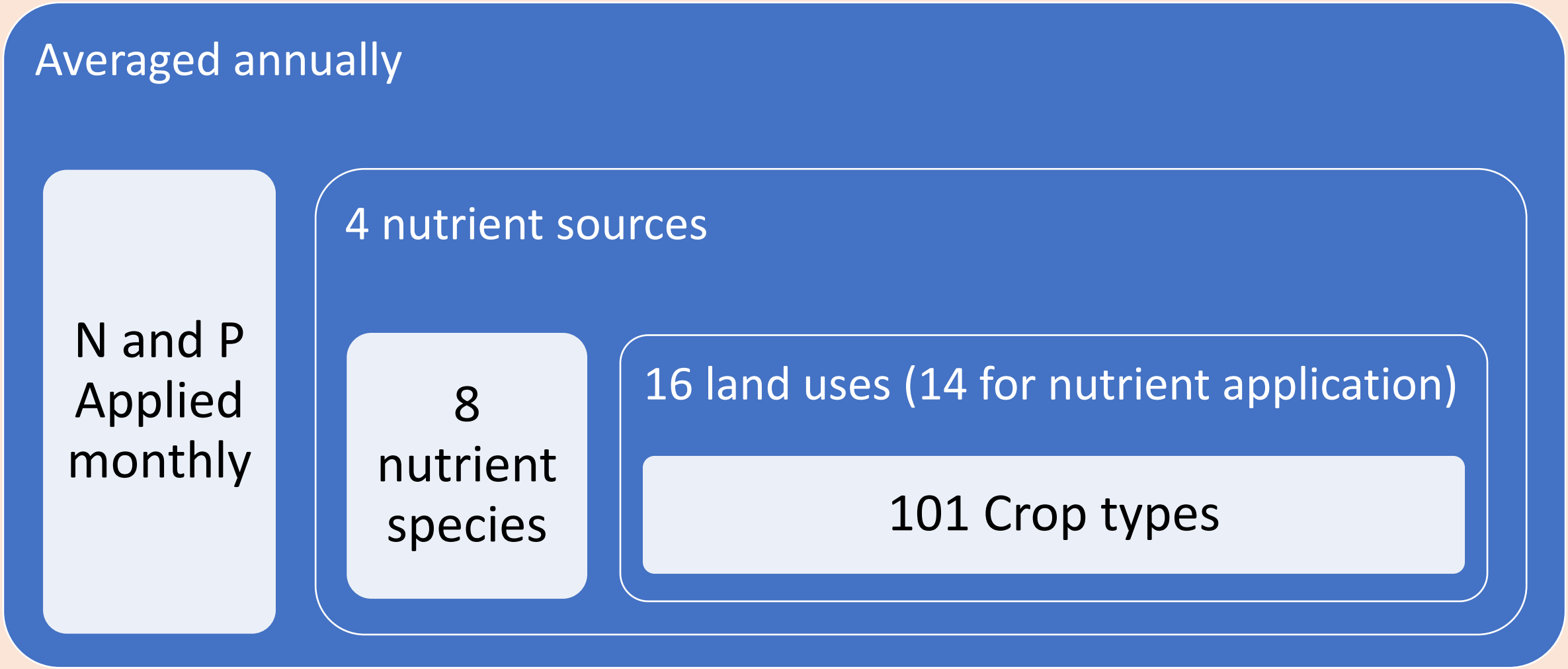


Figure 3-4 Conceptual diagram of nutrient fate through agricultural lands

CAST: A story of combinations



Project recap

What are we doing?

- Updating the agricultural input data

How are we doing this?

- Understanding the Chesapeake Assessment Scenario Tool (CAST)

Understanding CAST

County level walk-through

- Examine nutrients applied from CAST
- Most ag inputs are currently at this scale
- Find different “types” of counties

What different types of counties?

County type	Description
Organic nutrient dominated	mostly manure application
Mixed source	mixed manure and inorganic fertilizer applications
Inorganic nutrient dominated	primarily inorganic fertilizer application

Process to find county types

1. Go to CAST website
2. Download Nutrients applied report
3. Select relevant nutrients applied
4. Calculate ratios of manure vs inorganic fertilizer application
5. Select counties

Nutrients applied report

NUTRIENTS APPLIED	
Scenario Name	Name of the scenario
FIPS	Federal Information Processing Standard numeric code used to distinguish counties
CountyName	County name
StateAbbreviation	State or jurisdiction abbreviation
Sector	Source sector
LoadSource	Long name for modeled load source
Acres	Total acres of load source receiving these applications in a county
Ncrop Application Goal	Nitrogen crop application goal indicates the amount of nitrogen a crop needs under typical conditions for average yields
ManureNLbsApplied	The manure nitrogen pounds applied
BiosolidsNLbsApplied	The biosolid nitrogen pounds applied
FertilizerNLbsApplied	The fertilizer pounds applied to agricultural land
DirectDepositManureNLbsApplied	The manure nitrogen pounds applied from direct excretion by pastured animals
UrbanFertilizerNLbsApplied	The fertilizer nitrogen pounds applied on developed turf grass
TotalNApplication	The total nitrogen applied from manure, biosolids, direct excretion and urban fertilizer
TotalNApplicationPerAcre	Amount of N applied per acre
TotalNApptoNCropNeed	TotalNApplication / NCropNeed
LegumeNLbsFixed	The nitrogen fixed by leguminous plants that is available for plant uptake
Pcrop application goal	Phosphorus crop application goal indicates the amount of phosphorus a crop needs under typical conditions for average yields
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Selecting relevant nutrients applied

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Selecting relevant nutrients applied

- Direct deposited manure does NOT count towards crop need!!!

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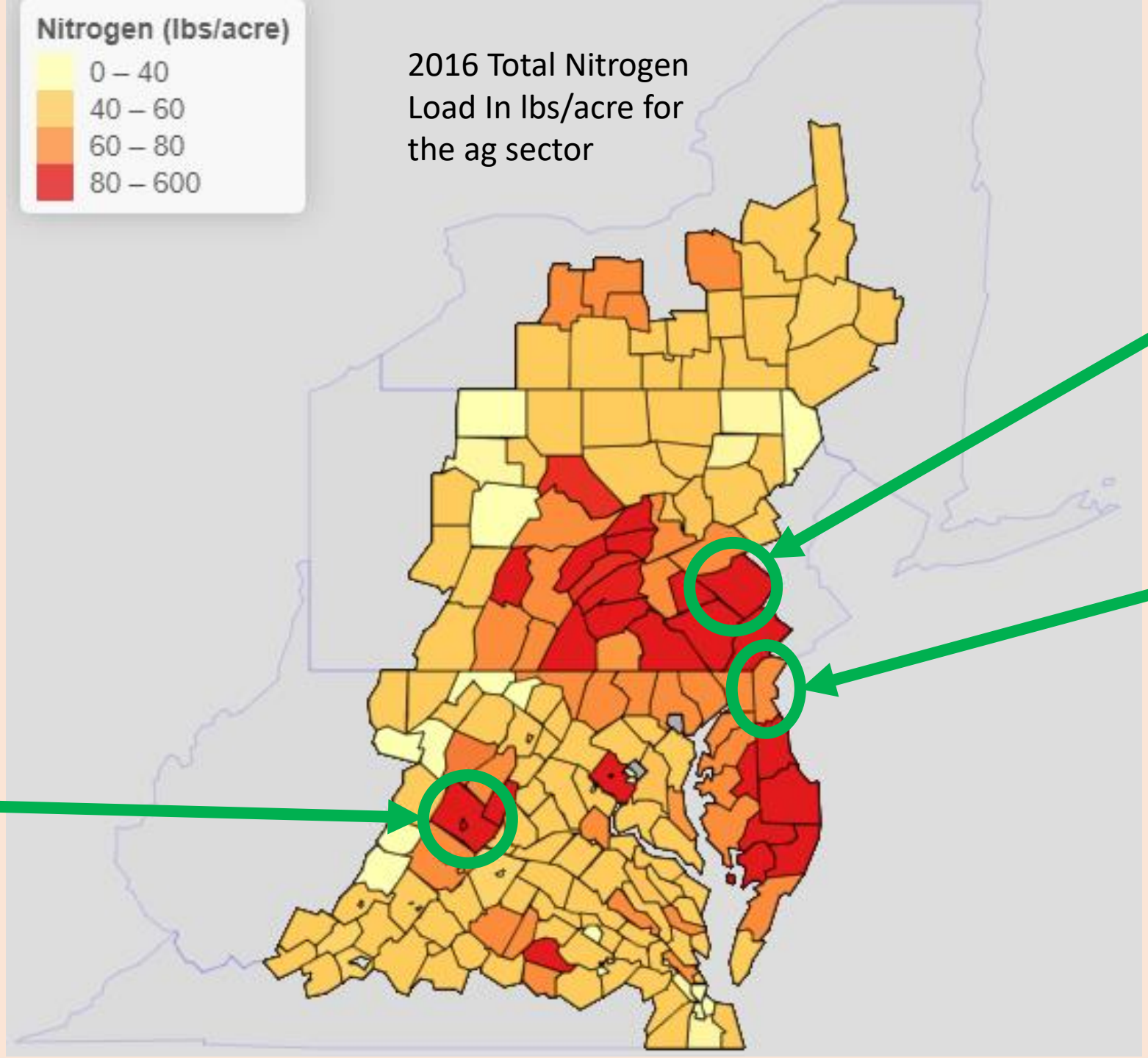
Ratios of manure vs inorganic fertilizer

- Overall applications can be higher in other counties
- Excluded municipalities
- Selected agriculturally intensive counties

Counties chosen

County type	Description	Chosen county
Organic nutrient dominated	mostly manure application	Rockingham, VA
Mixed source	mixed manure and inorganic fertilizer applications	Berks, PA
Inorganic nutrient dominated	primarily inorganic fertilizer application	New Castle, DE



2016 Total Nitrogen Load In lbs/acre for the ag sector

Berks, PA – Mixed source

New Castle, DE – Inorganic nutrient dominated

Rockingham, VA - Organic nutrient dominated

https://cast.chesapeakebay.net/Shiny/trends/nutrientapplied/

CAST run

2016

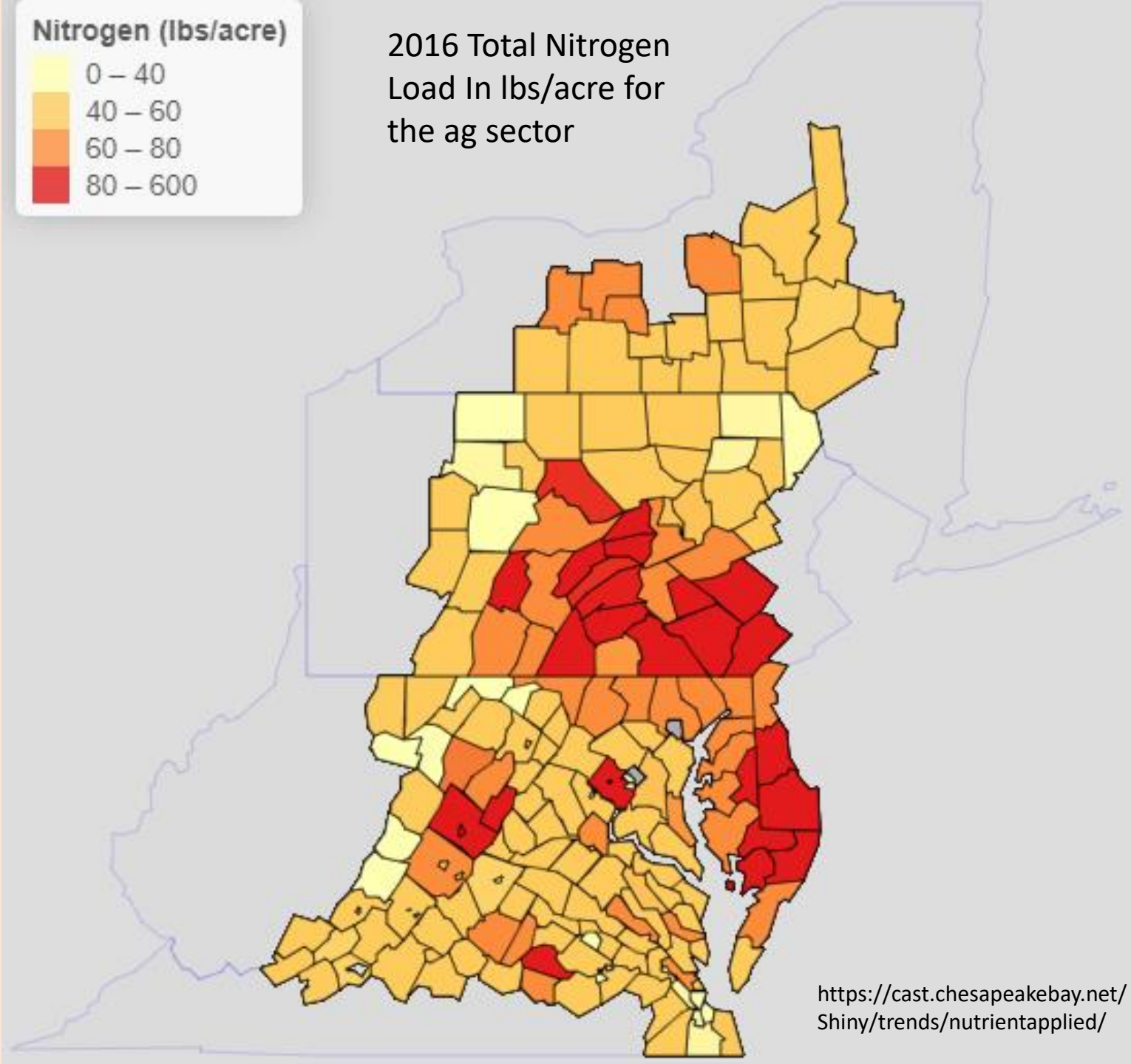
Final year of new data

Use fertilizer bucket

- Not done for each run

Calculate fraction of crop application goal met

- If application is 150% of the crop need, then 150% will be applied in later years.



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Crop need

Estimated amount of nutrient a crop requires to produce a typical crop yield

What is typical? Ask your states Land Grant!

- Typical rate = Total N in lbs / crop yield / acre

What is the actual application rate?

- Actual CAST rate = (Total N in lbs / crop yield / acre) * (NASS Crop yield / acre)

Application order

Different rates for each crop type (prioritized)

- Biosolids
- Manure
- Inorganic Fertilizer

Applications generally follow crop value

- Grains
- Pasture
- Legume

Total N applied per acre for Grain with Manure in each county vs crop need

County type	Chosen county
Organic nutrient dominated	Rockingham, VA
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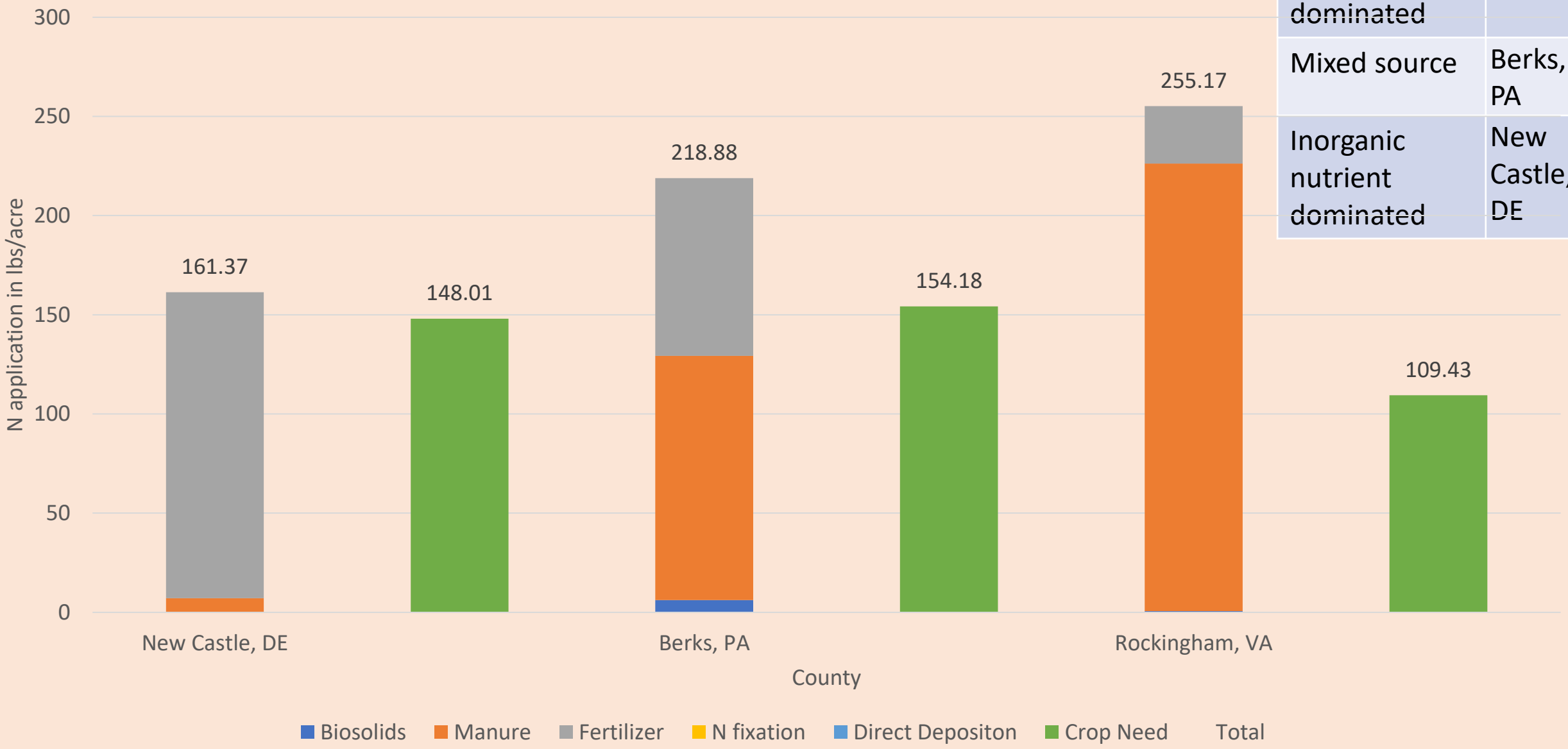
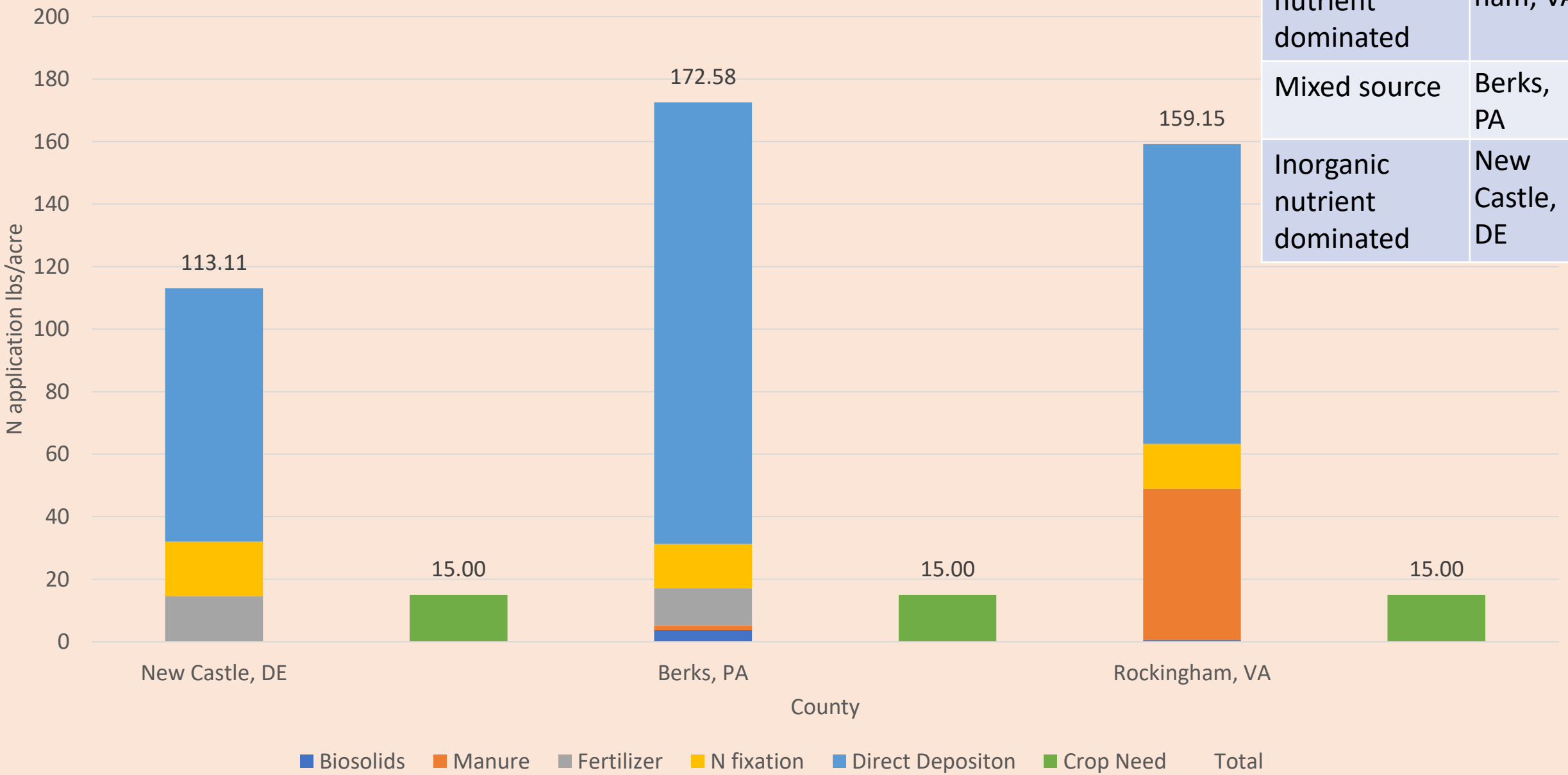


Total N applied in lbs/acre for Pasture in each county vs crop need



County type	Chosen county
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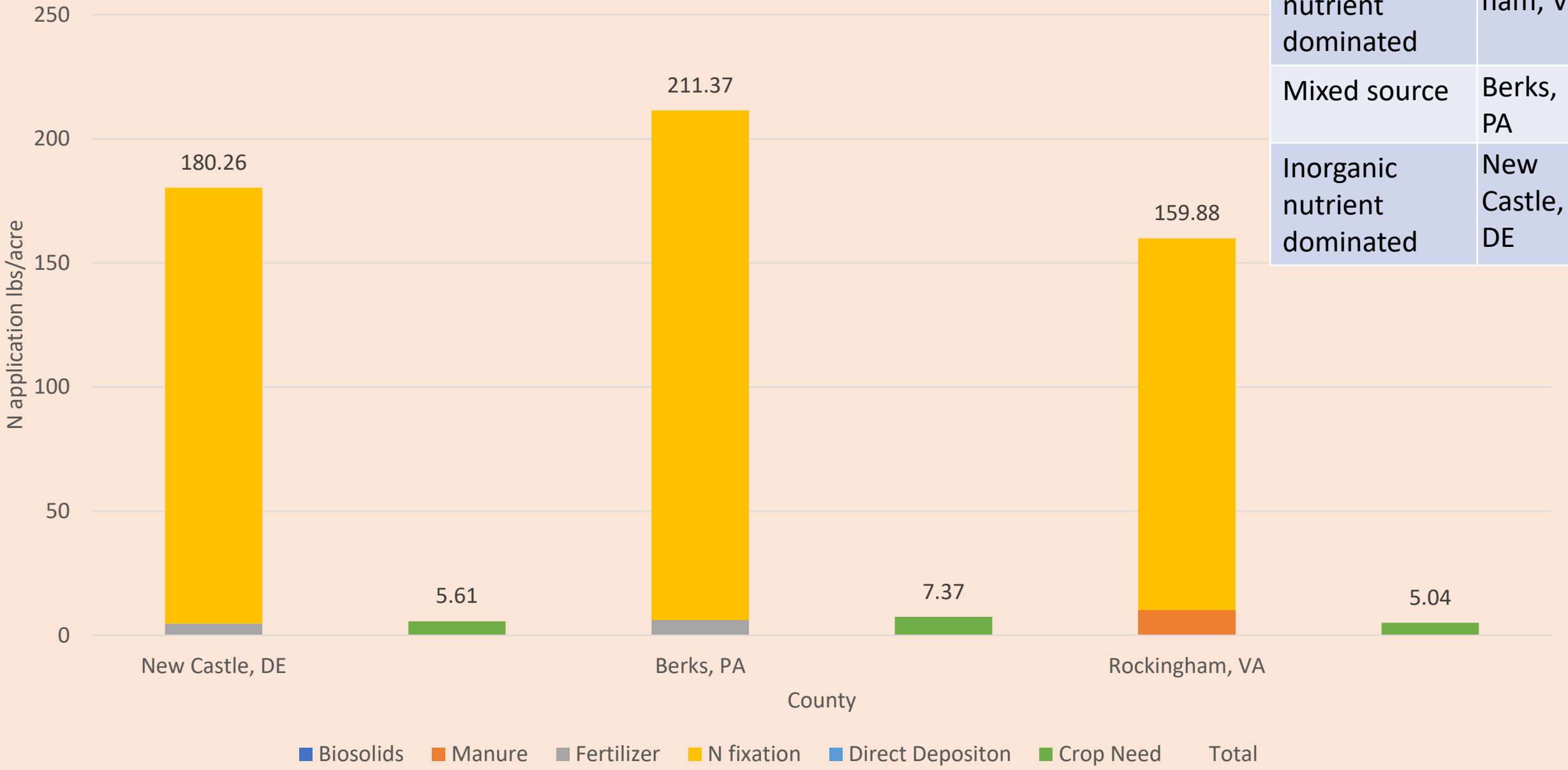
Total N applied in lbs/acre for Full Season Soybeans in each county vs crop need



County type	Chosen county
Organic nutrient dominated	Rockingham, VA
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Application isn’t the whole story

(Average Load +△ Inputs * Sensitivity)

Sensitivity	Manure	Fertilizer	N Fixation
Grain with manure	0.16	0.26	NA
Pasture	0.05	0.05	0.03
Full Season Soybeans	0.08	0.13	0.14

- Sensitivity governs how much change in export for change in applications
- Modeling WG sets

Takeaways:

- CAST
  - needs many agricultural data inputs
  - utilizes large scale averaging
- Counties behave differently based on their crop application needs
  - Rockingham, VA
    - Applied more manure and had less inorganic fertilizer
  - Berks, PA
    - Applied a mix of both manure and inorganic fertilizer
  - New Castle, DE
    - Applied more inorganic fertilizer than manure

Questions?

- Raw data are available upon request.