

Nutrient application algorithm

1/9/2026

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Outline/goal

Define process of applying nutrients in CAST

Collect feedback

GOAL:

- Understand and improve the model processes for applying nutrients when accounting for treatment/transport of organic sources for Phase 7.

CAST Agriculture nutrient categories

BOX Denotes item
is used for
application

Organic nutrients

Inorganic
nutrients

Manure

Biosolids

Fertilizer

Manure collected
(with losses)
within the
barnyard

Manure
deposited on
pasture

Manure
deposited within
riparian areas of
pasture

State reported
biosolids,
septage, and
spray irrigation

Inorganic
fertilizer available
for application to
crops

NOTE* Not all organic nutrients that are applied are Plant Available

A quick note on fertilizer application: N

Phase 6

Group 1

- Grain with manure
- Silage with manure
- Small grains and grains
- Other agronomic crops
- Specialty high and low
- Small grains and soybeans

Group 2

- Full season soybeans
- Legume hay

Group 3

- Pasture
- Other Hay

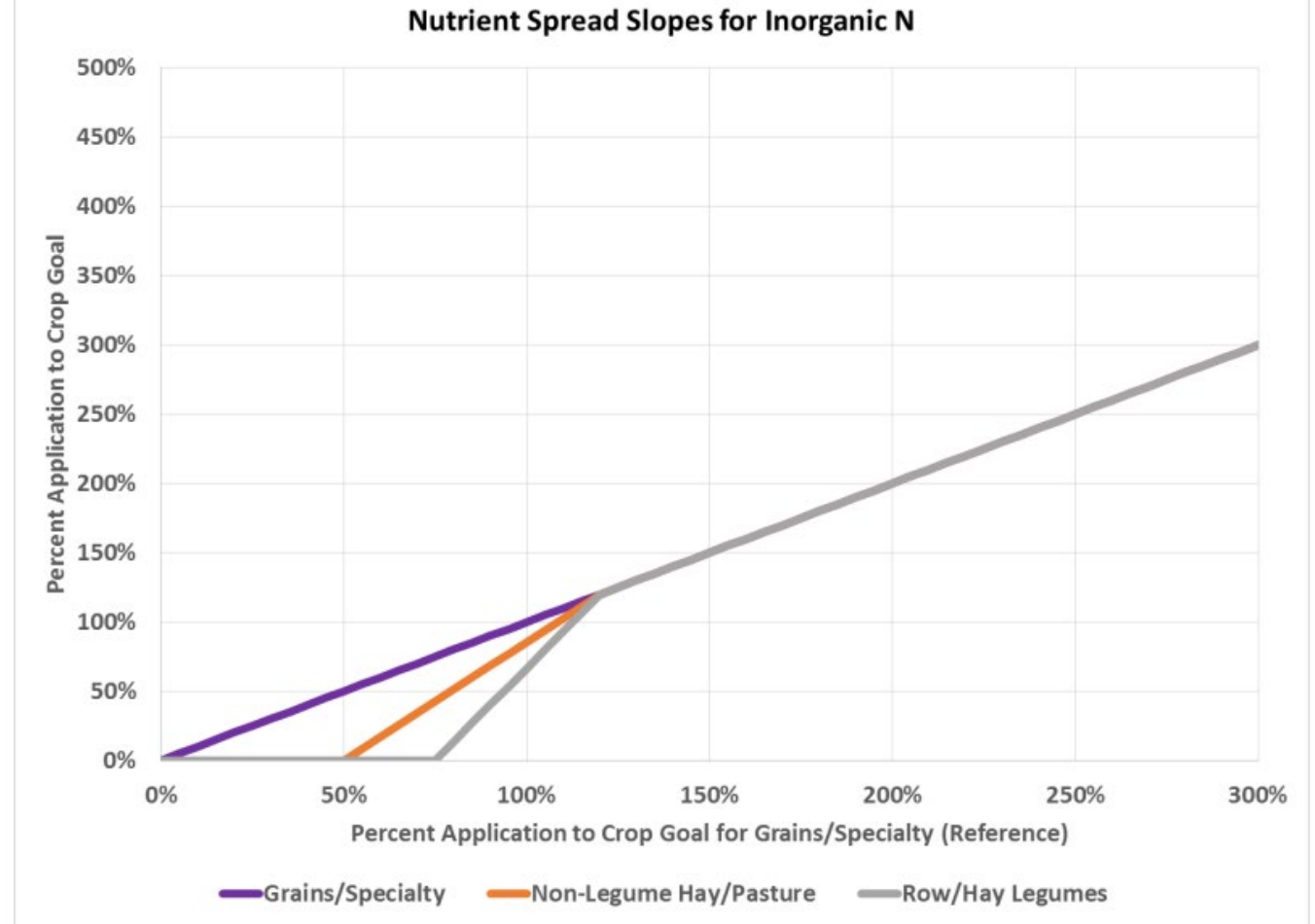


Figure 3-10: Inorganic Nitrogen Application Curves by Crop Group

A quick note on fertilizer application: N

Phase 6

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Phase 7

Group 1

- Grain with manure
- Silage with manure
- Small grains and grains
- Other agronomic crops
- Specialty high and low
- Small grains and soybeans
- **Pasture High**
- **Hay High**

Group 2

- Full season soybeans
- Legume hay

Group 3

- **Pasture Low**
- **Hay Low**

A quick note on fertilizer application: P

Phase 6

Group 1

- Grain with manure
- Silage with manure
- Small grains and grains
- Small grains and soybeans
- Full Season Soybeans
- Other agronomic crops
- Specialty high and low

Group 2

- Pasture
- Other Hay
- Legume hay

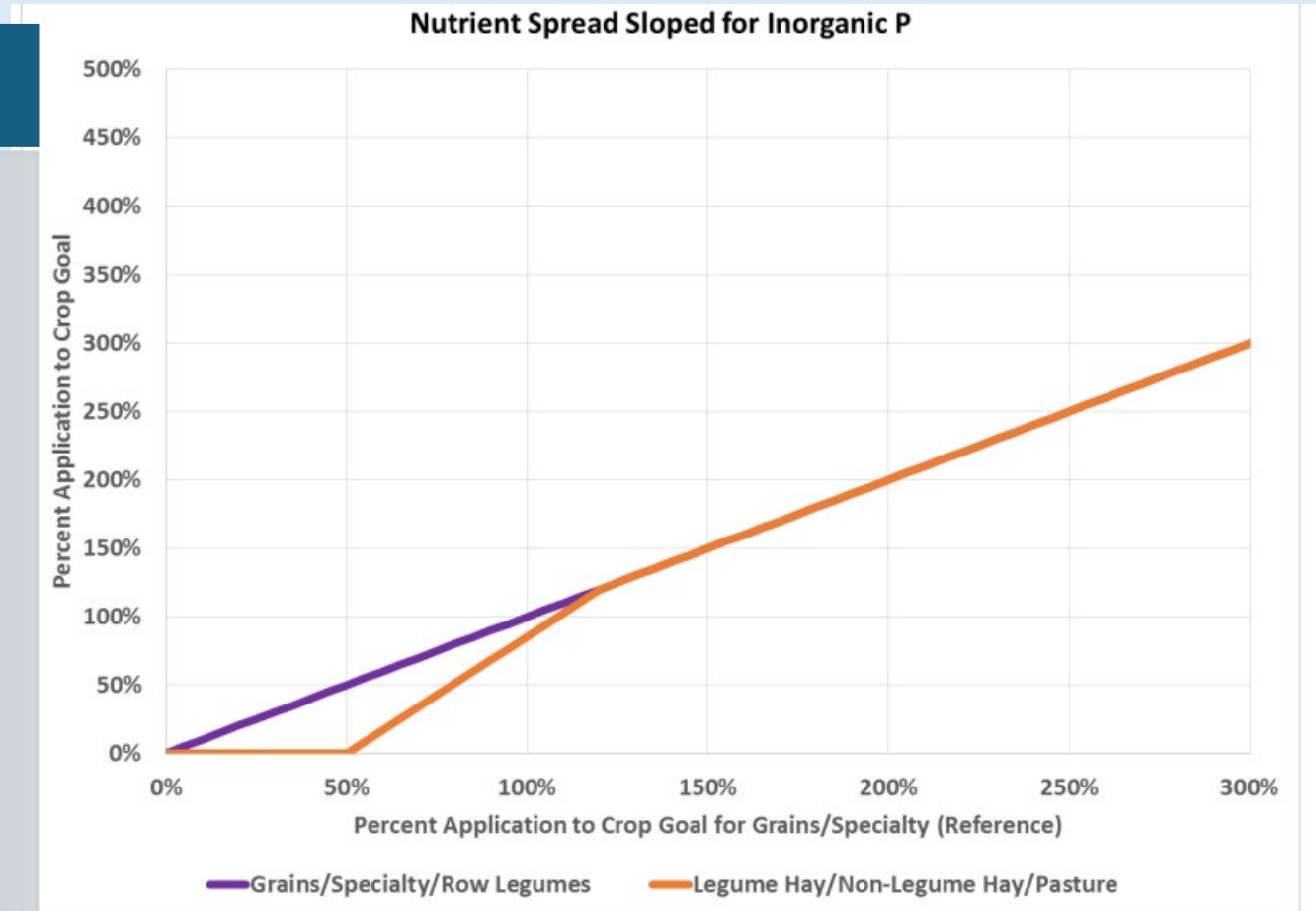


Figure 3-11: Inorganic phosphorus application curves by crop group

A quick note on fertilizer application: P

Phase 6

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Phase 7

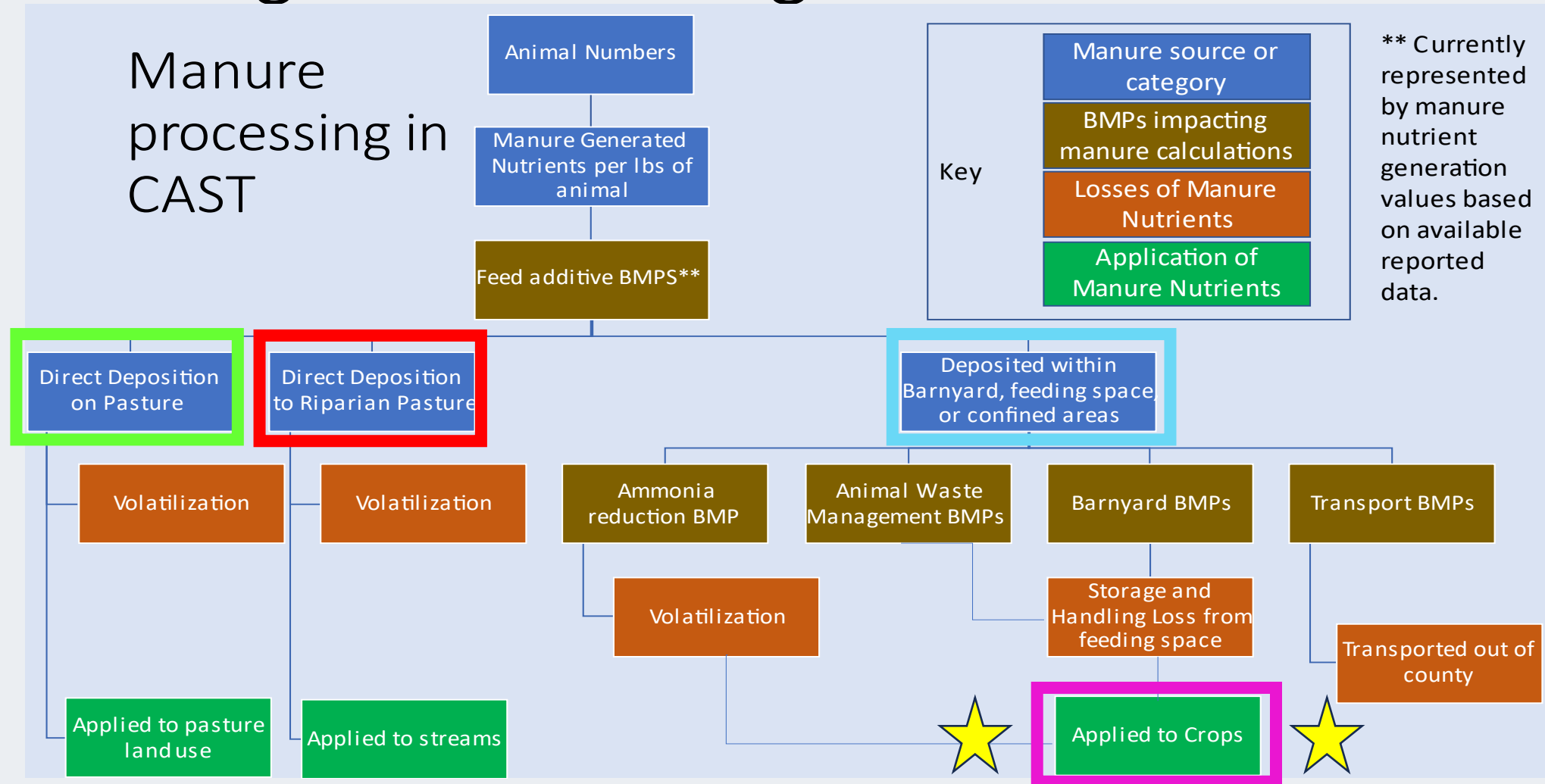
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- **Hay High**

Group 2

- **Pasture Low**
- **Hay Low**
- Legume hay

Manure generation diagram:



- Manure nutrients stay in their county of origin UNLESS they are transported
- Barnyard BMPs refers to runoff control management
- NOTE* after application to fields volatilization and additional BMPs can be used to increase the plant available nutrients

Manure Applications 3.4

Find an observed yield (NASS) and calculate the nutrients used to grow that yield (crop need)

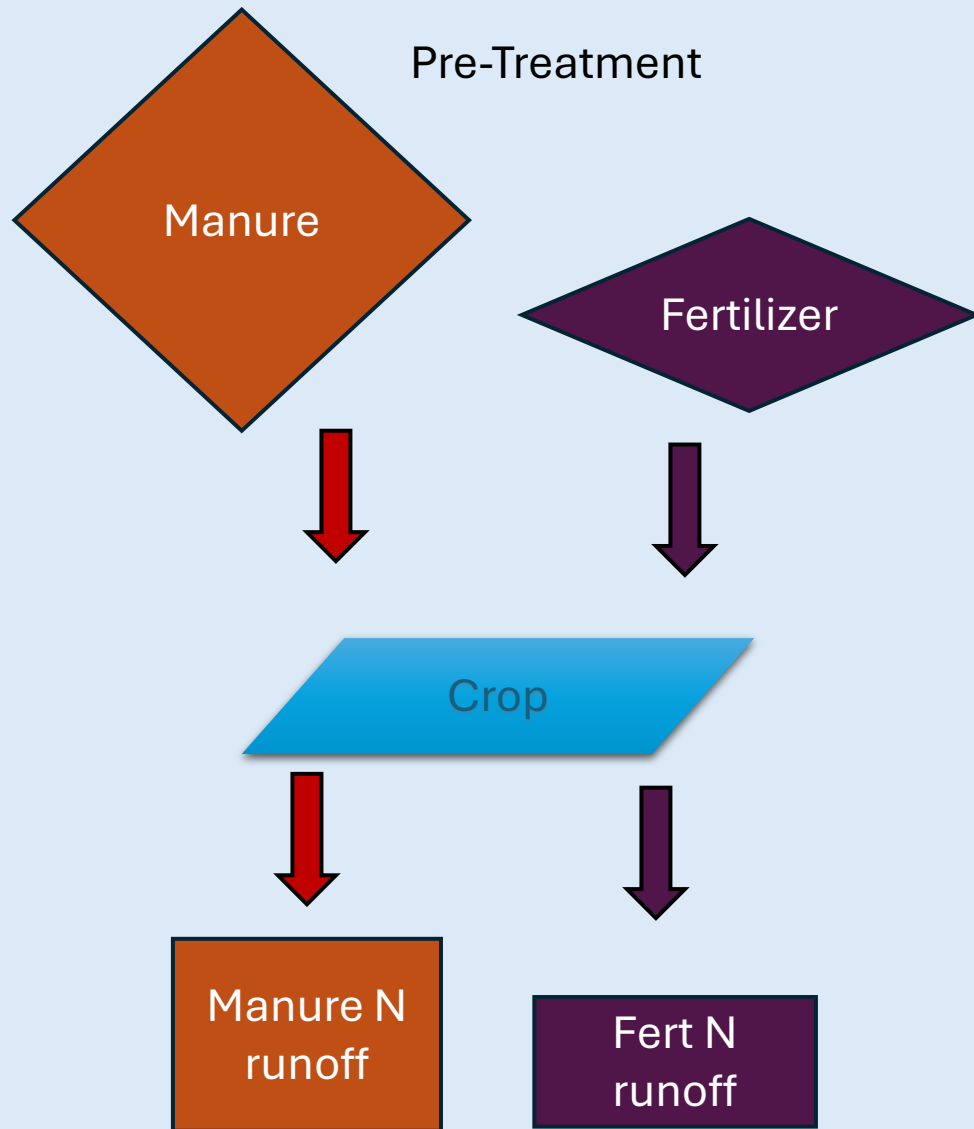
Sequential application:

- biosolids
- manure
- inorganic fertilizer

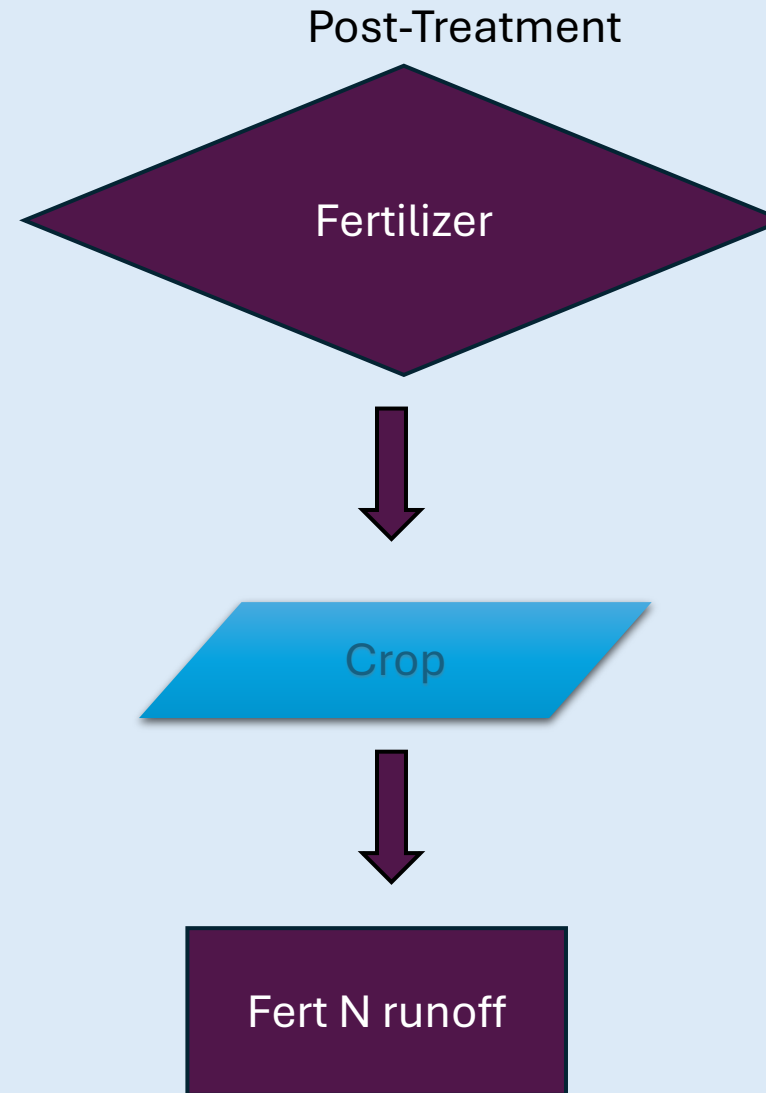
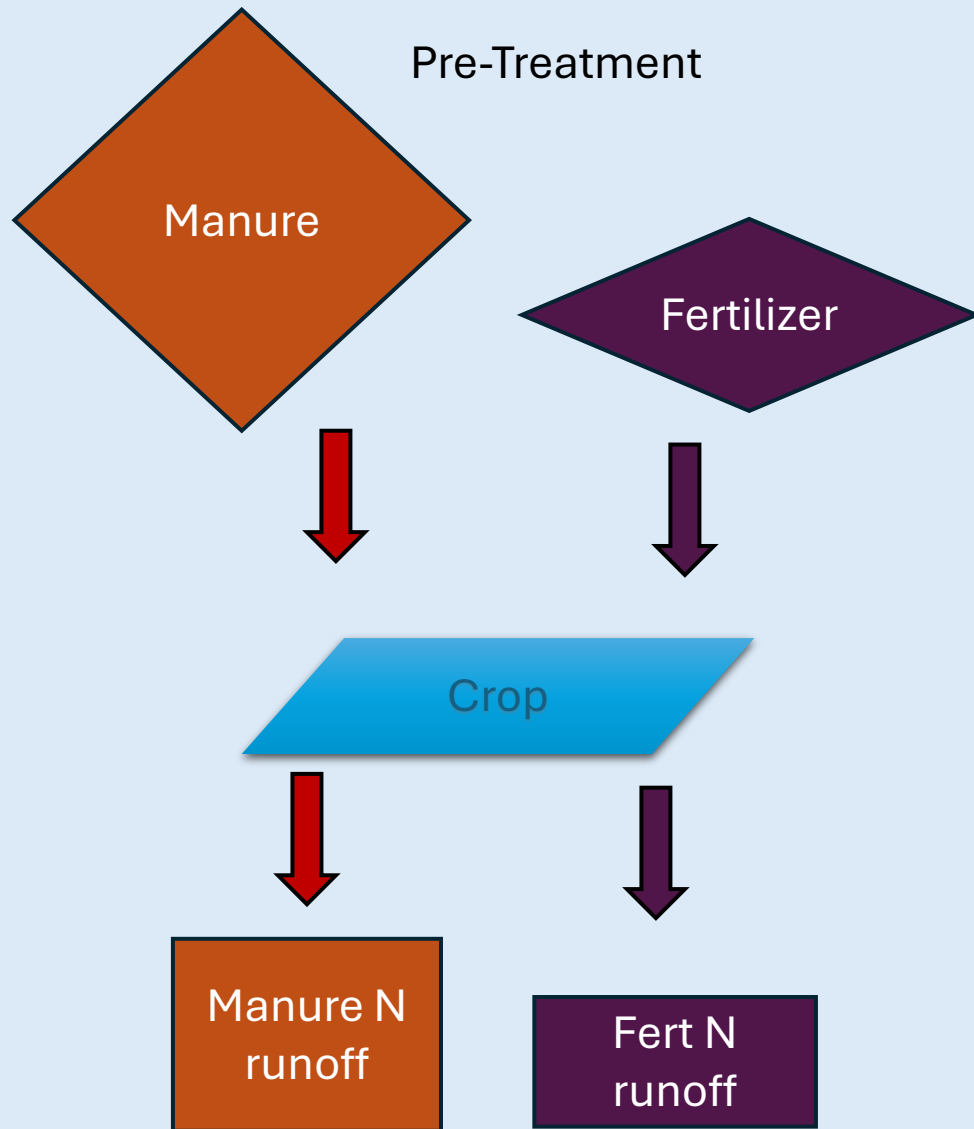
Meet crop need (application goal)

Not all manure is plant available

Visualizing the process



Visualizing the process



Assume that fertilizer is brought in to replace lost nutrients from manure

Credit

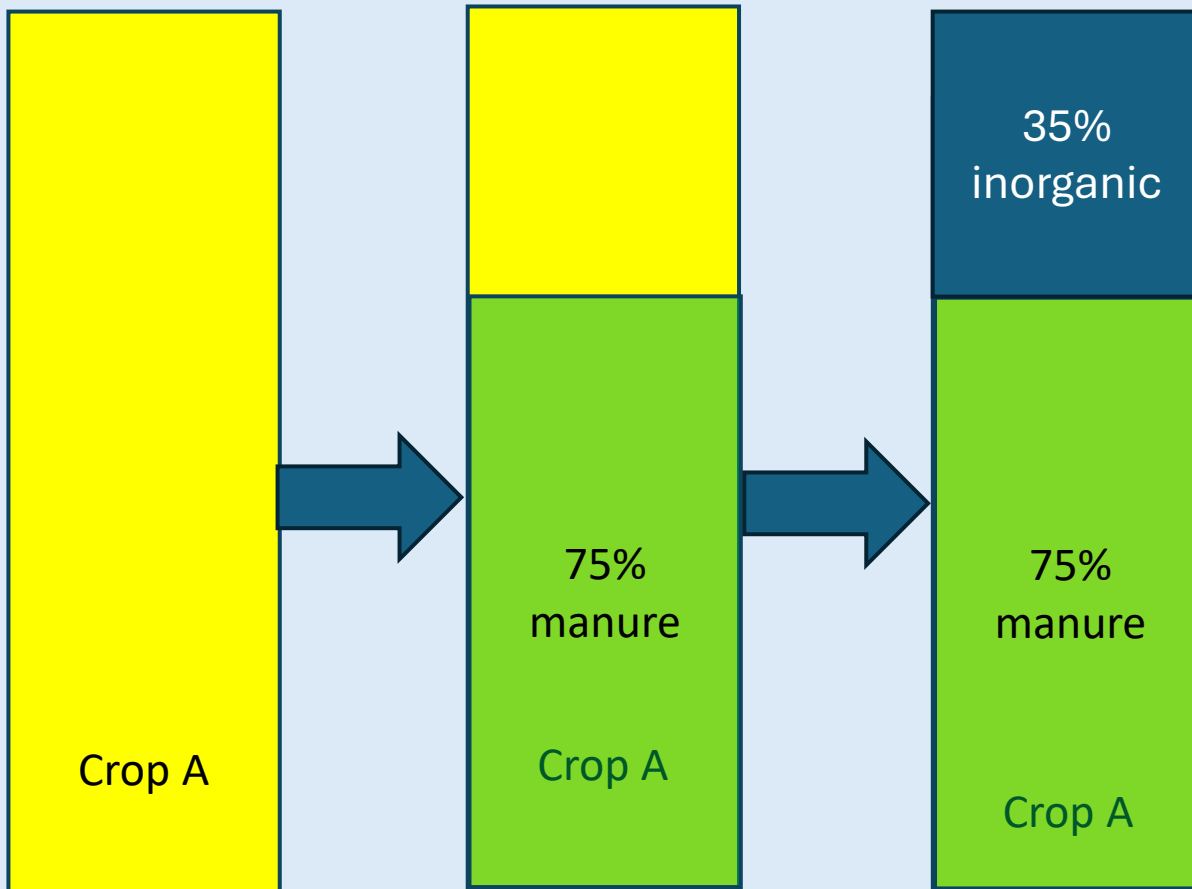


Another way to look at it

Crop A has
calculated
nutrient need

All available
manure nutrients
are applied

Inorganic nutrients are
calculated and applied – may
be more or less than need



- In this example we are satisfying 110% of crop need
 - $(75+30=110\%)$
- This is possible within CAST

Replacement – With a BMP

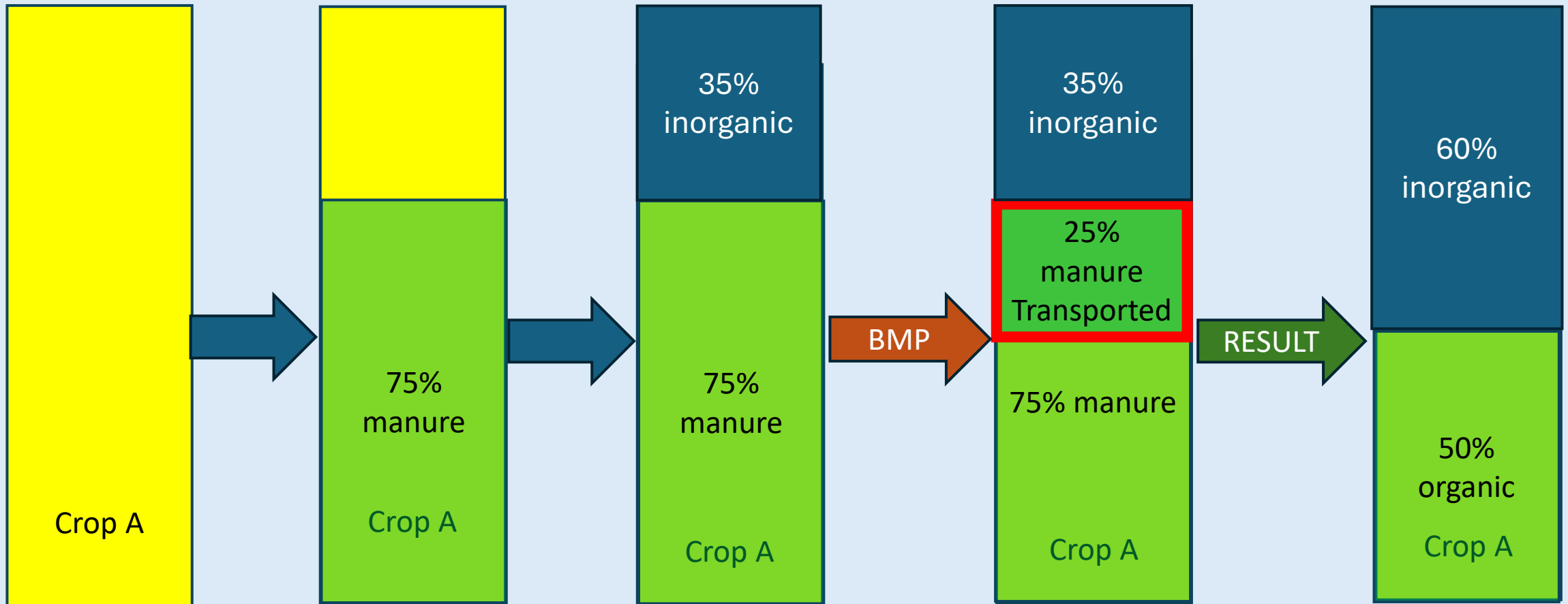
Crop A has
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All available
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Inorganic nutrients are
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Manure transport
removes manure
nutrients

Inorganic nutrients
are used to replace
transported manure



Still meeting crop need

Something to consider: Nutrient Management

The current replacement of organic nutrients with inorganic sources can cause unrealistic shifts in Nitrogen load

Implementing Nutrient Management in **CONJUNCTION** with manure treatment leads to a reduction in Nitrogen.

Replacement with NM

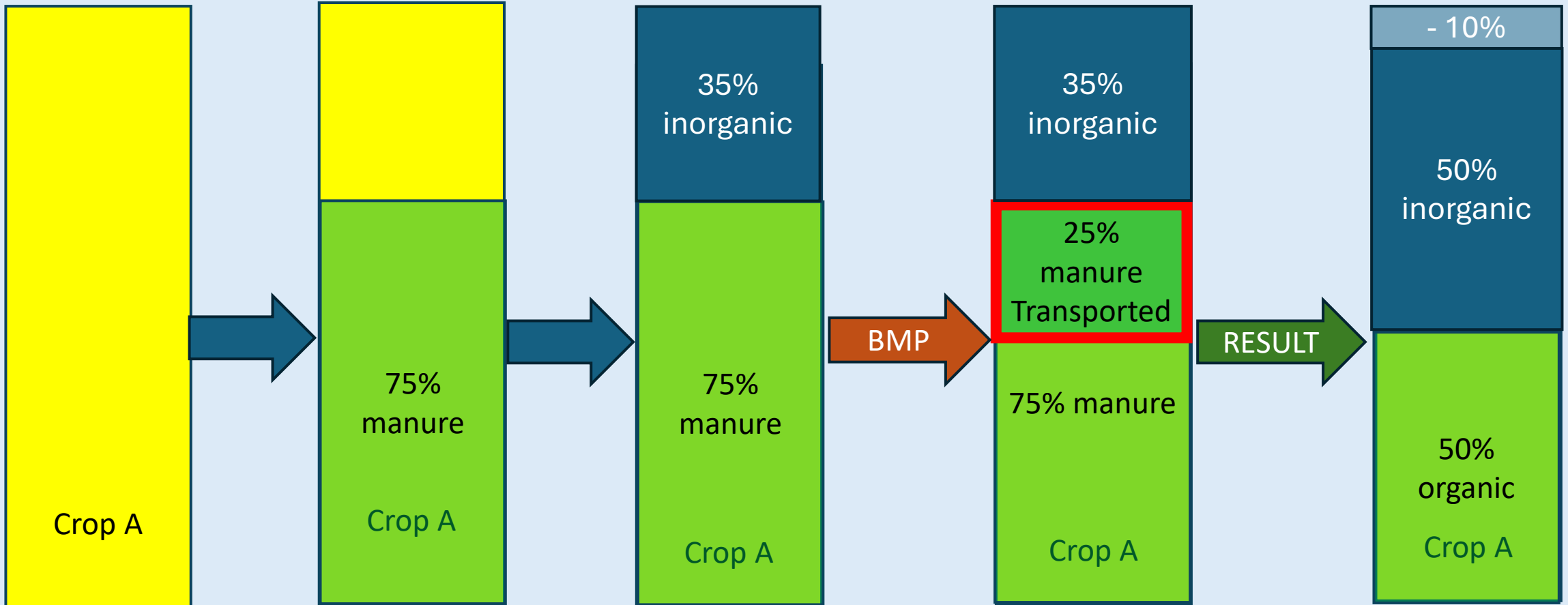
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**Reported Core
Nutrient Management
would reduce
inorganic nutrients**

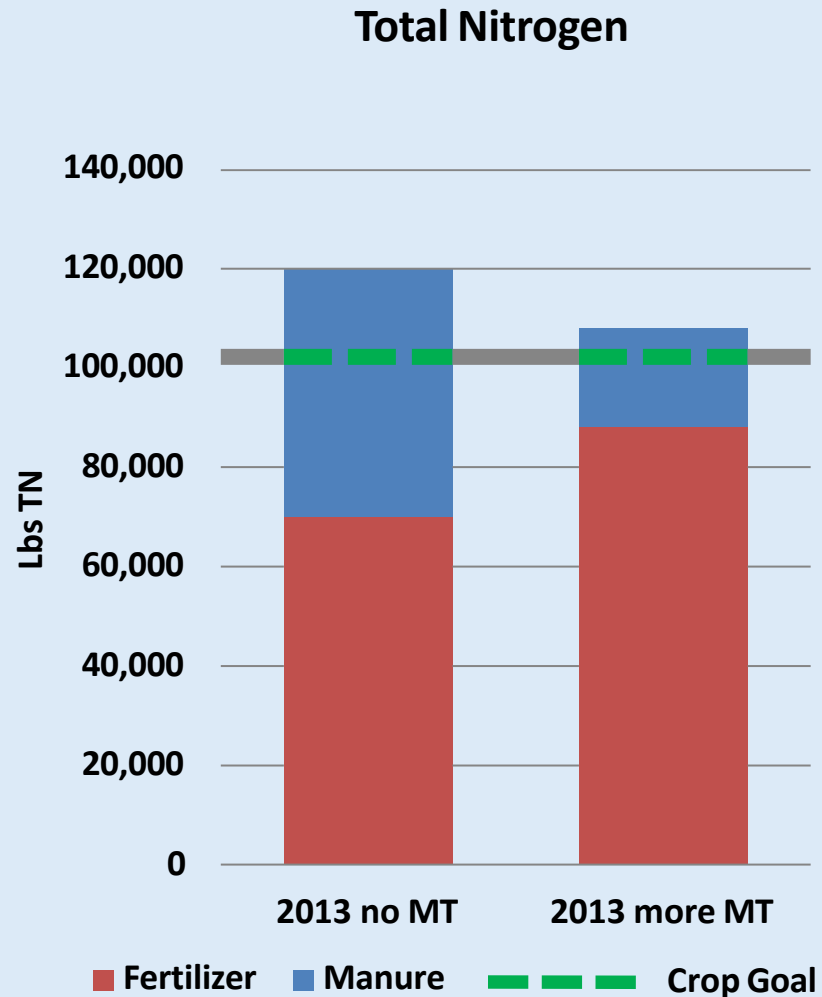


The rationale:

- How should credit be given for additional manure transport in counties where nutrients **exceed** crop goal?
- How should credit be given for additional manure transport in counties where nutrients **do not exceed** crop goal?
- AMS recommends the following for every county:
 - Every additional **pound of manure PAN** transported out of a county should be replaced with **one pound of inorganic PAN**.
- Phosphorus transport is tied to previous transport and manure/fertilizer availability e.g. :

Example Scenario	P Pounds transported	P Pounds removed
Base year (known fertilizer data)	500	
Year A	1000	-500
Year B	200	300

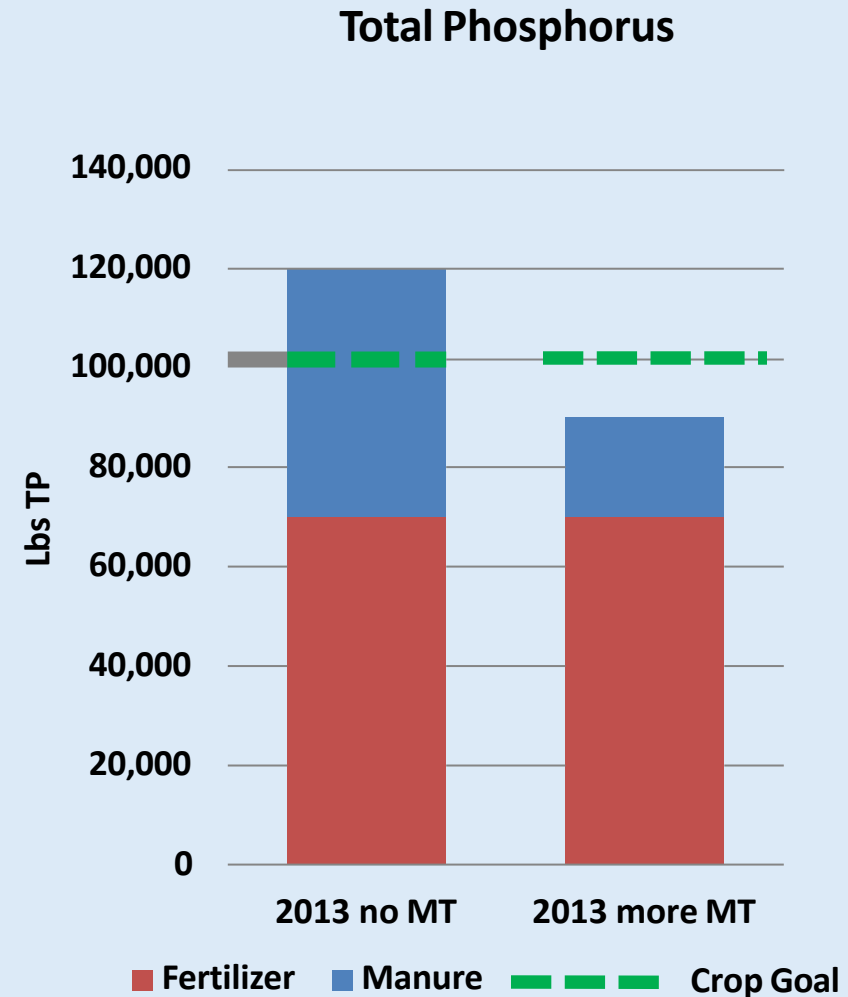
Crediting Manure Transport



Manure decreases.

Fertilizer increases at a 0.6:1 ratio.

Total applications-to-crop goal decrease.



Manure decreases.

Fertilizer remains constant.

Total applications-to-crop goal decrease.

Advantages of Manure Transport Methods

- Reflects more efficient use of N.
 - In 2012, every 1 lb of manure TN transported would be replaced with 0.6 lbs of inorganic TN (40% reduction in inputs, on average across watershed).
 - Value can vary by county and manure type being transported.
- Reflects likely current and future limits on use of P.
- Incentivizes manure transport for both nutrients and provides clear assumptions for trading credits if partners choose to use model's methodology.

Replacement; a concern:

- This method has NOT worked as intended.
 - Farmers are NOT replacing organic nutrients
 - Replacement of TN can potentially lead to high fertilizer application
- Leads to unexpected results
 - Fertilizer sensitivity to runoff is higher
 - Impacts loads negatively

Questions?

How can we improve? Let's Discuss!

- What we have heard:
 - NM will not allow applications over 100% of crop need (application goal)
- Change replacement
 - Install limit (100%?)
- Keep in mind modeling scale
 - County NOT farm
 - Rare that an entire county has more nutrients from manure than its crops need
 - Need to think along these lines