FERTILIZER CANADA
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4R Nutrient Stewardship

A Flexible Approach to Reducing GHG Emissions from Nitrogen Fertilizers

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Right Source @ Right Rate, Right Time & Right Place

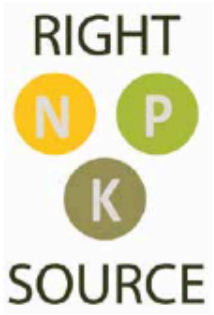
» Right Source - What N sources reduce emissions?

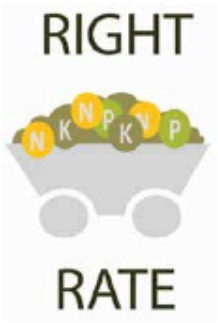
» Right Rate - How important is rate in determining emissions?

» Right Time – Does time of application affect emissions?

» Right Place – Does placement affect emissions?

» Can I measure and monetize on my farm?



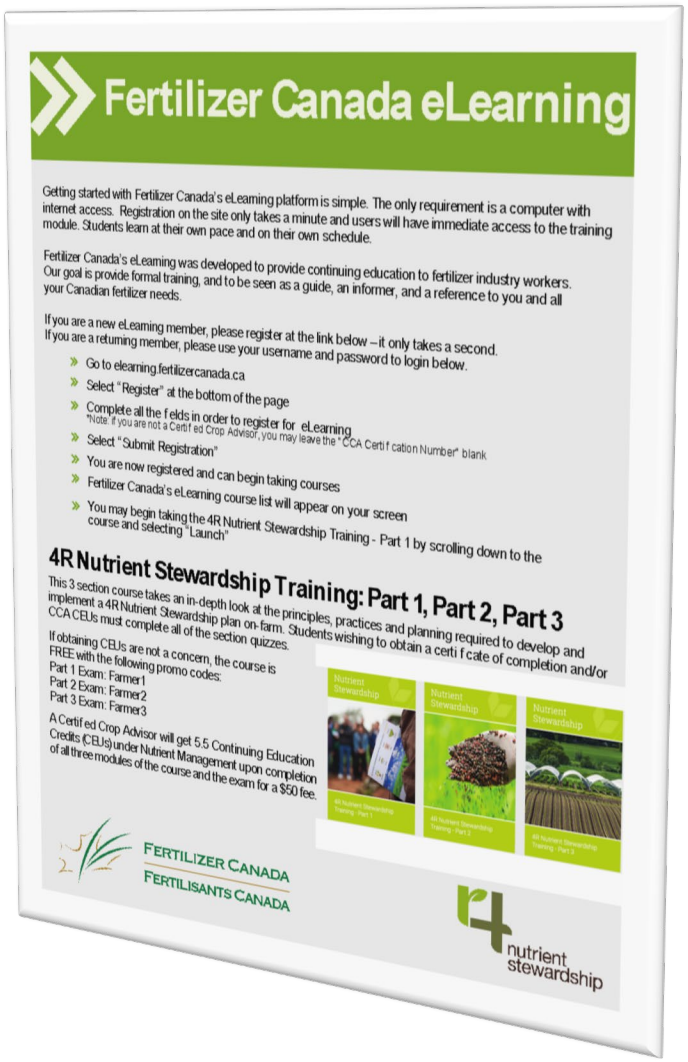


FERTILIZER CANADA ELEARNING

Getting started with Fertilizer Canada's eLearning platform is simple. The only requirement is a computer with internet access. Registration on the site only takes a minute and users will have immediate access to the training module. Students learn at their own pace and on their own schedule.

- 4R Essentials
- 4R Nutrient Stewardship Training (Parts 1-3)
- 4R GHG Reduction
- NERP
- 4R Saskatchewan

https://fertilizercanada.ca/nutrient-stewardship/elearning/4r-nutrient-stewardship/

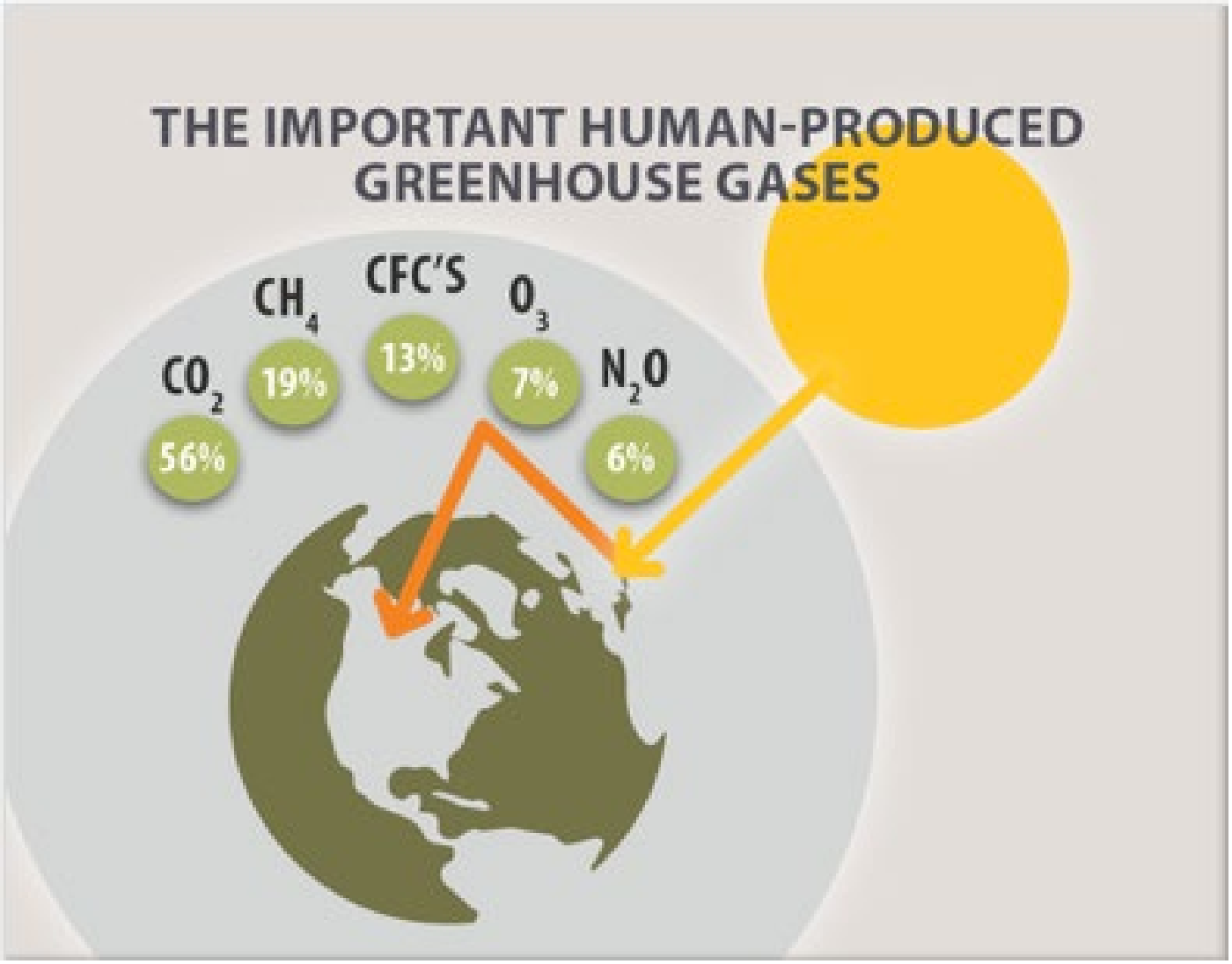


FAO CLIMATE-SMART AGRICULTURE

- HIGH PRODUCTION
- INTENSIFIED
- RESILIENT
- SUSTAINABLE
- LOW EMISSION

FAO	nutrient stewardship
HIGH PRODUCTION	**4R** SUPPORTS INCREASED PRODUCTION THROUGH BETTER MANAGEMENT
INTENSIFIED	**4R** ENCOURAGES HIGHER INTENSITY ON EXISTING FARMLAND
RESILIENT	**4R** PROMOTES CONSERVATION AGRICULTURE
SUSTAINABLE	**4R** SUPPORTS ECONOMIC VIABILITY, REDUCED ENVIRONMENTAL IMPACT AND SOCIETIES NEED FOR FOOD SECURITY
LOW EMISSION	**4R** REDUCES EMISSIONS PER UNIT OF CROP PRODUCED

Important Greenhouse Gases

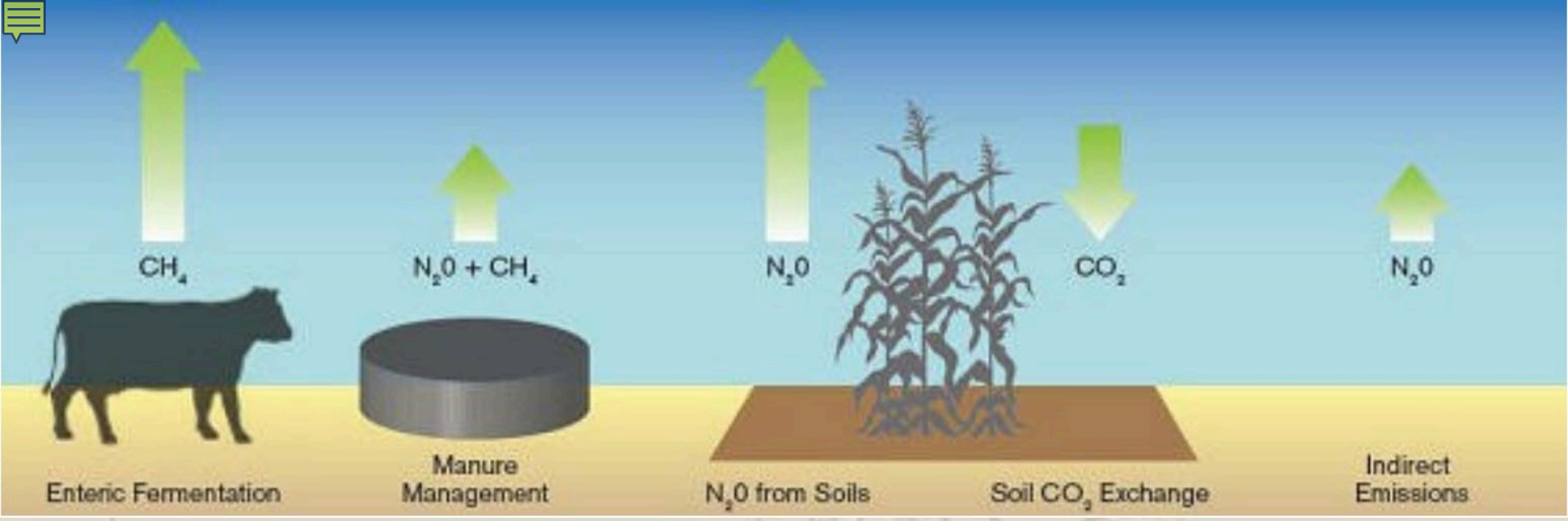


Global Warming Potential

1 kg N_2O = 298 kg CO_2

Carbon Dioxide Equivalents

or CO_2e



ENTERIC FERMENTATION

MANURE MANAGEMENT

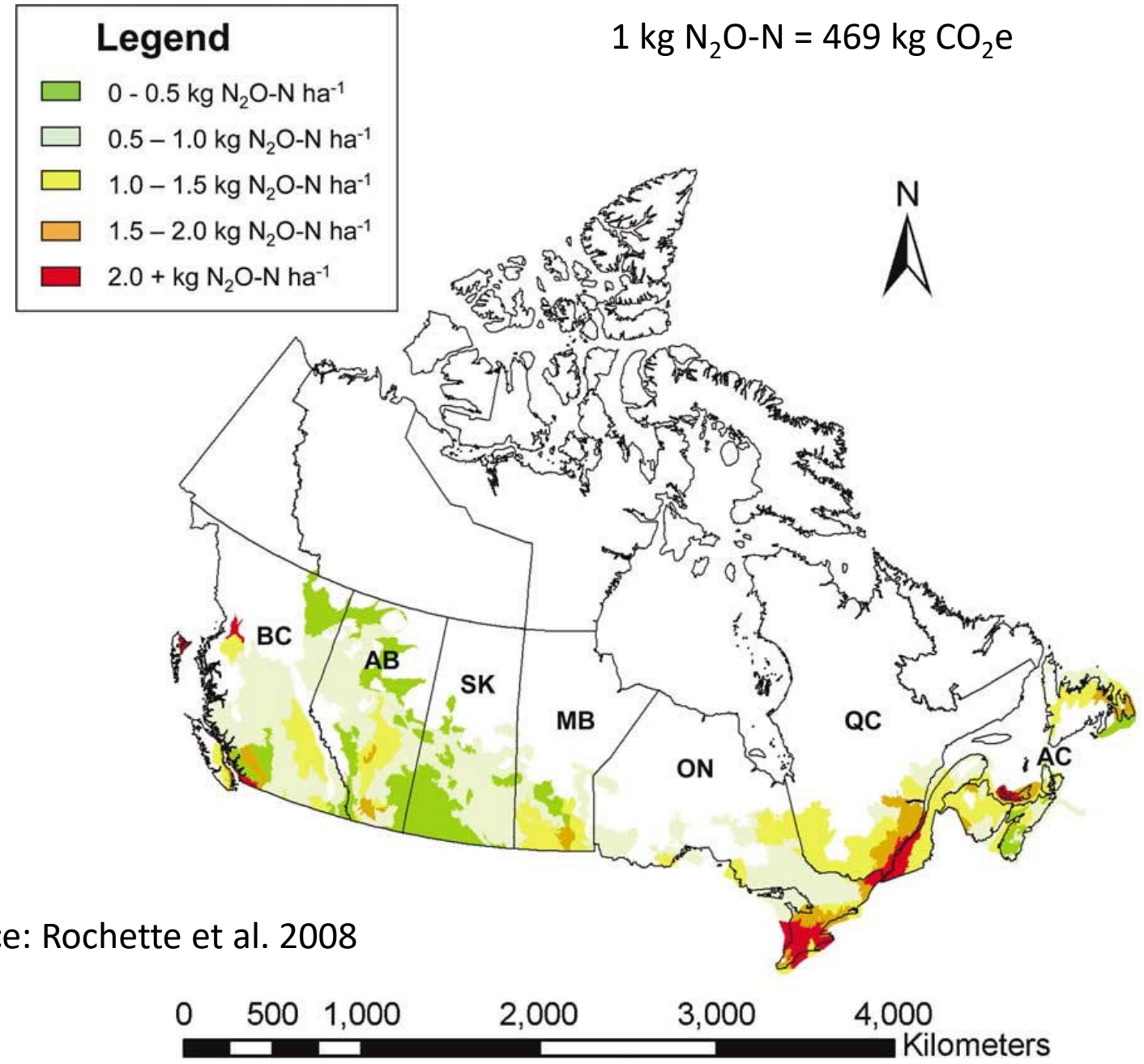
CROPPPING SYSTEMS

INDIRECT EMISSIONS

CANADIAN AGRICULTURE

nerp nutrient stewardship

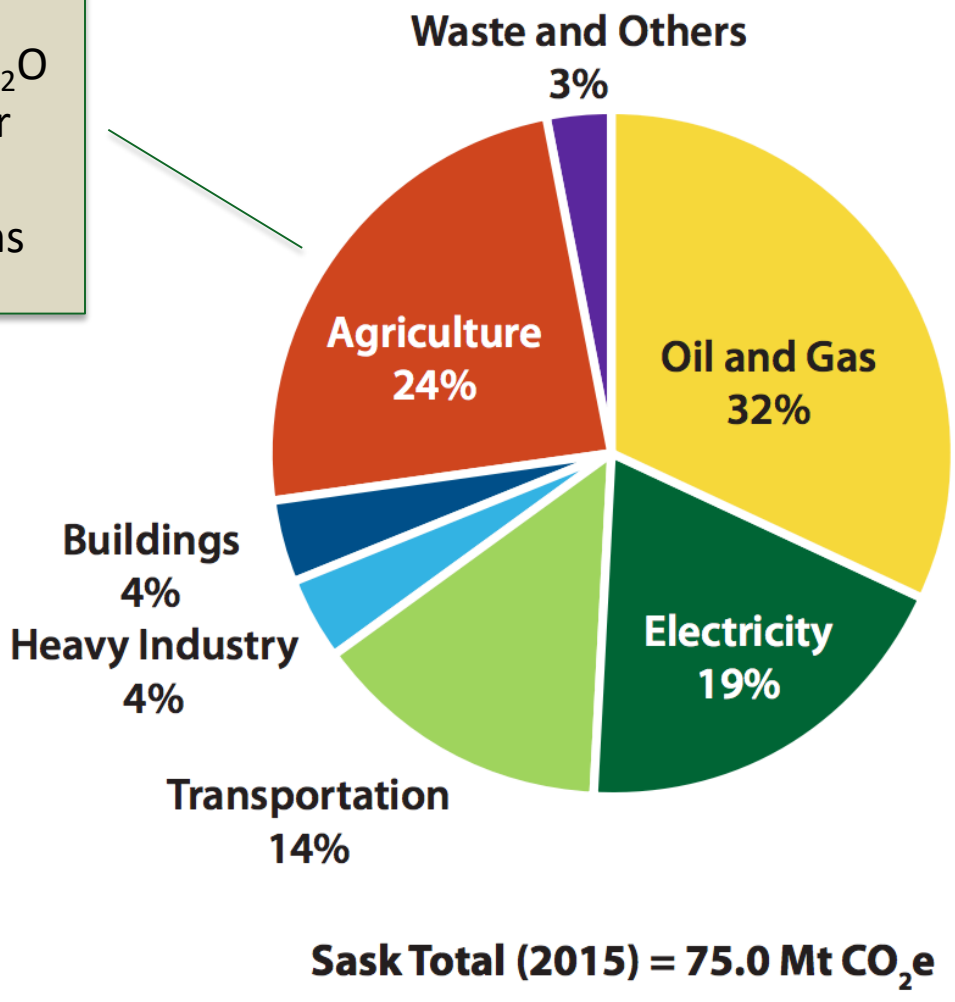
1 kg N_2O-N = 469 kg CO_2e



Source: Rochette et al. 2008

Saskatchewan's GHG Emissions by Economic Sectors (2015)

5-7 Mt CO_2e as N_2O from N fertilizer applications to cropping systems



Sask Total (2015) = 75.0 Mt CO_2e

- 0.15%
- 0.04%
- 0.015%
- 0.004%

Nitrous Oxide Emissions & Nitrogen Losses

Nitrous oxide emissions……

- account for only a small fraction of N loss.
- are highly variable in space and time.
- are difficult (impossible on farm) to measure.
- are generally non-economic in Saskatchewan.

Nitrogen losses……

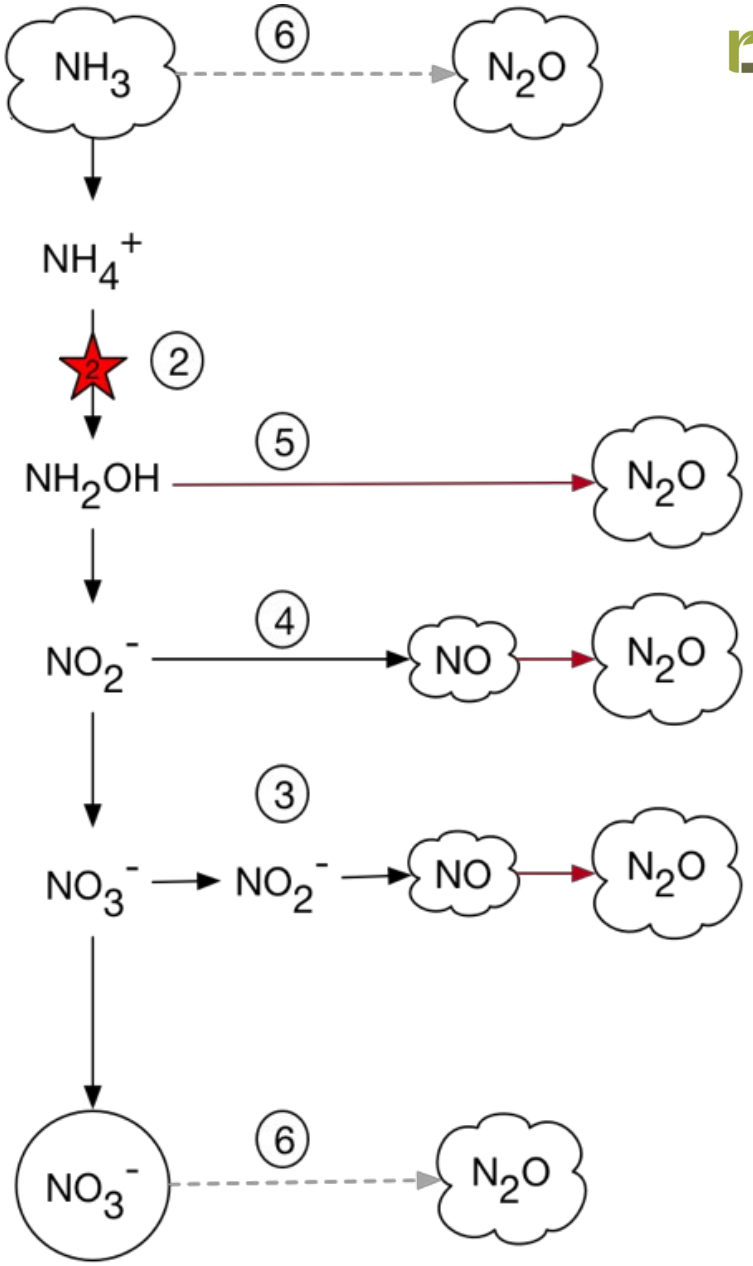
- contribute to indirect nitrous oxide emissions.
- are highly weather and landscape dependent.
- can be measured on farm.
- can have significant economic impact.

Right Source

» What sources reduce nitrous oxide emissions?

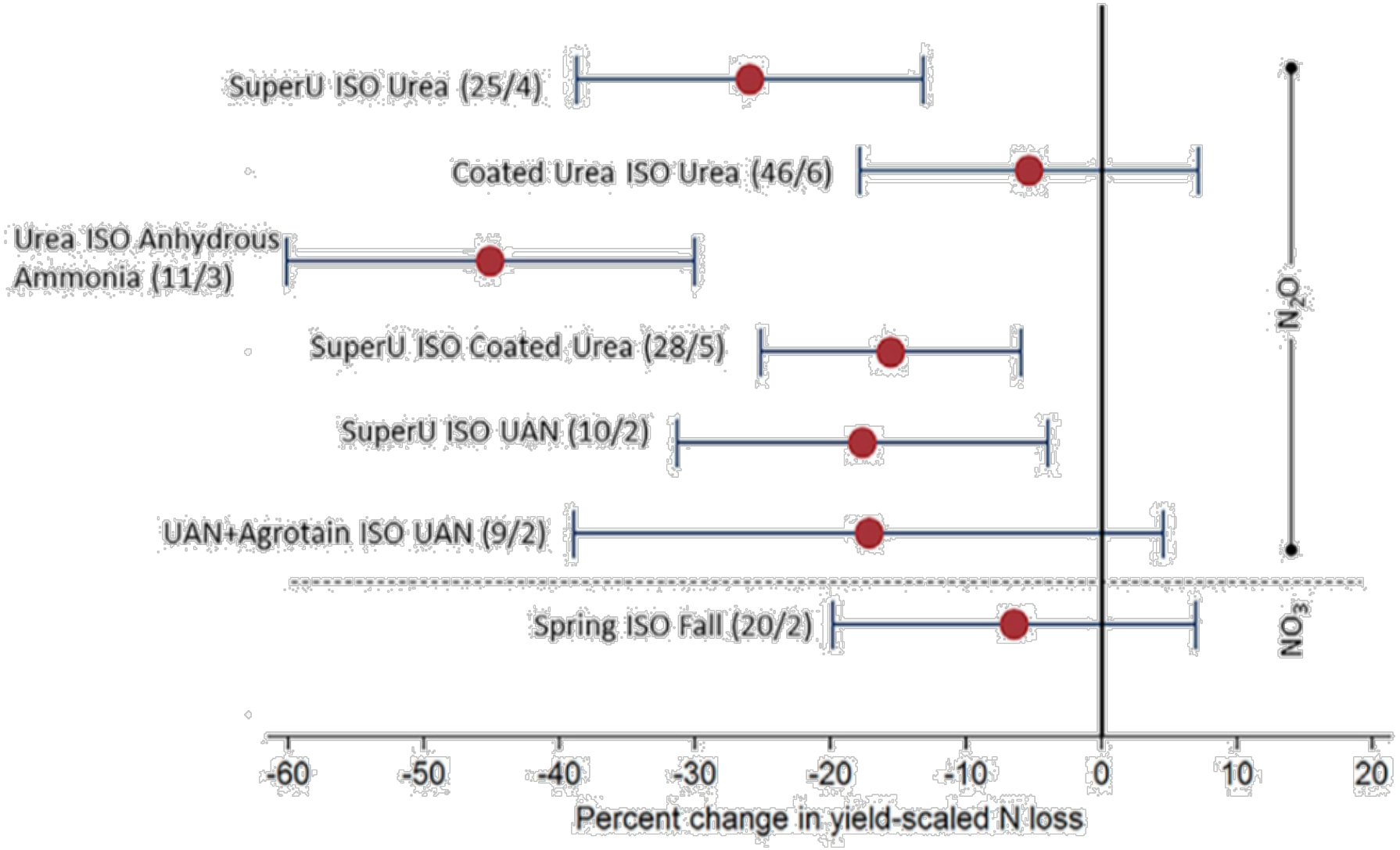
» Are there any nutrient interactions (+ or -)?

» The other 4Rs – Right Rate, Right Time, Right Place?



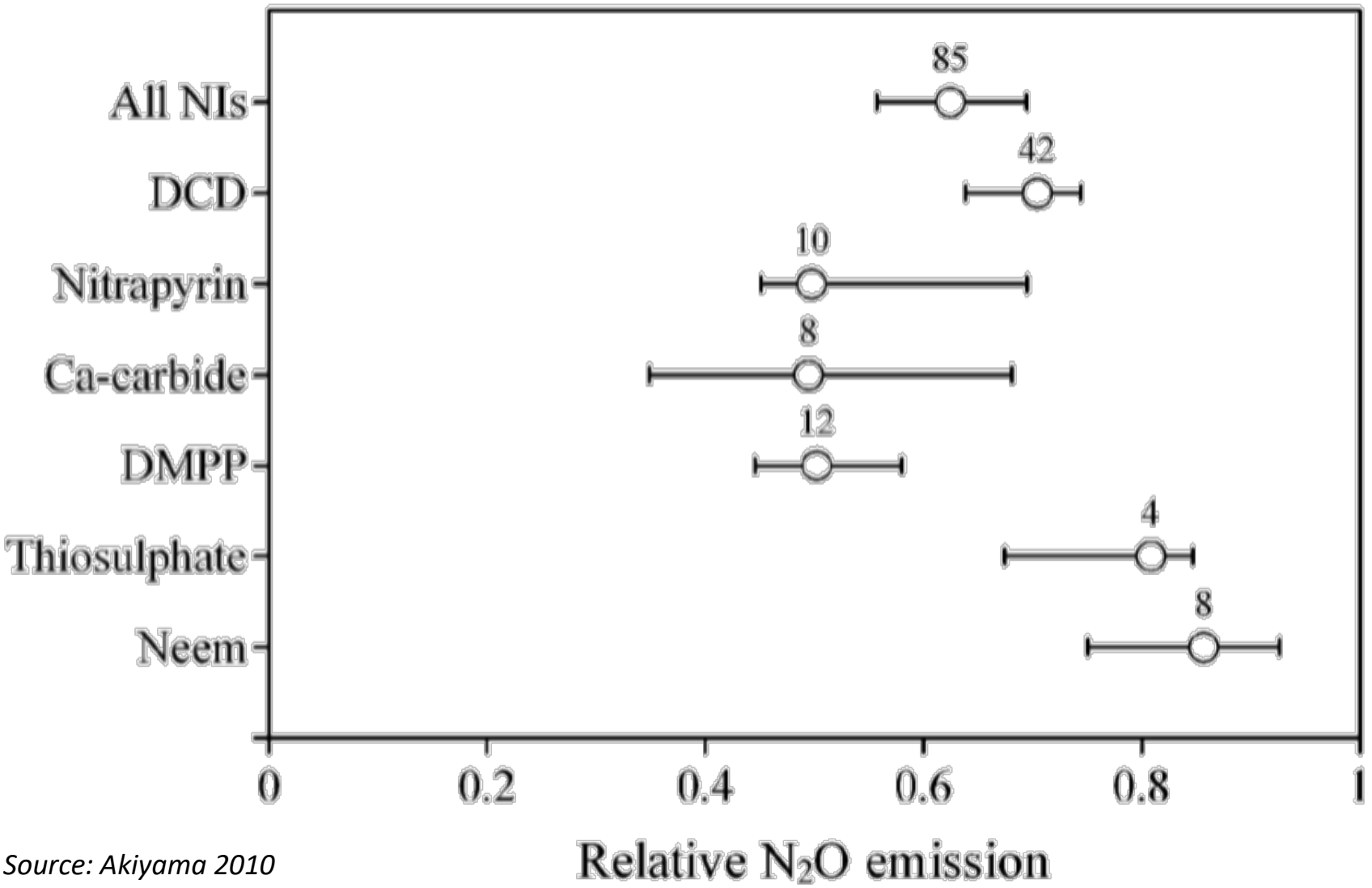
Source: Burton 2018

N Product Comparisons



Source: Eagle et al. 2017

Nitrification Inhibitors



Source: Akiyama 2010

Nitrous Oxide Reductions

Source	Reduction
Nitrification Inhibitors	35%
Urease Inhibitor* + NI	25%
Urease Inhibitor*	Highly Variable
Polymer Coated Urea	10%

Source: Burton 2018

Right Time

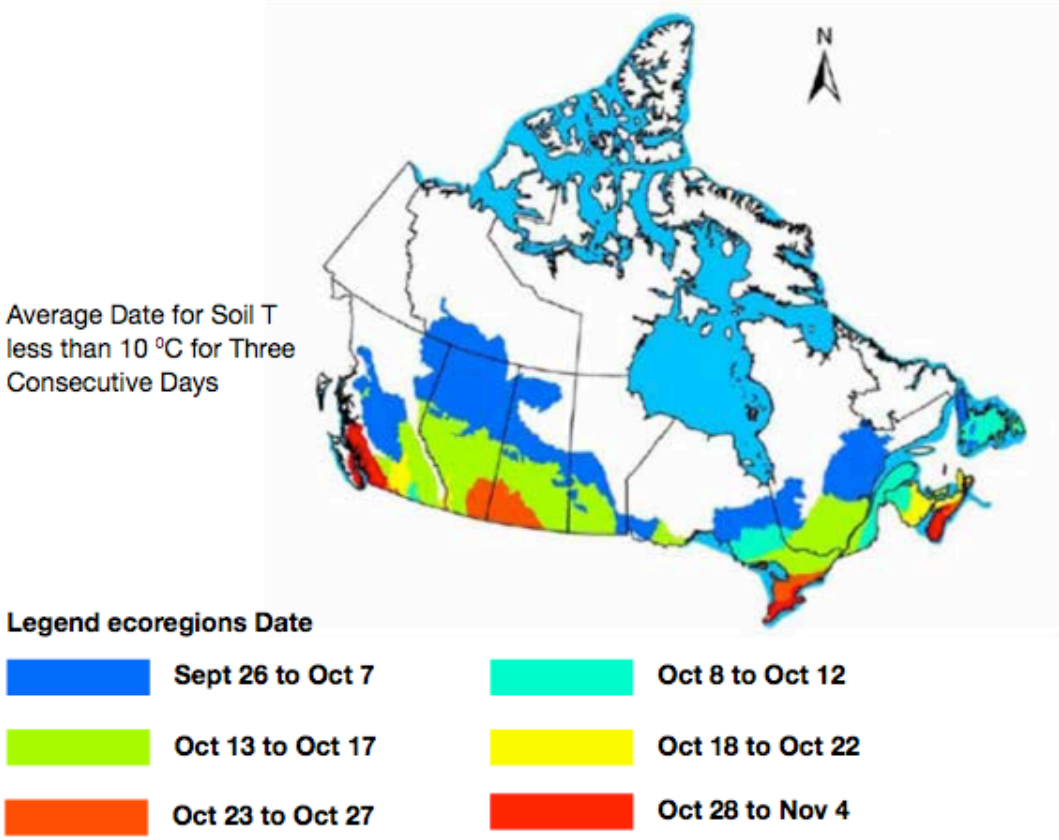
- Crop stage and timing of plant uptake.
- Dynamics of soil nutrient supply.
- Timing of nutrient mobility and loss.
- The logistics of on-farm field operations.

Nutrient Uptake & Loss

»Weather (moisture and temperature)

»Soil physical and chemical properties

»Best Management Practices



Denitrification Losses

»Spring flooding can cause losses of fall applied N and residual N by denitrification.

» Soils can lose 2 – 4 lbs N/acre/day at 5°C.

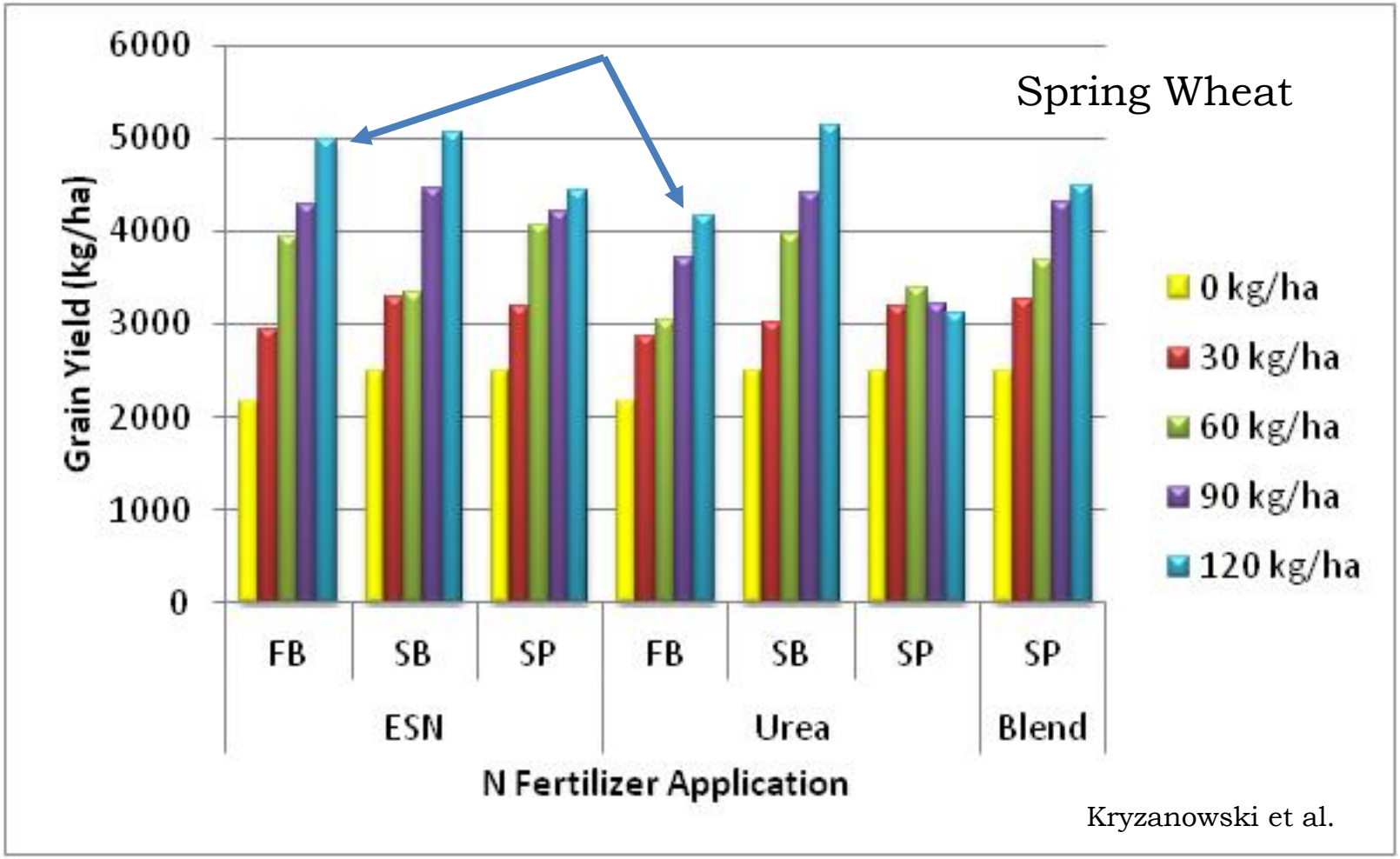
» 15 – 30 lbs of NO_3-N/acre/week could be lost.

Picture source: Farmwest

Right Time

BMP	ISO	GHG Reduction
Delay fall application of N until the soil has cooled to below 10° C or the use of an inhibitor.	Early fall-application of unprotected N.	30%
Switch to spring application.	Early fall-application of unprotected N.	20%
Split Application.*	All N at or before seeding.	15%
* With sub-surface placement or EEF source.		
Source: Burton (2018)		

Time-Place Interaction and Crop Yield

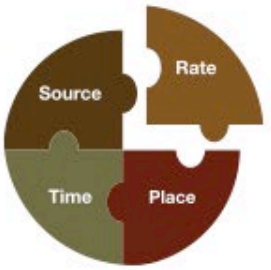


Kryzanowski et al.

Fertilizer Placement

» Sub-surface banding improves N-use efficiency and reduces the risk of N loss.
» Depth > 5 cm are effective at reducing N_2O emissions.

Right Rate



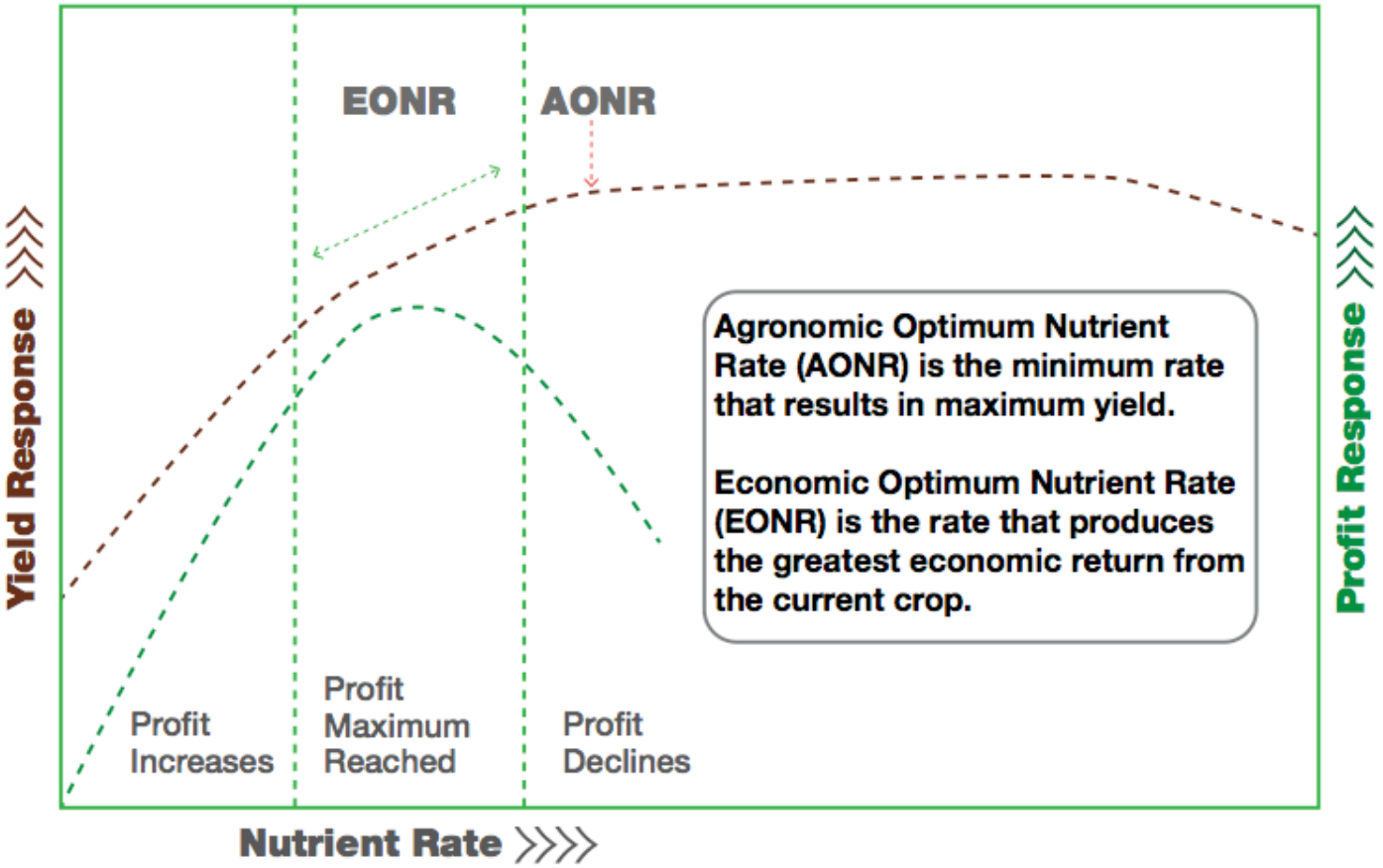
>> Source, Time, Place BMPs may allow for reduced rates.

>> Excess rates result in higher N_2O emissions and higher N losses.
- overwinter losses
- in-season losses
- residual post-harvest losses

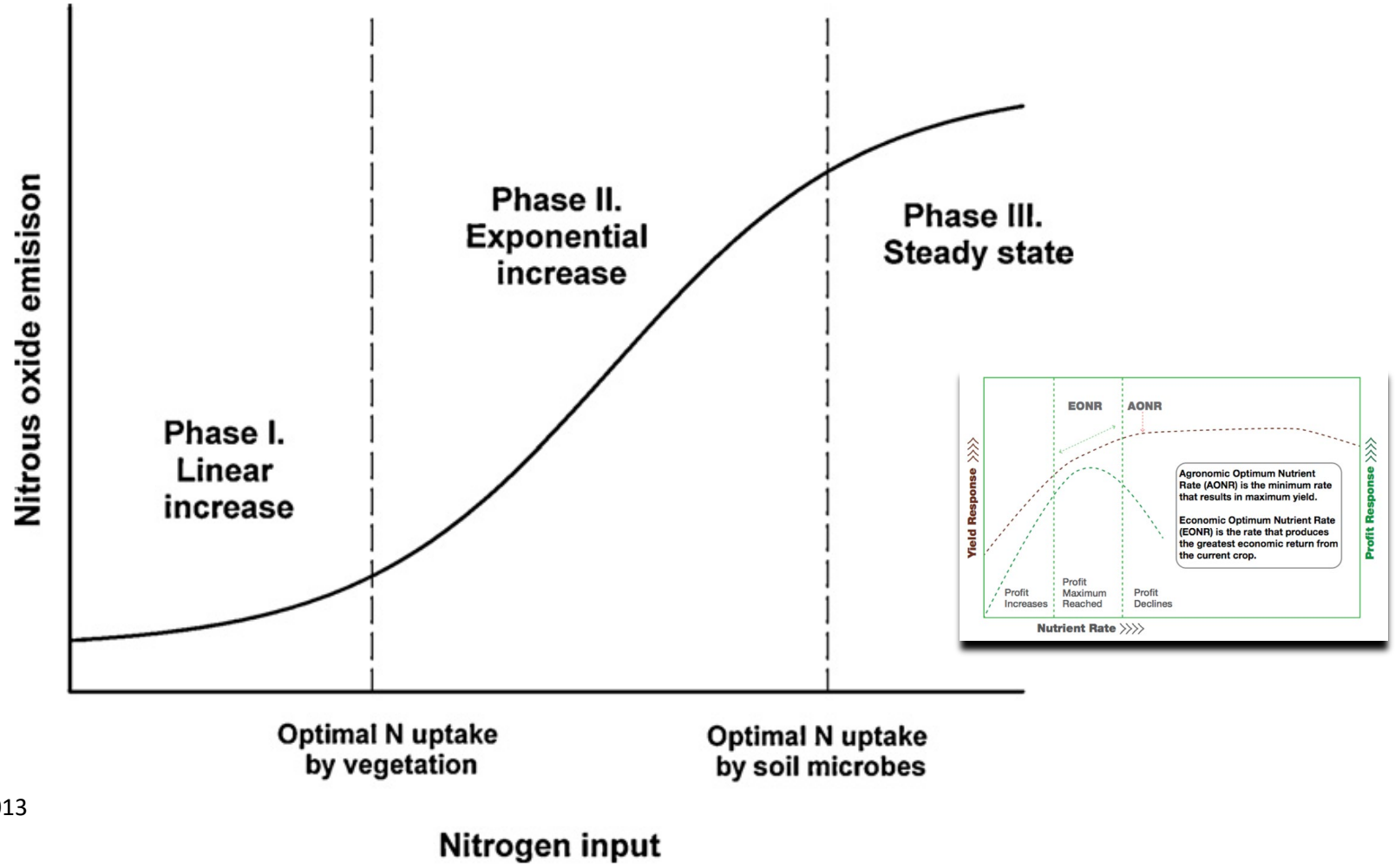
>> Resilient cropping systems mineralize more N.

>> Fertilizer N is more efficient under better moisture.

Maximize Profit Not Yield



N Rate and Nitrous Oxide Emissions



Kim et al. 2013


nutrient
stewardship
NERP
Nitrous Oxide Emission Reduction

General Emission Equation

$$N \times F_1 \times F_2 \times \frac{44}{28} = N_2O$$

- N is nitrogen inputs from fertilizer, manure, crop residue.
- $F_{1\&2}$ are emission and/or partitioning factors
- 44/28 is the N to N_2O conversion factor

QUESTIONS?