MSU-EPRI Methodology

Quantifying N_2O Emissions Reductions in US Agricultural Crops Through N Fertilizer Rate Reduction

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Guiding Principles

Scientifically Robust

- Peer reviewed literature
- Genuine environmental benefits

Transparent

- Intuitive to all stakeholders
- Minimize gaming opportunities

Practical

- Low farmer effort and cost
- Fast adoption
- Broad uptake

Empirical Backing

Method 1 – All N fertilized crops in U.S.

Hundreds of field studies show that N_2O emissions are related to N fertilizer rate - IPCC Tier 1: Linear (EF = 1 %)

Method 2 – Corn in North Central Region

Empirical research in Michigan and elsewhere shows non-linear relationship - IPCC Tier 2: Exponential

Eligibility Requirements

Credit based on N fertilizer rate reductions

Fertilizer Type and Management

- Synthetic and Organic N directly applied to soil
- Fertilizer applied at any time of year

Nitrous Oxide Emissions

- Direct (on site)
- Indirect (off-site and downstream)

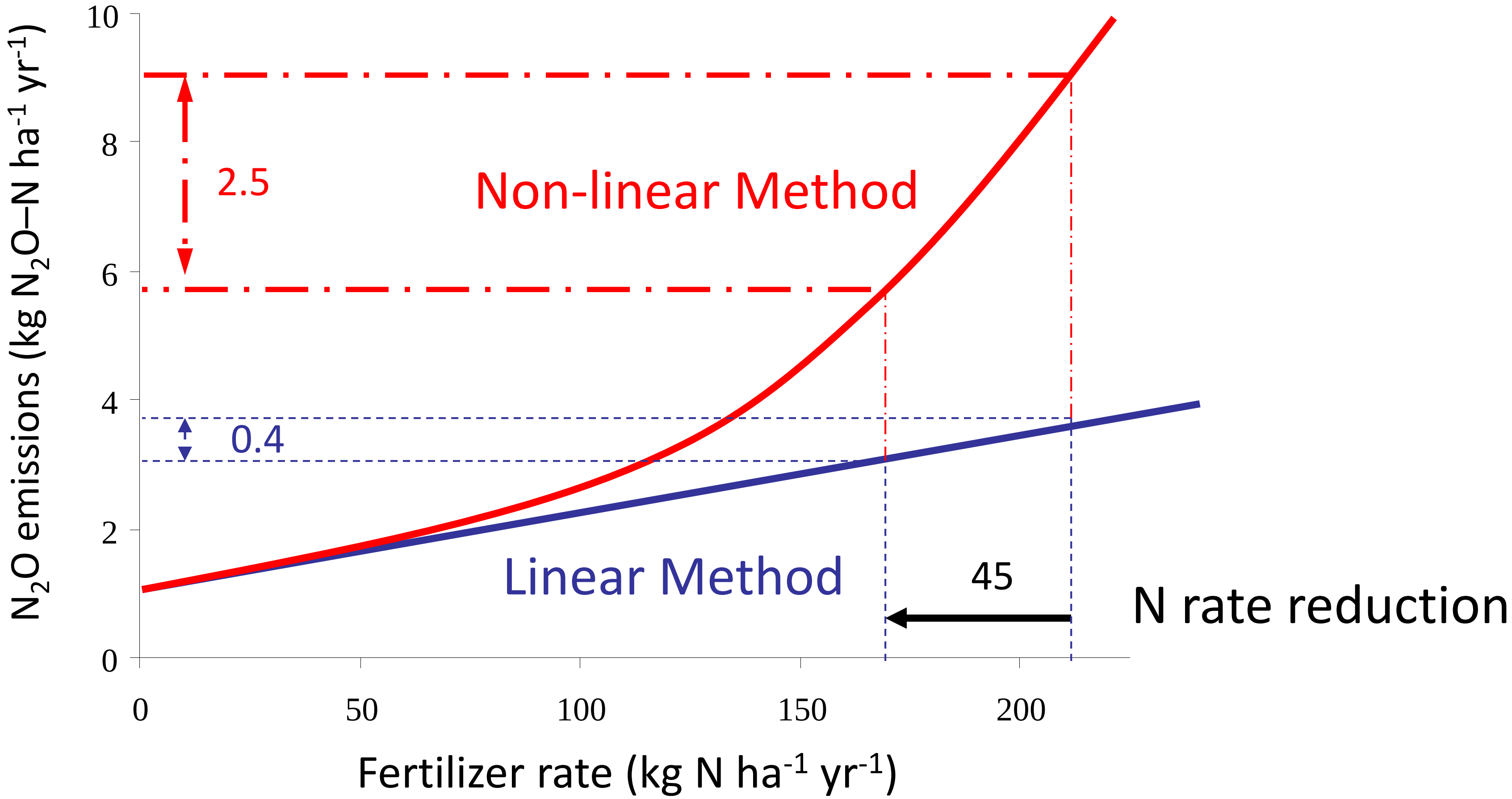
Flexibility to achieve N rate reduction

- Economic optimization – MRTN
- Timing – split application
- Source – slow release
- Cover crops

N rate reduction is result

Methodology Accounting

Direct N_2O emissions calculations – 2 Methods



Millar et al. 2010, Hoben et al. 2011

Baseline Definition

N_2O emissions that would have been emitted during the project, based on the N rate that would have been used absent the project (BAU)

- Baseline scenario assumes that BAU is equivalent to N fertilizer rate based on past N fertilizer use
- Baseline N_2O emissions are estimated using one of two Approaches - both generate a baseline N fertilizer rate from which N_2O emissions are calculated

Baseline Selection

Approach 1

Baseline N rate calculated from:

- Site-specific, farmer N fertilizer management records

Require at least five years prior to project period depending on rotation

Used preferentially due to finer spatial resolution

Approach 2

Baseline N rate calculated from:

- County-level yield records aggregated by the USDA NASS
- Yield goal equations for determining N fertilizer rate

Used if farmer records unavailable or unsuitable

Additionality Assessment

Additionality assessed using Performance Test

Regulatory Surplus

- No applicable mandatory law or other regulation is in place to reduce N fertilizer rate below BAU rate

Performance Standard

Exceed a performance (BAU) threshold that is:

- Based on yield-goal approach
- Identical to calculated baseline N rate under Approach 1 or 2

Reductions in N fertilizer N rate (N_2O emissions), below BAU threshold result in project additionality

Dealing with Permanence and Reversal

N_2O emissions avoided are:

- Immediate
- Irreversible
- Permanent

No risk mitigation mechanism for offsets

Producer aggregation

- Collective persistence of credits

Proving no Project Leakage

Farmers can reduce N rate without yield reduction

Yield Goal → Economic Optimization approach

- Yield goal - N rate recommendations from yield history
- Economic optimization - Fertilizer : Grain price ratio

Calculators are available for optimizing N rates

No yield reductions → No yield compensation

No additional N use → No extra N_2O emissions

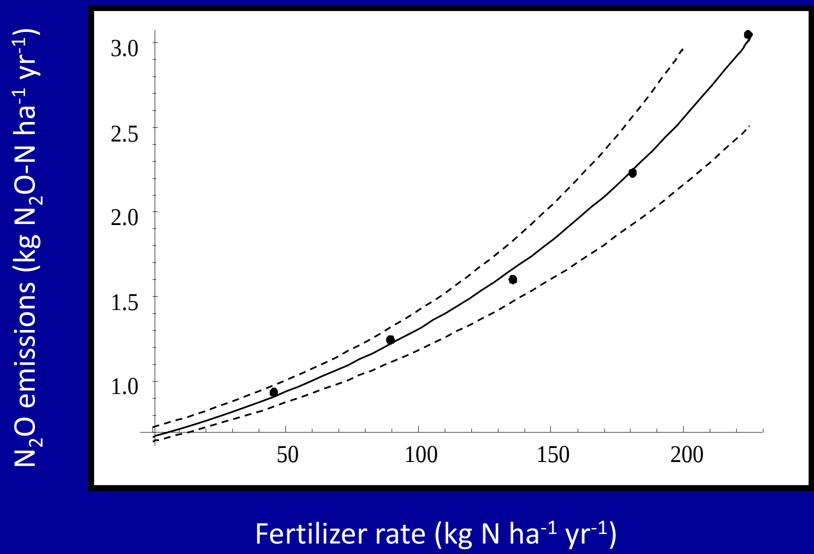
No Project Leakage

Emissions Reductions and Uncertainty

Uncertainty is quantified and included in credit award calculation

$$N_2O_{PR,\,t} = [(N_2O_{B\ total,\,t} - N_2O_{P\ total,\,t}) * AP] * UNC$$

- $N_2O_{PR,\,t}$ → Project emissions reductions
- $N_2O_{B\ total,\,t}$ → Total baseline emissions
- $N_2O_{P\ total,\,t}$ → Total project emissions
- AP → Project area
- UNC → Uncertainty deduction



Uncertainty range at 95% confidence level of project emissions reductions	**Uncertainty factor**
< ± 15%	1.000#
> ± 15% = ± 30%	0.943
> ± 30% = ± 50%	0.893
> ± 50% = ± 100%	0.836

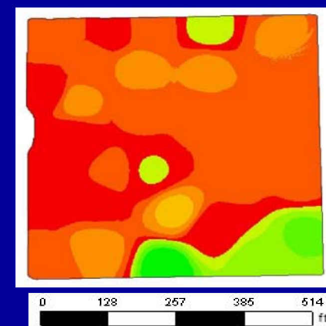
Monitoring and Verification

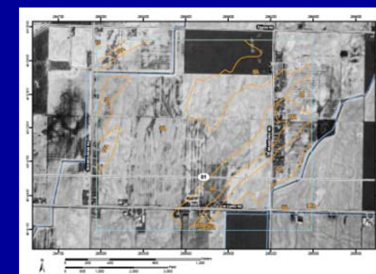
Proof of Practice

- N fertilizer management
- Rotation history
- Site (field) coordinates

Proof of ownership

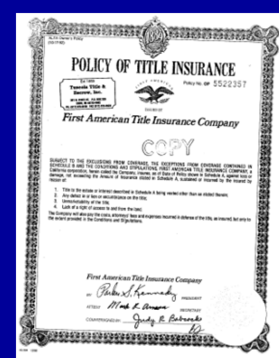
- Title /management documents





LBS/Ton	BIN #	MATERIAL	RPMs
644	6A	44 - 0 - 0 ESN	984
897	2A	Urea	522
460	3A	Potash	405

	lb/ac	ac	%
	0	< 0.01	0.00
	290 - 296	0.66	1.66
	296 - 301	0.95	2.37
	301 - 307	2.05	5.13
	307 - 313	1.69	4.22
	313 - 319	0.02	0.04
	319 - 325	0.50	1.26
	325 - 331	5.24	13.13
	331 - 336	18.63	46.65
	336 - 342	10.20	25.54
	Field Boundary		



#/TON	BIN#	PRODUCT
148	1A	11-52-00 MAP
700	2A	46-00-00 UREA
407	3A	00-00-62 WHITE
745	6A	POLY-COATED UREA
2000		

Validation Status

Verified Carbon Standard

- Public comments (completed)
- 1st Validation (completed)
- 2nd Validation (nearing completion)

American Carbon Registry

- Public comments (completed)
- Peer review (nearing completion)

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Transparent

- Stakeholder understanding

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