The Fertilizer Institute

Nourish, Replenish, Grow

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TFI Comments to Public Posting on VCS of Michigan State University and EPRI N_2O Methodology

1. Introduction

TFI represents the nation's fertilizer industry including producers, importers, retailers, wholesalers and companies that provide services to the fertilizer industry. Its membership is served by a full-time Washington, D.C., staff in various legislative, educational and technical areas as well as with information and public relations programs.

Because our members may be impacted by various agricultural greenhouse gas mitigation systems – TFI and its members have an interest in how these methodologies proceed and develop over time.

At several points in the comments below, the Canada National Inventory Report (CNIR) is referenced as good practice guidance. The CNIR is a good reference point in this case for two reasons. First, N_2O emissions are estimated in the Report as a Tier 2 method, which can be readily compared to Method 2 described in the posted Methodology (the US National Inventory Report uses a Tier 3 method, so it is not as readily comparable to Method 2). Second, the Canadian N_2O quantification method is published in the peer-review literature (Rochette *et al.* 2008), and, as a signatory in the Kyoto Protocol, the CNIR is vetted by international experts through the UNFCCC review process.

2. Development Process

The primary developers of the posted EPRI protocol are expert scientists, but inclusive protocol development requires a suite of multidisciplinary expertise which includes science, policy, and practical implementation. This methodology has been developed through an ad hoc process by a small group of first-time protocol developers, rather than through comprehensive and transparent process of discovering technical (science and policy) consensus.

In several sections, the developers point to the fact that components are published in the peer-review literature. It is important to note, publication of components of the protocol does not constitute the use of a consensus-based, structured, and transparent process of development. For example, publication of the N_2O method used does not necessarily mean that the method represents a consensus of scientific opinion. Further, the protocol for comment differs substantively from the published version (Millar *et al.* 2010, *Mitigation and Adaptation Strategies for Global Change*. DOI 10.1007/s11027-010-9212-7), but no description is given of the process of decision-making which led to these changes. For example, the published version:

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1. Does not address indirect emissions whereas the posted version does, involving a 'new' method for prediction of $Frac_{LEACH}$;
2. Is applied to the 7 Midwest states (involving 27 MLRA's) whereas the newer is deemed applicable to 12 States (involving about 100 MLRA's); and
3. Lacks baseline determination, leakage assessment, additionality, etc. but the posted version introduces the option of two approaches to baseline determination and addresses leakage and additionality.

3. Conformance to ISO 14064-2

The posted Methodology refers to the VCS 2007.1 Program Standard as part of a good VCS lists ISO 14064-2 as a "core" component of the VCS 2007.1 Program Standard:

> The VCS 2007.1 for project proponents, validators and verifiers provides a global standard for voluntary GHG emission reduction and removal projects and their validation and verification. It uses, as its core, the requirements in ISO 14064-2:2006, ISO 14064-3:2006 and ISO 14065:2007.

Based on the information provided in the MSU/EPRI N_2O documentation, it appears that the EPRI protocol does not conform to several requirements of ISO 14064-2. For example, here are some of the requirements that are not satisfied:

ISO 14064-2 Clause 5.1 – *In cases where good practice guidance from more than one recognized origin exists, the project proponent shall justify the reason for using the selected recognized origin*.

- The protocol identifies the VCS guidance documents, a number of CDM tools, and the IPCC guidance as sources of good practice guidance.

- The decision to focus on only CDM tools is puzzling. The CDM tools are designed for use in projects implemented in developing countries, which by definition are limited by lack of technical resources. The North Central Region of the USA, the target area of the posted Methodology, has some of the most comprehensive and sophisticated agricultural infrastructure in the world.

- The IPCC AFOLU guidance is essential to the development of a rigorous GHG reduction quantification protocol for alternative land management. However, there are instances with lack of conformance.

The EPRI protocol uses a limited breadth of scientific literature to support the derivation of the emission quantification equation used for Method 2. A series of one- or two-year studies in a small region of Michigan form the basis of the equation. The posted Methodology states "These field studies are the only ones in the North Central Region (NCR) to specifically investigate long–term N_2O emission responses to a large number of fertilizer N rate treatments in row–crop

agriculture" (Annex G). This limited science basis results in deficiencies discussed below.

ISO 14064-2 Clause 5.4 – *The project proponent shall demonstrate equivalence in type and level of activity of products or services provided between the project and the baseline scenario and shall explain, as appropriate, any significant differences between the project and the baseline scenario. (Rob it is unclear to me if the protocol addresses 'functional equivalence'.*

The newer protocol requires, presumably as a test of functional equivalence, that yield data are collected in both the baseline and the project. However, it does not specify the management practices required to assure production conditions are similar in the project as compared to the baseline. Further, emissions reductions are not calculated on an output intensity basis (kg CO_2e per kg crop), so this further undermines comparability of baseline and project[1].

ISO 14064-2 Clause 5.5 — *In developing the baseline scenario, the project proponent shall select the assumptions, values and procedures that help ensure that GHG emissions reductions or removal enhancements are not over-estimated.*

The efforts to minimize the risk of over-estimation are not thoroughly described in the protocol. Indeed, as will be addressed below, the selected quantification method likely tends to increase the risk of over-estimation.

ISO 14064-2 Clause 5.6 – *The project proponent shall justify not selecting any relevant GHG source, sink and reservoir for regular monitoring.*

The authors also do not justify the exclusion of nitrogen sources added as crop residues. This represents a substantive portion of the nitrogen cycling in a continuous corn system, and an even greater portion in a corn-soybean rotation. Excluding the crop residue GHG source is not only out of conformance with ISO, but likely represents an inconsistency, as will be addressed below, with the IPCC guidance.

ISO 14064-2 Clause 5.7 — If applicable, the project proponent shall select or develop GHG emissions or removal factors that:

(1) are derived from a recognized origin,
(2) are appropriate to the GHG source or sink concerned,
(3) are current at the time of quantification,
(4) take account of the quantification uncertainty and are calculated in a manner to yield accurate and reproducible results, and,
(5) are consistent with the intended use of the GHG report.

The posted Methodology has a number of deficiencies with respect to the selection and development of GHG emission factors. These deficiencies will be addressed in a number of

[1] For a detailed analysis of the importance of output-based intensity metrics, refer to the Draft Working Paper distributed by Nicholas Institute, http://nicholasinstitute.duke.edu/ecosystem/t-agg/output.offsets.pdf

sections below.

4. Completeness of posted Methodology Scope

The exclusion of quantification and monitoring of the nitrogen derived from crop residue creates a deficiency with respect to the ISO 14064-2 standard. In addition, exclusion of source from the protocol (1) is inconsistent with the IPCC guidance, (2) undermines the environmental integrity of implementation, and (3) limits the continuity of the documentation to other environmental services.

Quantification of nitrogen from crop residues is addressed in the IPCC guidance, and also is included in the Tier 2 approach in Canada's National Inventory Report (utlizing the 4R based system). In the corn:corn and corn:soybean rotations nitrogen from crop residues represents a substantive proportion of the active nitrogen in the system. The IPCC guidance (IPCC 2006) states:

> Crop residue N, including N from N-fixing crops and forage/pasture renewal, returned to soils (FCR) The term FCR refers to the amount of N in crop residues (above- and below-ground), including N-fixing crops, returned to soils annually. It also includes the N from N-fixing and non-N-fixing forages mineralised during forage/pasture renewal. Refer to the activity data section on direct N_2O emissions from managed soils (Section 11.2.1.3) and obtain the value for FCR.

An excellent synthesis of the science knowledge to emphasize the need for comprehensive monitoring of crop residue nitrogen is provided in the meta-analysis reported by Van Groenigen *et al.* (2010. *Towards an agronomic assessment of N_2O emissions: a case study for arable crops*. European Journal of Soil Science. doi: 10.1111/j.1365-2389.2009.01217.x). These researchers report the results of analysis to support the conclusion that N_2O emissions increase linearly up to a threshold level of added nitrogen, after which N_2O emissions increase exponentially. But, the analysis concludes, this limit represents the sum of nitrogen taken up by the above-ground crop, including grain and residue. The authors state:

> Our results point in one direction: in order to minimize N_2O emissions and maintain or increase crop yield, N uptake must be maximized.

To support the environmental integrity of modern production agriculture, therefore, it is necessary for the protocol to be revised to assess total nitrogen uptake through monitoring of crop residue nitrogen in addition to crop nitrogen.

Although not specifically intended for this purpose, it is reasonable to expect that quantification methods approved as voluntary offset protocols may influence initiatives such as carbon footprinting, or could even connect to other environmental services such as water quality trading. We believe that addressing crop residue nitrogen is critical for a science-based foundation for other environmental assessments (that may rely on a similar data set).

5. Implementation of Method I — Tier I Approach

Tier 1 approach is designed for use in developing nations, or in regions where no better data is

available. The protocol is designed for use in a region with more data than most developed nations. USA National Inventory Report method is Tier 3. The developers propose the Tier 1and derived "Tier 2" approach is more transparent than a Tier 3 approach; rather, the reverse is more accurate — the clearly described algorithms of the process model allow greater understanding of the emissions calculation than a black-box Tier 1 coefficient applied without regards for soil type, crop history, and fertilizer management. It seems inappropriate that a Tier 1 approach would be considered a science-based approach for a sophisticated region within a developed country.

6. Derivation and Implementation of Meth 2 — "Tier II" Approach

The empirical basis of the Method 2 is data from 8 site-years of data, spanning 2 calendar years from 5 sites. Of these sites, 3 sites are in one Major Land Resource Area (MLRA)[2], and the other 2 sites in MLRA's bordering the first. In contrast, the Tier 2 linear equation of Rochette *et al.* (2008) for Québec-Ontario is based on 72 observations from across this climatic region (Figure 1).

In the method published by Rochette *et al.* (2008), the emission equation for each ecodistrict, an ecological region similar to a Major Land Resource Area (MLRA), is modified to account for predominant climate, topography, soil texture, etc. These modifications are based on empirical evidence from the Québec-Ontario region). Method 2 uses the single exponential equation for the 12-state North Central Region, which comprises roughly 100 MLRA's.

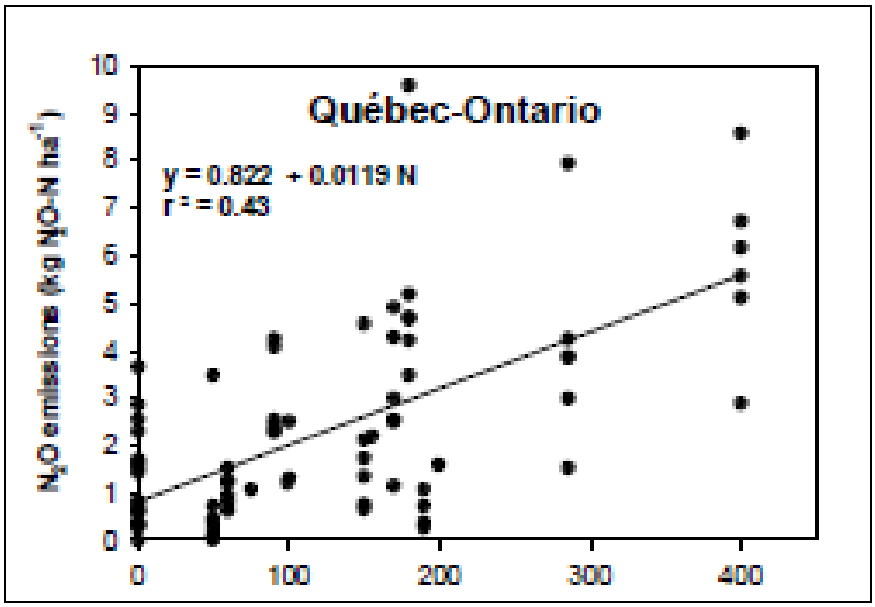

Figure 1. The relationship of N_2O emissions vs fertilizer N determined for the data from Québec-Ontario (n=72).

[2] The definition and a map of MLRA's is available at http://soils.usda.gov/survey/geography/mlra/.

Further, the developers of the posted Methodology report the non-linear response curve used in Method 2 results in more emissions, and consequently more offsets generated, than a Tier 1 approach. In contrast, Rochette *et al.* (2008) report:

> The "N_2O emissions vs fertilizer N" relationship determined for the Québec-Ontario region (Figure 1) had a slope (0.0119 kg N_2O-N kg N^{-1}) similar to the original (0.0125 kg N_2O-N kg N^{-1}) and the revised (0.01 kg N_2O-N kg N^{-1}) IPCC Tier I default EFs.

The claim of the posted Methodology that Method 2 represents a science-based Tier 2 approach to quantify the N_2O emissions for the North Central Region is not consistent with the good practice guidance provided by the Tier 2 method used in Canada's National Inventory Report.

7. Justification for Equations to Determine if Leaching and Runoff Occur (Annex A)

To drive the quantification of indirect emissions from added fertilizer EPRI calculates $Frac_{LEACH}$ is 0.30 when $Precip_{GS} / PET_{GS} \geq 1.00$, and $Frac_{LEACH}$ is 0 when $Precip_{GS} / PET_{GS} < 1.00$. The posted Methodology makes the claim that this derivation of $Frac_{LEACH}$ "is derived from 2006 IPCC and Rochette *et. al.* (2010)".

It is not clear how the $Frac_{LEACH}$ derivation is consistent with IPCC (2006) and Rochette et al. (2008). IPCC (2006) states:

> $Frac_{LEACH-(H)}$ [N losses by leaching/runoff for regions where Σ(rain in rainy season) - Σ (PE in same period) > soil water holding capacity, OR where irrigation (except drip irrigation) is employed], (Table 11.3)

And, Rochette *et al.* (2008) calculates $Frac_{LEACH}$, for areas "with a P/PE value ranging between 0.23 and 1.0" using the linear relation equation:

$$Frac_{,leachi} = 0.3247 * P/PE_i - 0.0247$$

As the methods used in the references provided do not align exactly with the EPRI method, it would be helpful for the developers to describe fully the derivation of their approach to calculation of $Frac_{LEACH}$.

8. Guidance for Implementation of Methodology

The quality of the offsets created by projects implementing the protocol will be judged according to the level of confidence supported by the practices prescribed and documentation required.

The state of the art and science of nitrogen management is represented in the 4R Nutrient Stewardship developed by the Canadian Fertilizer Institute, the Fertilizer Institute, and the International Plant Nutrition Institute[3]. The value of this framework for development of practices to minimize N_2O emissions is summarized in Snyder *et* al. (2009. Review of greenhouse gas emissions from crop production systems and fertilizer management effects.

[3] For a complete description of the 4R's, see the website at http://www.ipni.net/4r.

Agric. Ecosys. Environ. 133: 247-266.). This 4R framework has been adopted and endorsed by the United States Department of Agriculture (USDA, within the 590 Nutrient Management Standard, the Conservation Technology Innovation Center (CTIC), the Association of American Plant Food Control Officials (AAPFCO, state fertilizer regulatory body), the International Plant Nutrition Institute (IPNI), and others. Although aspects of the protocol are not inconsistent with the 4R framework, the practices need to more closely conform to 4R. That is, the protocol does not provide detailed guidance. Without this detailed guidance, it is expected it will be difficult to ensure projects are implemented to simultaneously minimize N_2O emissions while maintaining crop yield, soil quality, and environmental integrity.

In addition, there is essentially no guidance given concerning the documentation needed to provide verifiable evidence that projects have been implemented according to the posted Methodology. Without this detailed guidance, it is expected the project developers will interpret the Methodology to optimize their business opportunities, the project documentation will be deficient, and the verifiability of the practice changes needed to support environmental credibility will be compromised.

Substantive revision of the posted Methodology is needed to bring the guidance for practices prescribed and documentation required to the level needed to generate verifiable offsets.

Conclusion

TFI appreciates the opportunity to provide comments on this developing protocol. For questions or comments please contact me directly by telephone at (202) 515-2706 or via e-mail at wcherz@tfi.org.