CORRECTIONS AND CLARIFICATIONS TO *VM0042 METHODOLOGY FOR IMPROVED AGRICULTURAL LAND MANAGEMENT, V2.0*

Publication date: 22 January 2024
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This document provides corrections and clarifications applicable to *VM0042 Methodology for Improved Agricultural Land Management, v2.0*. Such corrections and clarifications are effective on their issuance date. Project proponents and validation/verification bodies (VVBs) shall apply and interpret *VM0042, v2.0* consistent with the clarifications set out in this document.

These updates will be incorporated into the next issued version of the methodology.

Correction/ Clarification	Description	Section reference in the corrected methodology version
Clarification 1	Added names of experts who provided input to v1 and v2 of VM0042	Preamble (page 2)
Clarification 2	Updated titles of CDM tools and clarified that tools inactivated due to procedural reasons are still applicable for use with the methodology	1, 8.2.2 and 9
Clarification 3	Revised definition of “Sample unit” (changed to “Quantification unit”). Added definition of “Stratum” (pl. “Strata”). Added illustration to Section 8.2.1.2. showing the hierarchy applied when defining quantification units and strata.	3 (term “Quantification unit” updated throughout the methodology) and 8.2.1.2
Clarification 4	Added footnotes clarifying that it is the responsibility of the project proponent to ensure they have any required licenses for models used in a project, and that the project proponent must include the model source in the project description.	4, Applicability Condition 4a

Correction/ Clarification	Description	Section reference in the corrected methodology version
Clarification 5	Moved sentence to VMD0053, Section 5.2.6. Review and Approval of Model Validation Reports	4, Applicability Condition 4e
Clarification 6	Changed $x = 3$ years to $x \geq 3$ years as minimum time frame to set the historical look-back period. Definition of variable t to improve readability.	6
Correction 7	Added liming to list of minimum specifications for ALM practices in the baseline scenario to be consistent with Section 8.2.4 Carbon Dioxide Emissions from Liming introduced from VM0042, v1 to v2.	6, Table 4
Clarification 8	Added sentence to clarify that when implementing only one activity, the adoption rate of that practice must be lower than 20 percent. Specified that all projects proposing independent local expert attestation must provide the qualifications of the expert and the methods used to inform their analysis.	7
Clarification 9	Specified that, when following Quantification Approach 1, measured data of CH_4 and N_2O fluxes as described in *VMD0053, v2.0* are required for model calibration and validation, but periodic measurements of CH_4 and N_2O fluxes as part of project monitoring are not required. Corrected inclusion of N2O from manure deposition allowable under Quantification Approach 1.	8.1, Table 5
Correction 10	Separation of SOC content and bulk density as model inputs with respective quantification requirements	8.2, Table 6 and 8.3, Table 8
Clarification 11	Clarifying guidance for project proponents that baseline control sites must remain constant over project lifetime	8.2

Correction/ Clarification	Description	Section reference in the corrected methodology version
Correction 12	Language harmonization between Table 4 and Table 7	8.2, Table 7
Correction 13	Updated equation numbers in equation map of this methodology and added subsection title “Summary”	8.2, Figure 1
Clarification 14	Added “processing” to subsection title “Collection and Processing of Soil Samples” and clarified procedures and reporting requirements for soil sample processing	8.2.1.3
Clarification 15	Added clarification of sampling requirement down to bedrock where soil depth is shallower than 30 cm	8.2.1.3, bullet 7b
Correction 16	Removed unnecessary requirement to sample contiguous cores to enable SOC stock change quantification on an equivalent soil mass basis	8.2.1.3, bullet 7c
Clarification 17	Added guidance for selecting laboratory to analyze soil samples	8.2.1.4
Correction 18	Corrected description for bulk density determination	8.2.1.5
Clarification 19	Added footnote pointing to VM0047 for project activities where woody biomass is expected to be the main carbon pool affected	8.2.2
Correction 20	Corrected position of conversion factor from kg to t	8.2.10, Eq. 29
Clarification 21	Changed location of guidance for selecting sources of data for emission factors	8.3, 8.1

Correction/ Clarification	Description	Section reference in the corrected methodology version
Correction 22	Replaced “manure” with “organic amendment”	8.4.1 and 9.2, parameter table for $CC_{wp,oa,t}$
Clarification 23	Added footnote specifying that leakage calculation also applies to project scenarios where application rate of organic amendments increases compared to the baseline	8.4.1
Clarification 24	Specified reference to Section 6.2 for applying CDM Tool 16, and corrected parameter definition	8.4.4 and 8.5, Eq. 38
Clarification 25	Added explanation of subtraction order in reductions and removals equations	8.5
Correction 26	Removed factor 44/12 from equation to calculate CO_2 removals resulting from enhancing the SOC pool	8.5.1, Eq. 40
Correction 27	Corrected order of parameters to quantify CO_2 reductions, and adjusted order of parameter descriptions	8.5.1, Eqs. 41 and 44
Clarification 28	Corrected parameter subscript (*wp* instead of *pr*) and edits linking VM0042 to VMD0053	8.6.1.1
Clarification 29	Clarified model update requirements after true-up sampling	8.6.1.3
Correction 30	Improved language of parameter descriptions to be more precise	8.6.4, Eq. 65
Correction 31	Moved Box 1 to Section 6 as it pertains to baseline emissions, and clarified that it applies to all parameters with subscript *bsl*	9, Box 1

Correction/ Clarification	Description	Section reference in the corrected methodology version
Clarification 32	Clarified that data are required for modeling baseline emissions	9.2, parameter tables BD_{corr} and d
Correction 33	Corrected source of data for parameter $CC_{wp,oa,t}$	9.2, parameter table for $CC_{wp,oa,t}$
Correction 34	Corrected parameters $Frac_{GASF}$, $Frac_{GASM}$ and $Frac_{LEACH}$ from Eqs. 23 and 24 to be consistent with the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*	9.2, parameter tables for $Frac_{GASF}$, $Frac_{GASM}$ and $Frac_{LEACH}$
Correction 35	Replaced bulk density with ESM in parameter tables for $\overline{SOC_{bsl,i,t}}$ and $\overline{SOC_{wp,i,t}}$	9.2, parameter tables for $\overline{SOC_{bsl,i,t}}$ and $\overline{SOC_{wp,i,t}}$
Correction 36	Replaced "monitoring period" with "verification period"	Throughout the methodology
Correction 37	Corrected section references and versioning of VCS documents	Throughout the methodology

CLARIFICATION 1

Clarification:

Version 1.0 of this methodology was developed by TerraCarbon LLC and Indigo Ag. The lead authors were David Shoch and Erin Swails from TerraCarbon. Contributions from Indigo were made by (in alphabetical order): Chris Black, Charlie Brummit, Nell Campbell, Max DuBuisson, Dan Harburg, Lauren Matosziuk, Melissa Motew, Guy Pinjuv and Ed Smith. Version 1.0 was approved on 19 October 2020.

Valuable input was provided by (in alphabetical order): Peter Beare (World Business Council for Sustainable Development, Switzerland), Deborah Bossio (The Nature Conservancy, USA), Rori Cowan (Climate Smart Group, USA), Annette Cowie (New South Wales Department of Primary Industries, Australia), Jessica Davies (Lancaster University, UK), Karen Haugen-Kozyra (Viresco Solutions, Canada), Louisa Kiely (Carbon Farmers of Australia, Australia), Johannes Lehmann (Cornell University, USA), Paul Luu (4 per 1000 Initiative, France), Ken Newcombe (C-Quest Capital, USA), Sean Penrith (Gordian Knot Strategies, USA), Jeffrey Seale (Bayer US – Crop Science, USA), Tom Stoddard (Native Energy, USA), Moritz von Unger (Silvestrum Climate Associates, LLC, USA), Matthew Warnken (Agriprove: Soil Carbon Solutions, Australia), and Leigh Winowiecki (World Agroforestry, Kenya).

Version 2.0 of this methodology was prepared by Verra. Revisions to the uncertainty section were prepared by Dan Kane and Jaclyn Kachelmeyer, TerraCarbon LLC with input from Brian McConkey, Viresco Solutions and Beth Ziniti, Applied Geosolutions; and in consultation with several external experts.

Valuable input was provided by (in alphabetical order): Denis Angers (Laval University, Canada), Eyal Ben-Dor (Tel Aviv University, Israel), Charlie Brummit (Indigo Ag, USA), Rich Conant (Colorado State University, USA), Ciniro Costa Jr (Alliance of Bioversity International and the International Center for Tropical Agriculture, Brazil), Annette Cowie (New South Wales Department of Primary Industries, Australia), Cole D. Gross (University of Alberta, Canada), Mario Guevara (National Autonomous University of Mexico, Mexico), Stefan Hauser (International Institute of Tropical Agriculture, Nigeria), Beverly Henry (Queensland University of Technology, Australia), Dan Kane (TerraCarbon, USA), Tony Knowles (Cirrus Group, South Africa), Emily Kyker-Snowman (Yale University, USA), Johannes Lehmann (Cornell University, USA), Jose Lucas Safanelli (Woodwell Climate Research Center, USA), Brian McConkey (Viresco Solutions, Canada), Emily Oldfield (EDF, USA), Guillermo Peralta (FAO/Carbon Group, Argentina), Cornelia Rumpel (INRAE, France), Jonathan Sandermann (Woodwell Climate Research Center, USA), Pete Smith (University of Aberdeen, Scotland), Adam von Haden (University of Wisconsin, USA), Britta Weber (Ruumi, Germany), John Wendt (International Fertilizer Development Center, Kenya), Niklas Witt (Klim, Germany), and Beth Ziniti (Regrow, USA).

Background:

Acknowledgment of experts involved in the methodology development and revision processes through ad-hoc working groups and consultations via e-mail.

CLARIFICATION 2

Clarification:

1 SOURCES

This methodology uses the latest versions of the following Clean Development Mechanism (CDM) methodologies and tools:

- *AR-TOOL14 Methodological Tool: Estimation of Carbon Stocks and Change in Carbon Stocks of Trees and Shrubs in A/R CDM Project Activities*
- *~~Simplified Baseline and Monitoring Methodology for Small Scale CDM Afforestation and Reforestation Project Activities Implemented on Lands Other Than Wetlands~~AR-AMS0007: Afforestation and reforestation project activities implemented on lands other than wetlands --- Version 3.1*
- *Tool for Testing Significance of GHG Emissions in A/R CDM Project Activities*[1]
- *TOOL24 Methodological Tool: Common Practice*
- *A/R Methodological Tool: Tool for the Identification of Degraded or Degrading Lands for Consideration in Implementing CDM A/R Project Activities*[2]
- *TOOL16 Methodological Tool: Project and Leakage Emissions from Biomass*

Background:

Confirm the applicability of CDM tools as part of the quantification of GHG emission reductions and removals in VM0042.

[1] This tool was deactivated by the CDM as it is no longer required in light of methodology improvements (see CDM Executive Board Meeting Report 68 from 16–20 July 2012). There were no technical concerns with the procedures described in the tool; therefore it is still valid in the context of VM0042.

[2] This tool was deactivated by the CDM as it is no longer required as a standalone document (see CDM Executive Board Meeting Report 75 from 30 September–4 October 2013). There were no technical concerns with the procedures described in the tool; therefore it is still valid in the context of VM0042.

CLARIFICATION 3

Clarification:

3 DEFINITIONS

~~Sample unit~~Quantification unit

Defined area within the project for which emissions reductions and removals are estimated using the selected quantification approach. ~~The entire project area is divided into multiple sample unit that must be demonstrated to be homogenous for the purposes of estimating emission reductions and removals (ERRs) (i.e., similar management activities, soil type, climate). Estimates of ERRs for each sample unit within the project area are then aggregated to produce an estimate for the entire project area. Sample units must be clearly defined in the description of the sampling design provided in the project description document.~~

Stratum

A subset of each quantification unit within which the value of a variable (e.g., SOC stocks), and the processes leading to change in that variable, are relatively homogenous.

[...]

8.1 Summary

[...]

The entire project area is divided into multiple quantification units that must be demonstrated to be more homogenous than the project area in its entirety, for the purposes of estimating emission reductions and removals (ERRs) (i.e., similar management activities, soil type, climate). In some cases, the entire project area may be considered as one quantification unit. Estimates of ERRs for each quantification unit within the project area are then aggregated to produce an estimate for the entire project area. In a staged (i.e., hierarchical, nested) design, additional units nested within a primary quantification unit may be implemented resulting in primary, secondary, tertiary, etc. quantification units (see Appendix 6 for an example). Quantification units must be clearly defined in the description of the sampling design provided in the project description document.

8.2 Baseline Emissions

Quantification Approach 2

[...]

Since stratified random sampling is the required sampling strategy for this methodology (see Section 8.2.1), there must be at least one control site per stratum or the control site must be divided into the same strata as the corresponding quantification unit.

[...]

8.2.1.2. Sampling Design: Stratified Random Sampling

Soil sampling must be conducted following the stratified random sampling strategy.[27] Each quantification unit within the project area should be divided into ~~homogenous strata~~ sub-units (i.e., strata) based on factors influencing SOC stock distribution (see below) that make each stratum more homogenous than the project area in its entirety.

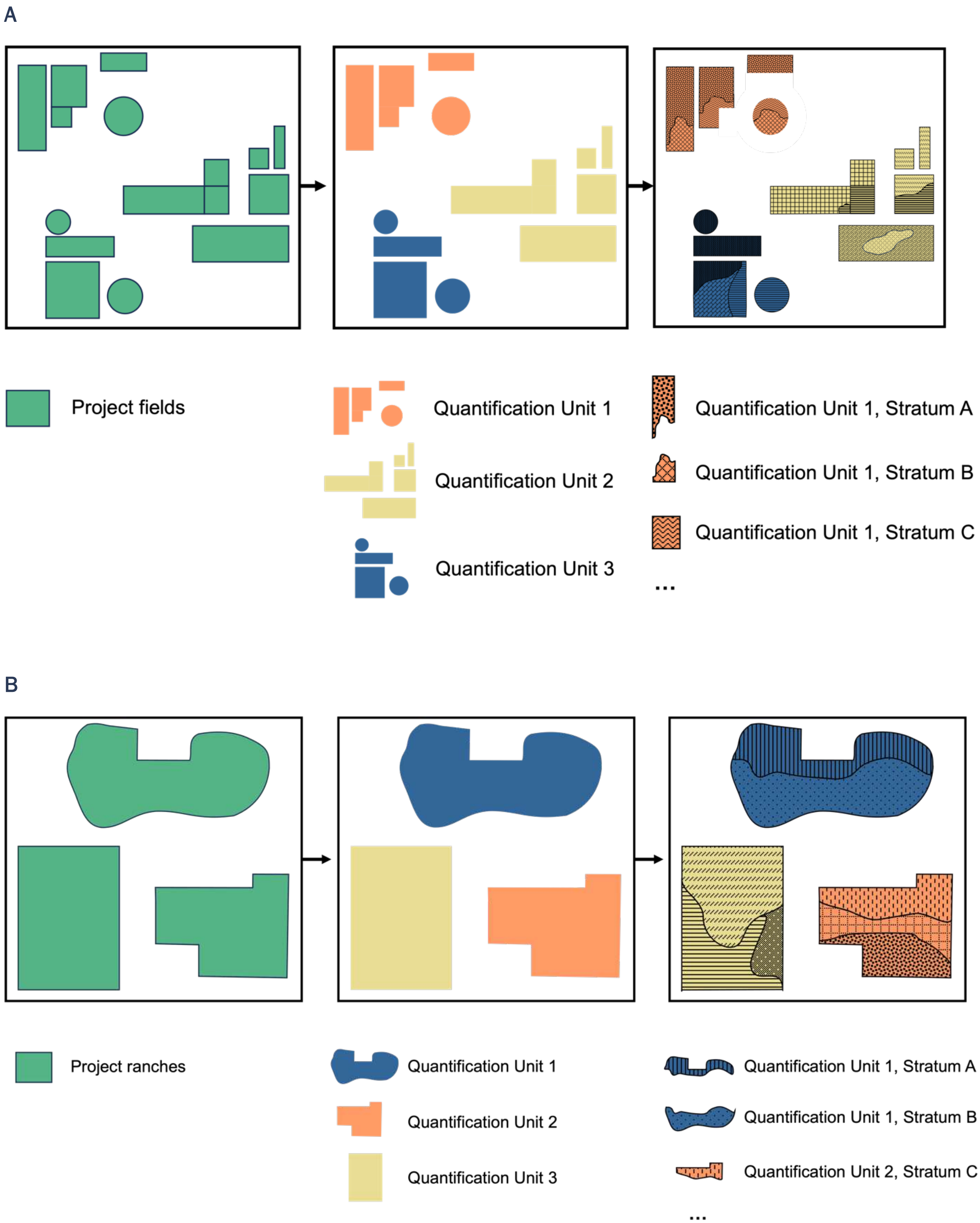
Each quantification unit within the project area must be divided into homogenous strata based on factors influencing SOC stock distribution. In a staged (i.e., hierarchical, nested) design, strata should be generated at the lowest level of quantification unit (see Appendix 6 for an example). Thus, if a sampling design establishes primary and secondary quantification units, strata should be generated as a subset of each secondary quantification unit. The aim of stratifying each quantification unit is to capture SOC stock variability more accurately. Depending on the size of the agricultural fields or paddocks, strata may span numerous fields/paddocks, or one field/paddock may be divided into several strata.

Figure 2 shows two examples of defining quantification units and strata. Random samples should be taken in each stratum.

[...]

[27] Detailed descriptions of how to conduct stratified random sampling are provided in Annex 3 in FAO (2020) and in Module B in World Bank (2021).

Figure 1: Examples of defined quantification units and strata



Numerous factors determine SOC heterogeneity at field (10–100 ha) and landscape (100–1000 ha) scales, including climate, topography, historical land use and vegetation, parent material, soil texture and soil type. Stratifying the project area (or sampling units) into ~~homogenous~~ strata that are more homogenous than the project area in its entirety, defined by factors that influence SOC stocks (e.g., those listed as similarity criteria for defining baseline control sites in Table), should improve sampling efficiency and reduce errors associated with project-scale estimates of SOC stocks.

Background:

Enhance clarity around the two terms “Quantification unit” (previously “Sample unit”) and “Stratum,” which are essential for designing sampling and quantification strategies as part of project monitoring, reporting and verification (MRV).

CLARIFICATION 4

Clarification:

4 APPLICABILITY CONDITIONS

4) Empirical or process-based models used to estimate stock change/emissions via Quantification Approach 1 must be:

   a) Publicly available, though not necessarily free of charge,[4] and from a reputable and recognized source (e.g., the model developer’s website, IPCC or government agency). Sufficient conceptual documentation of inputs, outputs and information on how the model functionally represents SOC dynamics must be accessible to the public. The project proponent must include the model source in the project description (e.g., hyperlink to the model and date of webpage access or citation of peer-reviewed publication). Providing the source code or an API for independent replication of calculations is not required;

Background:

Streamline project reviews by enhancing transparency of information required in project documents.

[4] It is the responsibility of the project proponent to ensure they have any required licenses for models used in a project.

CLARIFICATION 5

Clarification:

4 APPLICABILITY CONDITIONS

4) Empirical [...]

e) Using the same model version in the baseline and project scenarios. Further, the same parameters/parameter sets must be used in the baseline and project scenarios. Model input data must be derived following guidance in Table and Table. Model uncertainty must be quantified following guidance in Section 8.6. ~~Models may be recalibrated or revised based on new data, or a new model may be applied, provided the above requirements are met.~~

Background:

Streamline project reviews because information on model recalibration is not required at project validation.

CLARIFICATION 6

Clarification:

6 BASELINE SCENARIO

[...]

Note that under Quantification Approach 1, direct SOC stock estimates are also required at time $t = 0$ years to serve as model input for model initialization.[8]

[...]

Development of Schedule of Activities in the Baseline Scenario
[...] Where a crop rotation is not implemented in the baseline, $x \geq 3$ years. For each year, $t = -1$ to $t = -x$ (i.e., years preceding project start), information on ALM practices must be determined, per the requirements presented in **Table**.

[8] Per Table, baseline SOC stocks may be (back-)modeled to t = 0 from measurements collected within ±5 years of $t = 0$.

Background:

Clarify that the historical look-back period may be longer than three years where a crop rotation is not implemented in the baseline.

CORRECTION 7

Correction:

6 BASELINE SCENARIO

[...]

Table 4: Minimum specifications for ALM practices in the baseline scenario

ALM Practice	Qualitative	Quantitative
Crop Planting and Harvesting	• Crop type(s)	• Approximate date(s) planted (where applicable) • Approximate date(s) harvested/terminated (where applicable) • Crop yield (where applicable)
Nitrogen Fertilizer Application	• Manure (Y/N*) • Compost (Y/N) • Synthetic N fertilizer (Y/N)	• Manure type application rate (where applicable) • Compost type application rate (where applicable) • N application rate in synthetic fertilizer (where applicable)
Tillage and/or Residue Management	• Tillage (Y/N) • Crop residue removal (Y/N)	• Depth of tillage (where applicable) • Frequency of tillage (where applicable) • Percent of soil area disturbed (where applicable) • Percent of crop residue removed (where applicable)
Water Management/Irrigation	• Irrigation (Y/N) • Flooding (Y/N)	• Irrigation rate (where applicable)
Grazing Practices	• Grazing (Y/N) • Animal type (where applicable) • Harvesting/mowing (Y/N)	• Animal stocking rate (i.e., number of animals and length of time grazing in each area annually, where applicable) • Frequency of harvest

ALM Practice	Qualitative	Quantitative
Liming	• Application of calcitic limestone or dolomite (Y/N)	• Calcitic limestone or dolomite application rate (where applicable)

* Y/N: Yes/No

Background:

Addition of liming to list of minimum specifications for ALM practices in the baseline scenario to be consistent with Section 8.2.4 Carbon Dioxide Emissions from Liming introduced in *VM0042 v2.0*.

CLARIFICATION 8

Clarification:

7 ADDITIONALITY

Step 3: Demonstrate that adoption of the suite of proposed project activities is not common practice

The project proponent must determine whether the proposed project activity or suite of activities[10] are common practice in each region included within the project spatial boundary. Common practice is defined as greater than 20 percent adoption.[11] Where the project is implementing only one activity, the adoption rate of that practice must be lower than 20 percent in each region within the project spatial boundary. To demonstrate that a project suite of activities is not common practice, the project proponent must show that the weighted mean adoption rate of the two (or more) predominant[12] proposed project activities within the project spatial boundary is below 20 percent[13] (see Equation (1)).

[10] The suite of activities refers to all activities implemented across the aggregated project. It does not refer to the activities implemented on each individual farm.

[11] Twenty percent is the precedent for a common practice threshold established in Section 18 of the CDM Methodological tool: Common practice. Available at: https://cdm.unfccc.int/methodologies/PAmethodologies/tools/am-tool-24-v1.pdf.

[12] Determined based on the extent of the project area (i.e., hectares) covered.

[13] Where a project is planning to implement two activities, common practice must be assessed based on the weighted mean of those two activities. Where only one activity is implemented, common practice must be assessed solely based on that activity's adoption rate (i.e., the adoption rate of that activity must be below 20 percent).

[...]

Where evidence for a single proposed project activity in the region is not available from any of these sources, the project proponent may obtain a signed and dated attestation statement from a qualified independent local expert (e.g., agricultural extension agent, accredited agronomist) estimating the adoption rate for the weighted mean calculation. Where evidence on the suite of proposed activities is unavailable, a qualified independent local expert may provide a signed and dated attestation statement stating whether the proposed suite of project activities is common practice in the region and providing estimated values for the regional existing adoption rate of proposed project activities (EA_{ay}; see Equation (1)). All projects using independent local expert attestation must provide the qualifications of the expert and the methods used to inform their analysis.

Background:

Streamline project reviews by enhancing transparency of information required in project documents.

CLARIFICATION 9

Clarification:

8.1 Summary

Table 5: Summary of allowable quantification approaches

GHG/ Pool	Source	Quantification Approach 1: Measure and Model*	Quantification Approach 2: Measure and Remeasure	Quantification Approach 3: Default Factors
CO_2	SOC	X	X	
	Fossil fuel			X
	Liming			X
	Woody biomass**			
CH_4	Soil methanogenesis***	X		
	Enteric fermentation			X
	Manure deposition			X
	Biomass burning			X
N_2O	Use of nitrogen fertilizers***	X		X
	Use of nitrogen-fixing species***	X		X
	Manure deposition***	X		X
	Biomass burning			X

[...]

*** Measured data on CH_4 and N_2O fluxes as described in *VMD0053, v2.0* are required for model calibration and validation when following Quantification Approach 1. Periodic measurements of CH_4 and N_2O fluxes as part of project monitoring is not required.

[...]

Quantification Approach 1: Measure and Model

An acceptable model is used to estimate GHG flux based on soil characteristics, implemented ALM practices, measured initial SOC stocks and climatic conditions in quantification units. Measurements of SOC stocks are required every five years or more frequently (see Table). The remeasurement data is used to re-estimate model prediction error and recalibrate the model (i.e., "true-up", see Section 0). Neither initial nor periodic measurements of CH_4 and N_2O fluxes are required as part of project monitoring. High-quality observed experimental data on soil CH_4 and N_2O emissions from controlled research trials or approved data sources as described in *VMD0053* are required for model calibration (see Section 5.1 of *VMD0053* and validation (see Section 5.2.3 of *VMD0053*. Measured datasets must be drawn from peer-reviewed and published experimental datasets with measurements of N_2O and CH_4 fluxes, ideally using control plots to test the practice change. Datasets may also be drawn from a benchmark database maintained by a third party or from measurements made within the project boundary, where approved by the independent modeling expert (see Appendix 1 of *VMD0053*).

Background:

Clarify monitoring requirements for CH_4 and N_2O emissions when following Quantification Approach 1. Correct allowable quantification approaches for N_2O emissions from manure deposition.

CORRECTION 10

Correction:

8.2 Baseline Emissions

Table 6: Guidance on collection of biophysical model inputs for the baseline scenario, where required by the model selected

Model Input Category	Timing	Approach
SOC content ~~and bulk density~~ to calculate SOC stocks (initial)	Determined prior to project intervention via direct measurements at *t* = 0 or (back-) modeled to *t* = 0 from measurements	Directly measured via conventional analytical laboratory methods, for example dry combustion, or proximal sensing techniques (e.g., INS, LIBS, MIR and Vis-NIR) with known uncertainty following the criteria in Appendix 4 at *t* = 0 or (back-) modeled to *t* = 0 following VMD0053 guidance. See parameter table for $\overline{SOC_{bsl,i,t}}$.

	collected within ±5 years of *t* = 0	
Bulk density to calculate SOC stocks (initial)	Determined prior to project intervention via direct measurements at *t* = 0 or from measurements collected within ±5 years of *t* = 0	See Section 8.2.1.5
Soil properties (other than bulk density and SOC)	Determined prior to project intervention	Directly measured or determined from published soil maps with known uncertainty. Estimates from direct measurements must: • Be derived from representative (unbiased) sampling; and • Ensure accuracy of measurements through adherence to best practices.
[...]	[...]	[...]

[...]

8.3 Project Emissions

Table 8: Guidance on collection of model inputs, where required by the model selected, for Quantification Approach 1 for the project scenario.

Model Input Category	Timing	Approach
SOC content ~~and bulk density~~ to calculate SOC stocks	Determined at project start via direct measurements at *t* = 0 or (back-) modeled to *t* = 0 from measurements collected within ±5 years of *t* = 0. Subsequent measurements are required every five years or more frequently.	Directly measured via conventional analytical laboratory methods — for example dry combustion or proximal sensing techniques (INS, LIBS, MIR and Vis-NIR) — with known uncertainty, following the criteria in Appendix 4 and VMD0053 guidance. See parameter table for $\overline{SOC_{wp,i,t}}$.
Bulk density to calculate SOC stocks (initial)	Determined prior to project intervention via direct measurements at *t* = 0 or from measurements collected within ±5 years of *t* = 0	See Section 8.2.1.5

Soil properties (other than bulk density and SOC)	Determined ex ante	Measured or determined from published soil maps with known uncertainty. Estimates from direct measurements must: 1) Be derived from representative (unbiased) sampling; and 2) Ensure accuracy of measurements through adherence to best practices (to be determined by the project proponent and outlined in the monitoring plan).

Background:

Separate SOC content and bulk density in lists of required model inputs to correctly describe quantification approaches for bulk density.

CLARIFICATION 11

Clarification:

8.2 Baseline Emissions

Quantification Approach 2

[...]

Control sites may be managed by project proponents, implementing partners or by entities external to the project (e.g., experimental research stations outside of the project area). Management of control sites may change during the project but the location of baseline control sites themselves must remain constant over the project lifetime. Control sites must be sufficiently large to ensure that any changes in SOC stocks are driven by baseline management practices (i.e., edge effects must be eliminated) and to allow for baseline practices to continue unimpeded (e.g., tractors, combines or other equipment must be able to operate as they would under normal conditions).

Background:

Clarify guidance for project proponents when setting up baseline control sites.

Verified Carbon Standard
A VERRA STANDARD

CORRECTION 12

Correction:

8.2 Baseline Emissions

Quantification Approach 2

[...]

Table 7: Similarity criteria for linking baseline control sites to quantification units under Quantification Approach 2

Control Site Similarity Criterion	Threshold[a]
[...]	[...]
Historical ALM activities	Historical ALM activities must be the same as in the linked quantification unit for at least five years prior to project start date: • Tillage (Y/N[d]) and type of tillage practice (no tillage, conservation tillage or conventional (full) tillage) • Crop residue removal (Y/N) ~~Residue management – retained or burnt/removed~~ • Crop planting and harvesting (crop type[e]) ~~Cropping – continuous cash crops, cover crops or fallows~~ • Manure application (Y/N) • Compost application (Y/N) ~~Organic amendmenets (manure or compost) – yes or no~~ • Irrigation (Y/N) ~~– yes or no~~ Note that not all of these activities will be universally relevant to all agricultural systems and the project proponent must therefore provide evidence supporting the selected historical ALM activities used to link control sites with quantification units. See Box 1 for guidance on data sources for establishing historical ALM activities.
[...]	[...]

[...]

[d] Y/N: Yes/No

[e] Where crop type in the quantification unit of the project area cannot be matched in the baseline control site, a different crop from the same crop functional group may be selected. Crop functional group is defined in VMD0053 as "Broad category of crop species with similar characteristics (e.g., grasses, legumes, non-legume broadleaf species)."

Background:

Harmonize language between Table 4 (baseline requirements under Quantification Approach 1) and Table 7 (baseline requirements under Quantification Approach 2) to ensure that the approaches are equally rigorous.

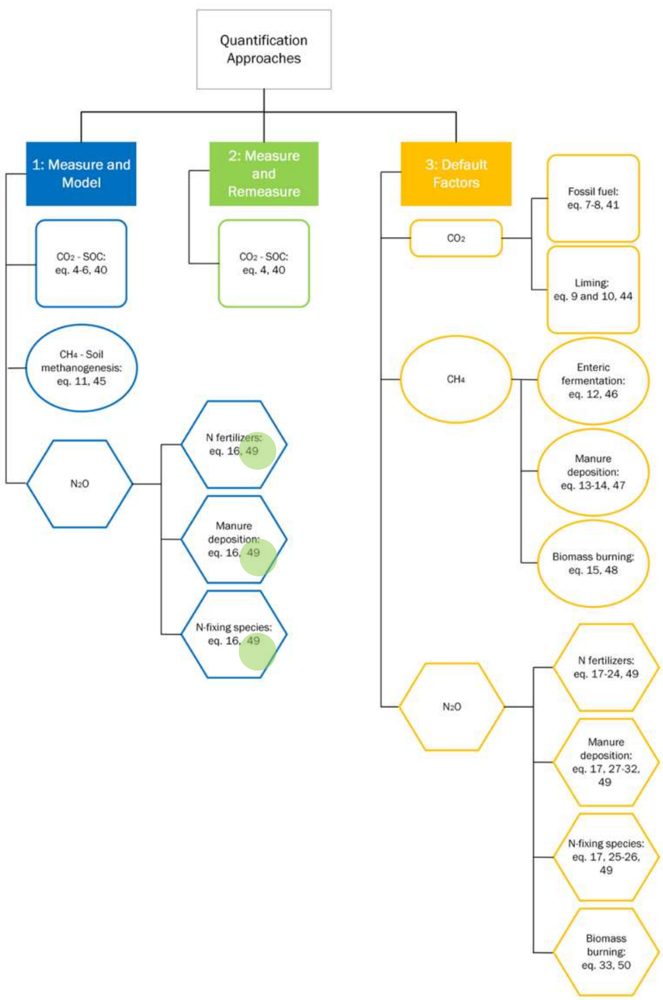
CORRECTION 13

Correction:

8.2 Baseline Emissions

Summary

Figure 1 summarizes which equations are to be applied to each GHG flux depending on the selected quantification approach (see also Table 5).



Background:

Added subsection title "Summary" for greater clarity on the section's structure and corrected reference to Equation 49 for N_2O emissions following Quantification Approach 1 in Figure 1.

CLARIFICATION 14

Clarification:

8.2.1.3 Collection and Processing of Soil Samples

The following are guidelines for collection and processing of soil samples and reporting~~.~~:

[...]

4) Soil mass must not include particles greater than 2 mm in diameter (i.e., gravel/stones) nor plant material.[30] Any coarse material must be prevented from passing through a 2 mm sieve. Drying and sieving procedures must follow laboratory-specific standard operating procedures (SOPs) and be consistent for all samples collected as part of the project, and during the entire project lifetime.

5) Soil samples must be shipped within five days of collection and kept refrigerated until shipping if they are stored in sealed plastic bags. Alternatively, soil samples should be aerated during storage, avoiding mixing of the different soil materials. ~~Drying and sieving procedures must follow laboratory-specific SOPs and be consistent for all samples collected as part of the project.~~

6) Sample processing procedures must be reported in detail, explicitly describing sieving and grinding procedures. These must remain consistent through the entire project lifetime even if there is a change in analytical laboratory.

Background:

Clarify reporting requirements on soil sample processing.

[30] Beem-Miller et al. (2016) provide a useful approach to ensuring high-quality sampling in rocky agricultural soils.

CLARIFICATION 15

Clarification:

8.2.1.3 Collection and Processing of Soil Samples

7) Reporting of SOC stock changes from direct measurements [...]

   b) SOC stocks and stock changes must be reported to a minimum depth of 30 cm (or down to bedrock/hardpan where soils are shallower than 30 cm). To eliminate the need for extrapolation outside of the measured range, soils must be sampled deeper than the minimum 30 cm required for reporting SOC stock changes.

Background:

Clarify sampling requirements for certain geographies.

CLARIFICATION 16

Clarification:

8.2.1.3 Collection and Processing of Soil Samples

7) Reporting of SOC stock changes from direct measurements [...]

   c) To enable the ESM approach, soil samples at re-sampling must ~~be taken as contigoug cores~~ be divided into at least two increments. Soil mass may be derived from bulk density measurements using soil corers.

Background:

Clarify sampling requiremets to enable SOC stock change quantification on an equivalent soil mass basis.

CLARIFICATION 17

Clarification:

8.2.1.4 Measurements of SOC Content

SOC content with known uncertainty should be measured using dry combustion (Dumas method). In addition, the following proximal sensing techniques are allowed: infrared spectroscopy, including near infrared (NIR), visible near infrared (Vis-NIR) and mid-infrared spectroscopy (MIR); laser-induced breakdown spectroscopy (LIBS); and inelastic neutron scattering (INS, also known as neutron-stimulated gamma ray analysis or spectroscopy). Appendix 4 provides criteria for evaluating the use of IR spectroscopy, LIBS and INS.

The selection of an analytical laboratory should be based on its listing as an approved analytical service provider of SOC measurements according to national and/or international standards/accreditation. Where possible, the selected analytical laboratory should be ISO/IEC 17025 accredited. All samples throughout the entire project lifetime should be analyzed in the same laboratory. A change of analytical laboratory requires justification. The project proponent must ensure that soil analysis methods and procedures remain consistent even if there is a change of laboratory.

The selected analytical laboratory should quantify and report analytical error statistics (determined by repeated analyses of the same sample) to project proponents on a regular basis. The selected laboratory should provide information on their internal quality control program, for example inclusion of soil reference material with known results, testing documentation according to quality cards (monitoring of variation in analysis, set of error thresholds). Further evidence of analytical quality performance evaluation should be provided by participation in round-robin testing (e.g., through participation in the North American Proficiency Testing program[32]) or registration as a member of the Global Soil Laboratory Network (GLOSOLAN[33]).

Walkley-Black (wet) oxidation and loss on ignition (LOI) are not recommended due to accuracy concerns but may be applied where no other method is available. The use of remote sensing to estimate and monitor SOC stock changes is not currently allowed. However, it may be permitted in the future once a specific VCS tool is developed and available that provides guidelines that ensure the robustness and reliability of this method.

Background:

Clarify guidance for selecting analytical soil laboratories as part of a project, to ensure integrity of soil data and to streamline VVB assessment.

[32] See https://www.naptprogram.org/

[33] See https://www.fao.org/global-soil-partnership/glosolan/en/

CORRECTION 18

Correction:

8.2.1.5 Measurements of Bulk Density

Bulk density must be ~~measured in the field following~~ determined applying the core, excavation or clod methods in the field, and subsequently processing the samples in the laboratory.

Background:

Correct language on determining bulk density by applying field methods to sample and subsequently processing the samples in the laboratory.

CLARIFICATION 19

Clarification:

8.2.2 Change in Carbon Stocks in Aboveground and Belowground Woody Biomass

[...]

Where woody biomass is included in the project boundary, the relevant Afforestation, Reforestation and Revegetation (ARR) requirements in the latest version of the *VCS Methodology Requirements* apply.[38] Where woody biomass is harvested, projects must calculate the long-term average GHG benefit following guidance in the latest version of the *VCS Methodology Requirements* Section 3.6.6, and the latest version of the *VCS Standard* Sections 3.2.28–3.2.30.

Background:

As VM0047 is the most recent VCS methodology applicable to project activities that increase vegetative cover, projects aiming to achieve CO_2 removals through increased woody biomass are recommended to apply that methodology. For transparency, methodology users are notified that aligning the woody biomass quantification approach with VM0047 is planned as a future revision.

[38] VCS Methodology VM0047 Afforestation, Reforestation and Revegetation is the recommended methodology for projects cultivating woody biomass as a primary project activity. The woody biomass quantification approach will be updated in a future revision of VM0042 drawing from approaches used in VM0047.

CORRECTION 20

Correction:

8.2.10 Nitrous Oxide Emissions from Manure Deposition

[…]

Direct nitrous oxide emissions due to manure deposition in the baseline scenario are quantified using Equations (28) and (29).

$$\overline{N2O\_md_{bsl,direct,i,t,P,S}} = \frac{\sum_{l=1}^{L} F_{bsl,manure,l,i,t,P} \times EF_{N2O,md,l,S} \times 44/28 \times GWP_{N2O}}{\cancel{1000 \times} A_i} \quad (28)$$

$$F_{bsl,manure,l,i,t,P} = 1000 \times \left[\left(Pop_{bsl,l,i,t} \times Nex_{l,P} \right) \times AWMS_{l,i,t,P,S} \times MS_{bsl,l,i,t} \right] \quad (29)$$

Background:

Correct equations for calculation of N_2O emissions from manure deposition.

CLARIFICATION 21

Clarification:

8.3 Project Emissions

[…]

Quantification Approach 3

See Section 8.1.

8.1 Summary

[…]

Quantification Approach 3: Default Factors

GHG flux is calculated following the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* using equations contained in this methodology.

Where a given activity is not practiced in the baseline or project scenarios, resulting in an effective input of zero for any equation element in this methodology, that equation element is not required.

Baseline and project emissions are calculated for each sample field using applicable default values and any monitored parameters. The most accurate available emission factor applicable to the project conditions must be used, in the following descending order of preference:

1) Where available, a project-specific emission factor from a peer-reviewed scientific publication[17] must be used.

2) Where there is no relevant peer-reviewed scientific literature, the project proponent may propose alternative sources of information (e.g., government databases, industry publications) to establish the default factor(s) and must provide evidence that the alternative source of information is robust and credible (e.g., independent expert attestation).

3) Where no alternative information source is available that is applicable to the project conditions, projects may derive emission factors using activity data collected during the project by following the guidance to derive Tier 2 emission factors in the respective sections of the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*.

4) Where projects justify a lack of sufficient activity data and project-specific information sources, Tier 1 and Tier 1a emission factors from the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories* may be selected.

Background:

Clarify that this generally applicable guidance for selecting source of data for emission factors when following Quantification Approach 3 is valid for both baseline and project emissions.

CORRECTION 22

Correction:

8.4.1 Accounting for Leakage from New Application of Organic Amendments from Outside the Project Area

Where new[43] [...]

[17] As stated in Section 2.5.2 of the latest version of the VCS Methodology Requirements, peer-reviewed scientific literature used to derive (default) emission factors must be in a journal indexed in the Web of Science: Science Citation Index.

[43] In this context, “new” refers to ~~manure~~organic amendment application to fields that did not have ~~manure~~organic amendment applied during the historical look-back period.

$$LE_{OA,t} = \sum_{l} \left(M\_OA\sout{manure}_{wp,l,t} \times CC_{wp,oa\sout{l},t} \times 0.12 \times \frac{44}{12} \right) \quad (34)$$

Where:

$LE_{OA,t}$	=	Leakage from organic amendments in year *t* (t CO_2e)
$M\_OA_{wp,l,t}$	=	Mass of organic amendment applied as fertilizer in the project area in year *t* (tonnes)
$CC_{wp,oa\sout{l},t}$	=	Carbon content of organic amendment applied as fertilizer in the project area in year *t* (t C/t ~~manure~~ organic amendment)
0.12	=	Fraction of manure (i.e., organic amendment) carbon expected to remain in project area soils (unitless)
$\frac{44}{12}$	=	Ratio of molecular weight of carbon dioxide to carbon

[…]

9.2 Data and Parameters Monitored

[…]

Data/Parameter	$CC_{wp,oa\sout{l},t}$
Data unit	t C/t ~~manure~~ organic amendment
Description	Carbon content of ~~manure from livestock type l~~ organic amendment applied as fertilizer on the project area in year *t*
Equations	(34)
Source of data	Carbon content provided by retailer of organic amendment may be used. Peer-reviewed published data may be used.
Description of measurement methods and procedures to be applied	Record of carbon content of manure, where available. For manure application, data should be disaggregated for each livestock type *l*.
Frequency of monitoring/recording	Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently.
QA/QC procedures to be applied	Guidance provided in IPCC (2003) Section 5.5 or IPCC (2000) Chapter 8 must be applied.
Purpose of data	Calculation of leakage from application of new organic amendments from outside of the project area ~~of project emissions from leakage~~
Calculation method	Not applicable

Comments	None

Background:

Consistent use of term “organic amendment” for leakage calculation.

CLARIFICATION 23

Clarification:

8.4.1 Accounting for Leakage from New Application of Organic Amendments from Outside the Project Area

Where new[43] or additional[44] manure, compost or biosolids[45] are applied in the project that were not applied in the historical look-back period, there is a risk of activity shifting leakage. [...]

Background:

Specify that leakage calculation also applies to project scenarios where application rate of organic amendments increases compared to the baseline.

CLARIFICATION 24

Clarification:

8.4.4 Accounting for Leakage from Diversion of Biomass Residues Used for Energy Applications in the Baseline Scenario

Where manure or crop residue management is a component of the project activity, and the manure or crop residues are diverted from energy applications (e.g., fuel for cookstoves or biomass power generation) in the baseline scenario there is a risk of leakage. Due to the

[43] In this context, “new” refers to organic amendment application to fields that did not have organic amendment applied during the historical look-back period.

[44] In this context, “additional” refers to organic amendment application to fields that had organic amendment applied during the historical look-back period, where the amount of organic amendment increases in the project scenario.

[45] Biosolids are the nutrient-rich organic materials resulting from the treatment of domestic sewage in a wastewater treatment facility (i.e., treated sewage sludge).

implementation of the project activity, these competing applications might be forced to use inputs which are not carbon neutral. Leakage emissions $LE_{BR,Div,t}$ must be determined following procedures in CDM *Tool 16: Project and leakage emissions from biomass*,[50] Section 6.2 Leakage due to diversion of biomass residues from other applications in year *y*.[51]

[…]

8.5 Net GHG Emission Reductions and Removals

Net GHG emissions removals are quantified as:

$$E_{rem,t} = \left(\left(\Delta CO2_{soil_t} - LE_{OA,t} - LE_{BR,Div,t} \right) \times \left(1 - UNC_{t,CO2} \right) \right) + \Delta C_{TREE,t} + \Delta C_{SHRUB,t} \quad (38)$$

Where:

$E_{rem,t}$	=	Estimated net GHG emissions removals in year *t* (t CO_2e)
$\Delta CO2\_soil_t$	=	Total carbon dioxide emission removals from increasing the SOC pool in year *t* (t CO_2e)
$LE_{BR,Div,t}$	=	Leakage emissions from the diversion of manure or crop residues from baseline energy applications in year *t* (t CO_2e)
$\Delta C_{TREE,t}$	=	Total carbon dioxide emission removals from increasing tree biomass in year *t* (t CO_2e)
$\Delta C_{SHRUB,t}$	=	Total carbon dioxide emission removals from increasing shrub biomass in year *t* (t CO_2e)
$UNC_{t,CO2}$	=	Uncertainty deduction in year *t* associated with modeling or measuring SOC stock changes (fraction between 0 and 1)

Background:

Clarify which section of *CDM Tool 16* must be applied and adjust parameter description.

[50] See Section "Leakage due to diversion of biomass residues from other applications" in the latest version of CDM Tool 16.

[51] For consistency with other parameters in Equation (38), the subscript t pertaining to "year" is used instead of y as in the CDM tool.

CLARIFICATION 25

Clarification:

8.5 Net GHG Emission Reductions and Removals

[...]

In the following subsections, emission reductions are calculated by subtracting baseline (subscript *bsl*) from project (subscript *wp*) emissions, as the emissions are expected to be lower in the project than in the baseline scenario. On the contrary, emission removals are calculated by subtracting project C stocks from baseline C stocks, as C stocks are expected to be higher in the project than in the baseline scenario.

Background:

Clarify why certain equations in this section subtract *bsl* from *wp* emissions and others *wp* from *bsl* emissions.

CORRECTION 26

Correction:

8.5.1 Carbon Dioxide Emission Reductions and Removals

Carbon dioxide emission removals by enhancing the SOC pool for quantification unit *i* in year *t* are quantified using Equation (40).

$$\Delta CO2\_soil_t = \sum_{i=1}^{n}\left(\left(\left(\overline{SOC_{wp,i,t}} - \overline{SOC_{wp,i,t-1}}\right) - \left(\overline{SOC_{bsl,i,t}} - \overline{SOC_{bsl,i,t-1}}\right)\right) \times \frac{44}{12}\right) \times A_i \quad (40)$$

Where:

$\overline{SOC_{wp,i,t}}$	=	Areal mean carbon stocks in the SOC pool in the project scenario for quantification unit *i* at the end of year *t* (t CO_2e/ha)
$\overline{SOC_{wp,i,t-1}}$	=	Areal mean carbon stocks in the SOC pool in the project scenario for quantification unit *i* at the end of year t–− 1 (t CO_2e/ha)
$\overline{SOC_{bsl,i,t}}$	=	Areal mean carbon stocks in the SOC pool in the baseline scenario for quantification unit *i* at the end of year *t* (t CO_2e/ha)
$\overline{SOC_{bsl,i,t-1}}$	=	Areal mean carbon stocks in the SOC pool in the baseline scenario for quantification unit *i* at the end of year t–− 1 (t CO_2e/ha)

The initially measured SOC (at t = 0 determined through direct measurements or (back-) modeled to t = 0 from measurements collected within ±5 years of t = 0) is the same in both the baseline and project scenarios at the outset of the project (i.e., $SOC_{wp,i,0} = SOC_{bsl,i,0}$) for Quantification Approach 1. As a result, the first calculation of Equation (40) for quantification unit i simplifies to $SOC_{wp,i,t} - SOC_{bsl,i,t}$. Note that SOC stock changes must be converted to t CO_2e using the factor 44/12 (ratio of molecular weight of carbon dioxide to carbon).

Background:

Remove factor 44/12 from this equation because units of parameters are already t CO_2e/ha.

CORRECTION 27

Correction:

8.5.1 Carbon Dioxide Emission Reductions and Removals

[…]

Carbon dioxide emission reductions from fossil fuel combustion are quantified as:

$$\Delta CO2\_ff_t = \sum_{i=1}^{n}\left(\overline{CO2\_ff_{bsl\cancel{wp},i,t}} - \overline{CO2\_ff_{wp\cancel{bsl},i,t}}\right) \times A_i \tag{41}$$

[…]

Carbon dioxide emission reductions from liming are quantified as:

$$\Delta CO2\_lime_t = \sum_{i=1}^{n}\left(\overline{CO2\_lime_{bsl\cancel{wp},i,t}} - \overline{CO2\_lime_{wp\cancel{bsl},i,t}}\right) \times A_i \tag{44}$$

Where:

$\overline{CO2\_lime_{bsl,i,t}}$	=	Areal mean carbon dioxide emissions from liming in the baseline scenario for quantification unit i in year t (t CO_2e/ha)
$\overline{CO2\_lime_{wp,i,t}}$	=	Areal mean carbon dioxide emissions from liming in the project scenario for quantification unit i in year t (t CO_2e/ha)
~~$\overline{CO2\_lime_{bsl,i,t}}$~~	~~=~~	~~Areal mean carbon dioxide emissions from liming in the baseline scenario for quantification unit i in year t (t CO_2e/ha)~~

Background:

Correct calculation of CO_2 emission reductions.

CLARIFICATION 28

Clarification:

8.6.1.1 Analytical Calculation of Error Propagation

[...]

8.6.1.1.1 Model Prediction Error

[...]

Assuming that the variance of the model prediction is the same in the project and baseline scenarios (i.e., $s^2_{model,\bullet,wp\cancel{r}} = s^2_{model,\bullet,bsl}$ which is denoted by $s^2_{model,\bullet}$), then:

$$s^2_{model,\Delta\bullet} = s^2\left(\widehat{\Delta\bullet}_{bsl} - \widehat{\Delta\bullet}_{wp\cancel{r}}\right) = 2\left[s^2_{model,\bullet} - cov\left(\widehat{\Delta\bullet}_{wp\cancel{r}}, \widehat{\Delta\bullet}_{bsl}\right)\right] \quad (51)$$

Where:

$s^2_{model,\Delta\bullet}$	=	Variance of modeled estimates of emission reductions in gas or pool • (t CO_2e/ha)^2
$\widehat{\Delta\bullet}_{bsl}$	=	Modeled estimate of change in emissions reductions in gas or pool • in the baseline scenario (t CO_2e)
$\widehat{\Delta\bullet}_{wp\cancel{r}}$	=	Modeled estimate of change in emissions reductions in gas or pool • in the project scenario (t CO_2e)
$s^2_{model,\bullet}$	=	Estimated variance of errors made by model prediction of emissions in gas or pool • (estimated from measurements in fields that need not be side-by-side trials with baseline and project scenarios) (t CO_2e/ha)^2

By writing $cov(\widehat{\Delta\bullet}_{wp\cancel{r}}, \widehat{\Delta\bullet}_{bsl})$ in terms of a correlation coefficient:

$$\rho = \frac{cov(\widehat{\Delta\bullet}_{wp\cancel{r}}, \widehat{\Delta\bullet}_{bsl})}{\sqrt{(s^2_{model,\bullet\, wp\cancel{r}})(s^2_{model,\bullet\, bsl})}} \quad (52)$$

Then:

$$s^2_{model,\Delta\bullet} = 2\, s^2_{model,\bullet}\,(1-\rho)$$

Where:

ρ	=	Correlation of errors in project and baseline scenario pairs (estimated from side-by-side field trials of baseline and project scenarios)

Note – See parameter tables in Section 9.2 for derivation of $\bar{\Delta}_{\bullet,t}$ and $\bar{\bullet}_t$

Because side-by-side trials are rare, ρ is estimated from fewer data points than $s^2_{model,\bullet}$. In the initial stages of a project, it is expected that the datasets used to estimate model prediction error will be ~~the same as those used to validate the model, following the~~

~~procedures outlined in~~from peer-reviewed publications or readily available benchmark datasets that meet the requirements outlined in Section 5.2.3 of VMD0053. As the project proceeds and SOC stocks in the project scenario are periodically remeasured, ~~those~~data from true-up sampling should be ~~used~~added to the model calibration/validation dataset to update the estimate of model prediction error for the SOC pool (see Section 0 for additional details). An updated model validation report (MVR) must be re-submitted for assessment by an independent modeling expert. For other GHG fluxes that are modeled under Quantification Approach 1 (e.g., N_2O, CH_4), model prediction error should continue to be based on the use of validation datasets but may be updated as new validation datasets become available that match the criteria outlined in VMD0053.

[…]

Background:

Consistent parameter subscripts and improved clarity of the linkages between VM0042 and VMD0053.

CLARIFICATION 29

Clarification:

8.6.1.3 Remeasurement, Model True-Up and Cumulative ~~Crediting~~ Modeling

As outlined in Section 0, SOC stocks must be directly remeasured every five years in the project scenario. These data are used to re-estimate model prediction error and/or recalibrate the model in relation to measured SOC stocks.

Prior to remeasurement, model structural error during simulation of SOC stocks for initial model validation will ~~be based solely on the procedures outlined in VMD0053~~ be based on data from peer-reviewed publications and available datasets meeting the requirements detailed in Section 5.2.3 of VMD0053. Specifically, the model is used to simulate changes in stocks from a set of selected external datasets (i.e., field trials for which data have been previously collected).

Following remeasurement (i.e., true-up sampling), data from external datasets and remeasurement within the project area are combined to create a new calibration/validation dataset~~, which is used as follows:~~. If the project proponent so chooses, this dataset may be used to recalibrate model parameters (or parameter distributions in the case of Bayesian models) in an effort to improve model accuracy, although model recalibration is not required. Following remeasurement, project proponents must repeat model validation procedures outlined in VMD0053, submit an updated MVR for review and validation, and update the model prediction error term used in the estimation of the project uncertainty deduction.

1) ~~Where the analytical error propagation method is used, data on remeasured stocks should be used to re-estimate model prediction error following the procedures outlined in Section 8.6.1.1. Since the baseline scenario is modeled under Quantification Approach 1, remeasured stocks may only be used to update estimates of error for the project scenario. Equations (51) and (52) should be followed, in which the correlation coefficient of model errors in the baseline and project scenarios determined at initial model validation is used to adjust the model prediction error estimate.~~

2) ~~Where the Monte Carlo error propagation method is used, remeasured SOC stocks should be used to update the probability distribution functions of model parameters/hyperparameters using the same approach as was applied at initial model validation as per VMD0053.~~

~~Following model true-up via either procedure outlined above~~Once the MVR is approved, proponents should rerun model simulations for both the baseline and project scenarios from t_0 up to present day and recalculate uncertainty deductions to be applied to future credit vintages. VCUs that have been issued in previous verifications will remain unchanged

Background:

Clarify linkages to VMD0053 requirements regarding procedures to update the applied model and the assessment of the model validation report.

CORRECTION 30

Correction:

8.6.4 Uncertainty Deductions

Uncertainty deductions are estimated and applied separately for each ERR source within the project boundary. This deduction is estimated using a probability of exceedance method as follows (see the latest version of the *VCS Methodology Requirements* Section 2.4):

$$UNC_{\bar{\Delta}\cdot,t} = Uncertainty \times t_{\alpha=0.666} \tag{65}$$

$$Uncertainty = \frac{\sqrt{s^2_{\bar{\Delta}\cdot,t}}}{\overline{\Delta\cdot}_t} \times 100$$

Where:

$UNC_{\bar{\Delta}\cdot,t}$	=	Uncertainty deduction for each ~~gas~~GHG or C pool • to be applied in verification period *t* (%)

Uncertainty	=	Half-width of the one standard deviation interval as a percentage of the mean of the ERR estimate for each ~~gas~~GHG or C pool • in verification period *t* (%)
$\overline{\Delta\cdot}_t$	=	Mean ERR estimate~~d emission reduction~~ for each ~~gas~~GHG or C pool • across the entire project area in year *t* (t CO_2e/ha)
$s^2_{\overline{\Delta\cdot},t}$	=	Variance of the mean ERR estimate ~~of mean emission reductions~~ from each ~~gas~~GHG or C pool • at time *t*. See Figure 4 to determine how this is estimated based on the methods employed in the project (t CO2e/ha)^2
$t_{\alpha=0.666}$	=	Critical value of a one-sided student's t-distribution at significance level α = 0.666 (66.6%) with degrees of freedom appropriate to the sampling design used. Equal to approximately 0.4307 at large sample sizes (dimensionless)

Background:

Consistent language use throughout the methodology.

CORRECTION 31

Correction:

6 BASELINE SCENARIO

Continuation of pre-project ALM practices is the most plausible baseline scenario. For each sample unit (e.g., for each field), [...]

Box 1: Sources of qualitative and quantitative data

Sources of information for all undefined activity/management-related model input variables (see Table and Table), and all parameters ~~$FFC_{bsl,j,i,t}$, $Pop_{bsl,l,i,t,P}$, $M_{bsl,SF,i,t}$, $M_{bsl,OF,i,t}$ and $MB_{g,bsl,i,t}$~~ relevant to the **baseline scenario** (i.e., all parameters with the subscript *bsl* that reference Box 1 in its respective parameter table) must follow the requirements detailed below.

[...]

Background:

Correct position of Box 1 to ensure coherence with its applicability to baseline scenario parameters.

CLARIFICATION 32

Clarification:

9.2 Data and Parameters Monitored

[…]

Data/Parameter	BD_{corr}
Data unit	g/cm^3
Description	Corrected bulk density of the fine soil fraction (after subtracting the mass proportion of the coarse fragments), for calibration of SOC models
Equations	(5)
[…]	[…]
Purpose of data	~~Determination of~~ Modeling baseline scenario, calculation of baseline and project emissions
[…]	[…]

Data/Parameter	*d*
Data unit	cm
Description	Soil depth, for calibration of SOC models
Equations	(5)
[…]	[…]
Purpose of data	~~Determination of~~ Modeling baseline scenario, calculation of baseline and project emissions
[…]	[…]

Background:

Clarify connection of parameters BD_{corr} and *d* to data requirements in VMD0053.

CORRECTION 33

Correction:

9.2 Data and Parameters Monitored

[...]

Data/Parameter	$CC_{wp,oa,t}$
Data unit	t C/t organic amendment
Description	Carbon content of organic amendment applied as fertilizer on the project area in year *t*
Equations	(34)
Source of data	~~See Box 1.~~ Carbon content provided by retailer of organic amendment may be used. Peer-reviewed published data may be used.
Description of measurement methods and procedures to be applied	Record of carbon content of organic amendment, where available. For manure application, data should be disaggregated for each livestock type *l*.
Frequency of monitoring/recording	Monitoring must be conducted at least every five years, or prior to each verification event where verification occurs more frequently.
QA/QC procedures to be applied	Guidance provided in IPCC (2003) Section 5.5 or IPCC (2000) Chapter 8 must be applied.
Purpose of data	Calculation of leakage from application of new organic amendments from outside of the project area
Calculation method	Not applicable
Comments	None

Background:

Correct source of data for carbon content of organic amendment. Box 1 applies to baseline scenario parameters, while project scenario parameters must be determined with data collected during the project.

CORRECTION 34

Correction:

9.2 Data and Parameters Monitored

[...]

Data/Parameter	*$Frac_{GASF}$*~~$_{i,S}$~~
Data unit	~~Dimensionless~~ kg N volatilized/kg N applied
Description	Fraction of all synthetic N added to soils that volatilizes as NH_3 and NO_x ~~for livestock type *i* and manure management system *S*~~
Equations	(23)
Source of data	See Section 0 under Quantification Approach 3. When no information source is available that is applicable to the project conditions, project proponents may define value from Lookup Table 11.3~~10.22~~, Chapter 11~~10~~, Volume 4 in IPCC (2019).
[...]	[...]

Data/Parameter	*$Frac_{GASM}$*~~$_{i,S}$~~
Data unit	~~Dimensionless~~ kg N volatilized/kg N applied
Description	Fraction of all organic N added to soils and N in manure and urine deposited on soils that volatilizes as NH_3 and NO_x ~~for livestock type *i* and manure management system *S*~~
Equations	(23), (31)
Source of data	See Section 0 under Quantification Approach 3. When no information source is available that is applicable to the project conditions, project proponents may define value from Lookup Table 11.3~~10.22~~, Chapter 11~~10~~, Volume 4 in IPCC (2019).
[...]	[...]

Data/Parameter	*$Frac_{LEACH}$*~~$_{i,S}$~~
Data unit	~~Dimensionless~~ kg N/kg N additions
[...]	[...]

Background:

Correct parameter use and reference to relevant section of the *2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories*.

CORRECTION 35

Correction:

9.2 Data and Parameters Monitored

[...]

Data/Parameter	$\overline{SOC_{bsl,i,t}}$
[...]	[...]
Comments	SOC stocks at time *t* = 0 are calculated based on directly measured SOC content and ~~bulk density~~ESM at *t* = 0 or (back-) modeled to *t* = 0 from measurements collected within ±5 years of *t* = 0. This initially measured SOC is the same in both the baseline and project scenarios at the outset of the project (i.e., $SOC_{wp,i,0} = SOC_{bsl,i,0}$) in Quantification Approach 1.

Data/Parameter	$\overline{SOC_{wp,i,t}}$
[...]	[...]
Comments	Initially measured SOC stocks are the same in both the baseline and project scenarios at the outset of the project (i.e., $SOC_{wp,i,0} = SOC_{bsl,i,0}$) under Quantification Approach 1. SOC stocks at time *t* = 0 are calculated based on directly measured SOC content and ~~bulk density~~ESM at *t* = 0 or (back-) modeled to *t* = 0 from measurements collected within ±5 years of *t* = 0.

Background:

Alignment with new requirement to determine SOC stock changes on an equivalent soil mass (ESM) basis introduced in v2.

Verified Carbon Standard
A VERRA STANDARD

CORRECTION 36

Correction:

[…]~~monitoring period~~ verification period[…]

Background:

Change of terminology to use verification period instead of monitoring period to be consistent with the terminology of the *VCS Program Definitions, v4.4*.

CORRECTION 37

Correction:

> […]*VCS Standard*, *v4.45*[…]
>
> Where woody biomass is harvested, projects must calculate the long-term average GHG benefit following guidance in the latest version of the VCS Methodology Requirements,[39] and the latest version of the VCS Standard.[40]
>
> […]
>
> Alternative approaches (e.g., modeling on an areal basis) are considered a deviation and project proponents must demonstrate that such approaches will not negatively impact the conservativeness of GHG emissions reduction estimates per the latest version of the *VCS Standard* ~~Section 3.18~~.[52]
>
> […]
>
> - The number of buffer credits that must be deposited is calculated by multiplying the non-permanence risk rating[57] by the net change in carbon stocks.[58] ~~(see Section 3.8.8 in the latest version of the *VCS Methodology Requirements*)~~

Background:

Correct reference to VCS program documents to better guide user.

---

[39] See Section 3.6.6 in the *VCS Methodology Requirements, v4.4*

[40] See Sections 3.2.28-3.2.30 of the *VCS Standard, v4.5*

[52] See Section 3.20 of the *VCS Standard, v4.5*

[57] As determined by the AFOLU Non-Permanence Risk Tool

[58] See Section 3.8.8 in the *VCS Methodology Requirements, v.4.4*