Introductory Webinar on VM0042 *Methodology for Improved Agricultural Land Management*, v2.0

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Photo by Bale Mountain REDD Project

Agenda


Photo by FUNDAECO / REDD Conservation Coast Project

1. VCS Program overview
2. VM0042 overview
3. Revision process
4. Key methodology updates
5. VVB accreditation scope requirements
6. Q&A

VCS Program Overview

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VCS Program Overview

>1,800 projects

> One billion
carbon credits issued

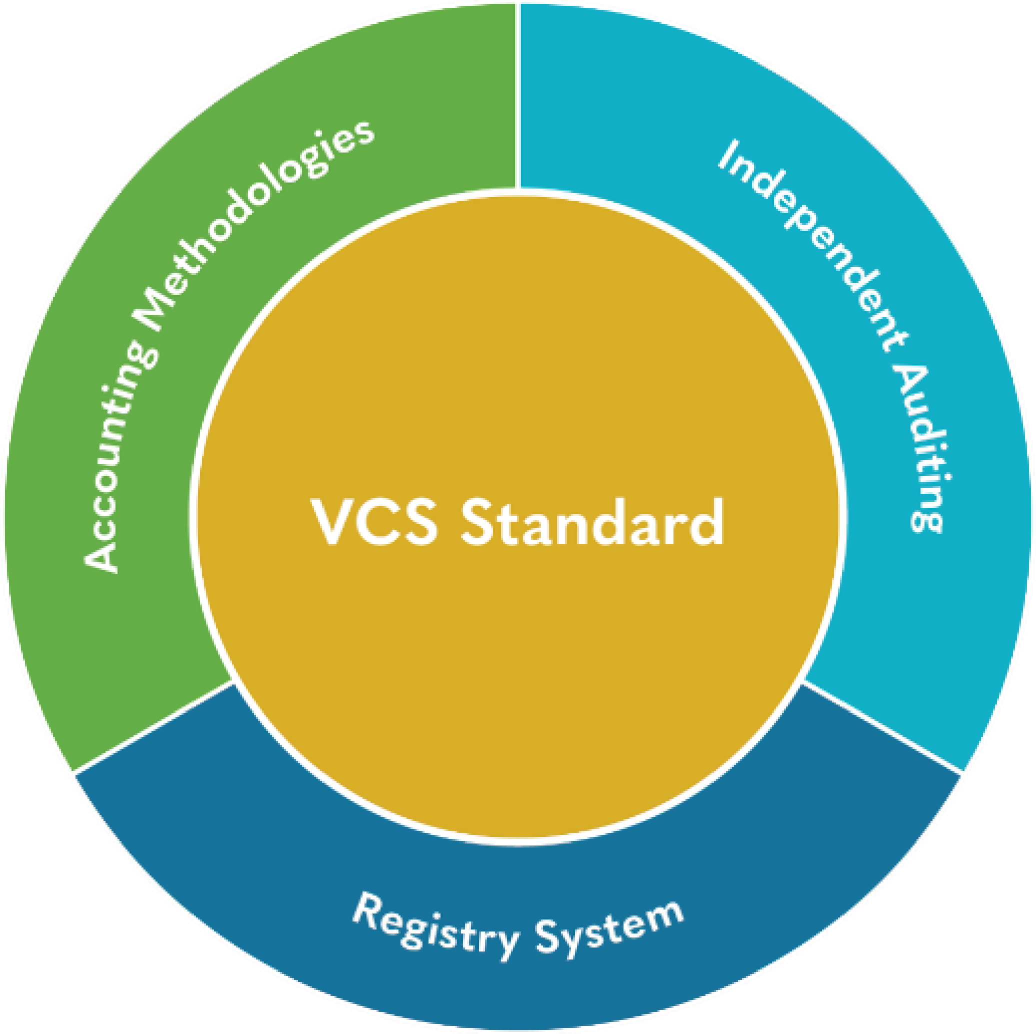
Equivalent to the emissions of >260 coal-fired power plants in one year

Environmental Finance
Voluntary Carbon Market Rankings 2022
Winner

VCS: Best GHG Crediting Programme
2012, 2013, 2014, 2015, 2016, 2018, 2019, 2020, 2021, 2022

VCS Program Overview

- VCS Standard
  - Rules and requirements which all projects must follow in order to be registered and issue.
- Accounting Methodologies
  - Quantify GHG ERRs specific each project type
- Independent Auditing
  - Third-party VVBs approved by Verra
- Registry System
  - Central storehouse of data on all registered projects and VCU issuances



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VM0042 overview

VM0042 Overview and History

- Incentivizes improved crop and livestock management practices
  - E.g., cover cropping, crop rotations, reduced tillage, rotational grazing, improved fertilizer use, etc.
- Enhance soil organic carbon (SOC) stocks and reduce N_2O and CH_4 emissions
- GHG quantification via direct measurement, models and/or default emission factors
- Version 1.0 published October 2020

Verified Carbon Standard

VCS Methodology

VM0042

METHODOLOGY FOR IMPROVED AGRICULTURAL LAND MANAGEMENT

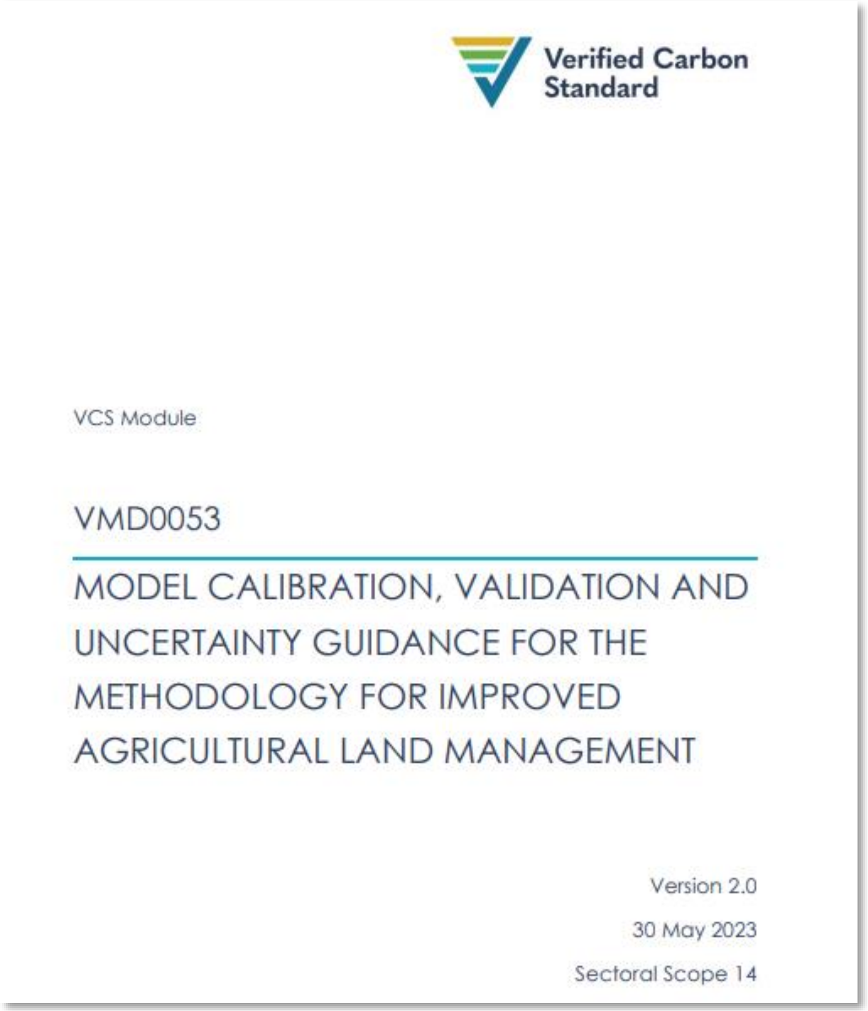
Version 1.0

19 October 2020

Sectoral Scope 14

VMD0053 Module

- Specific to Quantification Approach 1 – Measure and Model
- Procedures for model calibration, validation and verification
  - Empirical or process-based models
  - Standardizes the approach to test model performance
- Model Validation Report (MVR)
  - Assessed by Independent Modeling Experts (IMEs)



Verified Carbon Standard

VCS Module

VMD0053

MODEL CALIBRATION, VALIDATION AND UNCERTAINTY GUIDANCE FOR THE METHODOLOGY FOR IMPROVED AGRICULTURAL LAND MANAGEMENT

Version 2.0

30 May 2023

Sectoral Scope 14

VM0042 revision process and details

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VM0042 v2.0 Revision Process

- “Major” revision initiated in Q2 2021 per the VCS *Methodology Development and Review Process*
- Verra gathered feedback from dozens of stakeholders to inform draft v2.0
- Viresco Solutions and TerraCarbon supported updates to Section 8.6 Uncertainty
- 45-day public comment period Dec 2021 - Jan 2022 with ~500 comments received
- Ad hoc expert groups convened to inform technical issues
- VVB assessment with SCS Global Services
- Final approval and publication May 2023

VM0042 v2.0 – What's New?

1. One-time land use change
2. Baseline control sites
3. Use of proximal sensing technologies
4. Independent modeling experts
5. Emissions from liming
6. Leakage from bioenergy
7. Stratified random sampling
8. Uncertainty

- And many more clarifications and updates…

VCS

VM0042, v2.0

DOCUMENT HISTORY

Version	Date	Comment
v1.0	19 Oct 2020	Initial version
v2.0	30 May 2023	• Introduction of a baseline control sites option to allow for direct SOC measurement under Quantification Approach 2 • Update of Section 8.6 on uncertainty assessment to clarify statistical procedures and align with the *VCS Methodology Requirements* • Introduction of guidance on the use of proximal sensing technologies to estimate SOC content in Appendix 4 • Introduction of an applicability condition allowing for one-time land conversion from grassland to cropland or vice versa to restore degraded lands in Section 4 and Appendix 2 • Introduction of a requirement and procedures to account for emissions associated with use of agricultural limestone in Section 8.2.4 • Introduction of a requirement to account for leakage from diversion of biomass residues used for energy applications in the baseline scenario • General improvements, errata and clarifications

Land use change to promote mixed systems and restoration

- V1.0 no land use change allowed
- V2.0 allows for one-time land use change cropland <> grassland or vice versa
    - Integrated-crop livestock system
    - Project will restore degraded lands
- See Applicability Condition 3 and Appendix 2

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Baseline control sites – Quantification Approach 2

- QA2 Measure and Re-measure
  - Direct SOC measurement – no modeling
  - Only for SOC pool
- Baseline control sites are:
  - Matched to project sites according to "similarity criteria"
    - E.g., topography, soil texture/group, SOC content, historical ALM activities and land cover, native vegetation, climate zone, precipitation
  - Managed according to historical baseline practices
  - Measured over time for SOC stock change in parallel to project sites
  - May be controlled by projects or externally, e.g., experimental research stations
- See Section 8.2 and Table 7

Photo: Lynn Ketchum, © Oregon State University

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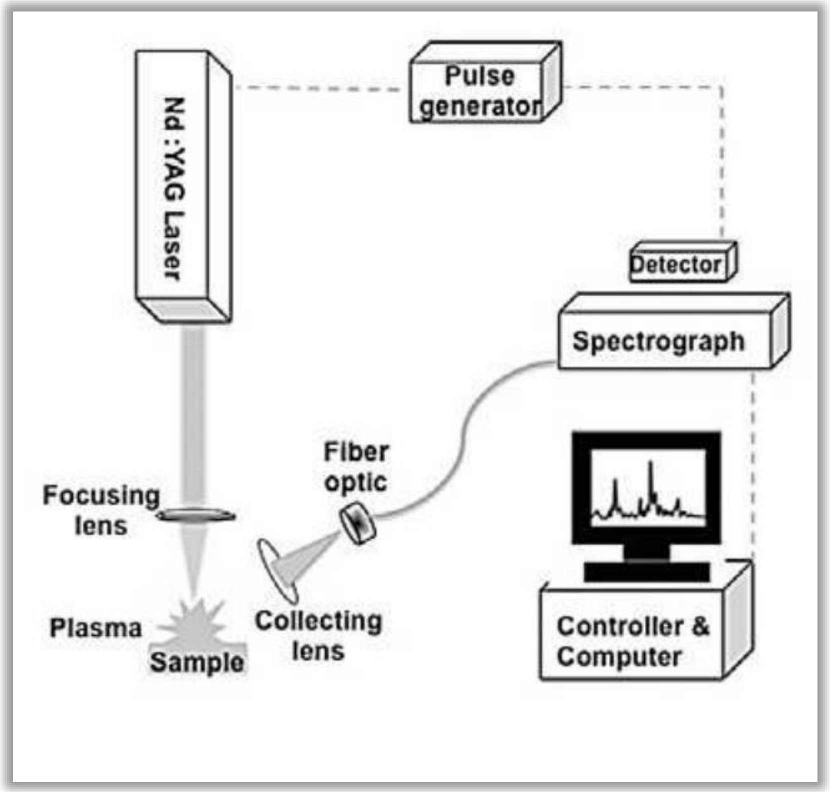
Use of proximal sensing technologies (new Appendix 4)

- Applicability demonstrated in at least 3 peer-reviewed scientific articles
- Monitoring plan and reports must describe:
    - technology and specific equipment and instrument
    - pretreatment or preprocessing methods
    - modeling approach based on proximal sensing data
    - calibration/validation data represent actual project area
- Evaluation criteria provided for:
    - Inelastic neutron scattering (**INS**)
    - Laser-induced breakdown spectroscopy (**LIBS**)
    - Mid-infrared (**MIR**) and visible near-infrared (**Vis-NIR and NIR**) spectroscopy, including diffuse reflectance spectroscopy (**DRS**) and diffuse reflectance infrared Fourier transform (**DRIFT**)
- Service providers may be used if technology specificities are made available for VVB review



Senesi, G. S., & Senesi, N. (2016). Laser-induced breakdown spectroscopy (LIBS) to measure quantitatively soil carbon with emphasis on soil organic carbon. A review. Analytica Chimica Acta, 938, 7–17. https://doi.org/10.1016/j.aca.2016.07.039

Independent modeling experts (IMEs)

- Biogeochemical modeling of soil carbon stock changes requires highly specialized expertise
- Model validation report (MVR) shows:
  - VMD0053 procedures are followed
  - Model calibration and validation are specific to model, cropping system, project conditions
  - Data sources for calibration and validation data are applicable to project conditions
- VMD0053, v2.0, Appendix 1 describes model assessment by an IME

PP generates MVR → VVB contracts IME → IME generates assessment report → VVB approves IME assessment report

Further changes resulting from the revision process (1)

- Section 8.2.4 Carbon Dioxide Emissions from Liming

$EL_{bsl,i,t}$	=	Carbon dioxide emissions from liming in the baseline scenario for sample unit *i* in year *t* (t CO_2e)

$$EL_{bsl,i,t} = ((M_{Limestone,bsl,i} \times EF_{Limestone}) + (M_{Dolomite,,bsl,i} \times EF_{Dolomite})) \times \frac{44}{12} \quad (10)$$

Where:

$M_{Limestone,bsl,i}$	=	Amount of calcitic limestone ($CaCO_3$) applied to sample unit *i* in year *t* (tonnes)
$EF_{Limestone}$	=	Emission factor for calcitic limestone (0.12) (t C per t of limestone)
$M_{Dolomite,bsl,i}$	=	Amount of dolomite ($CaMg(CO_3)_2$) applied to sample unit *i* in year *t* (tonnes)
$EF_{Dolomite}$	=	Emission factor for dolomite (0.13) (t C per t of dolomite)
44/12	=	Molar mass ratio of CO_2 to C applied to convert CO_2-C emissions to CO_2 emissions

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Further changes resulting from the revision process (2)

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

- Baseline scenario:
  manure or crop residues used as fuel for cookstoves or as biomass for power generation

- Project scenario:
  manure application to fields or crop residue retention and
  increased fossil fuel combustion

CLEAN DEVELOPMENT MECHANISM

TOOL16

Methodological tool

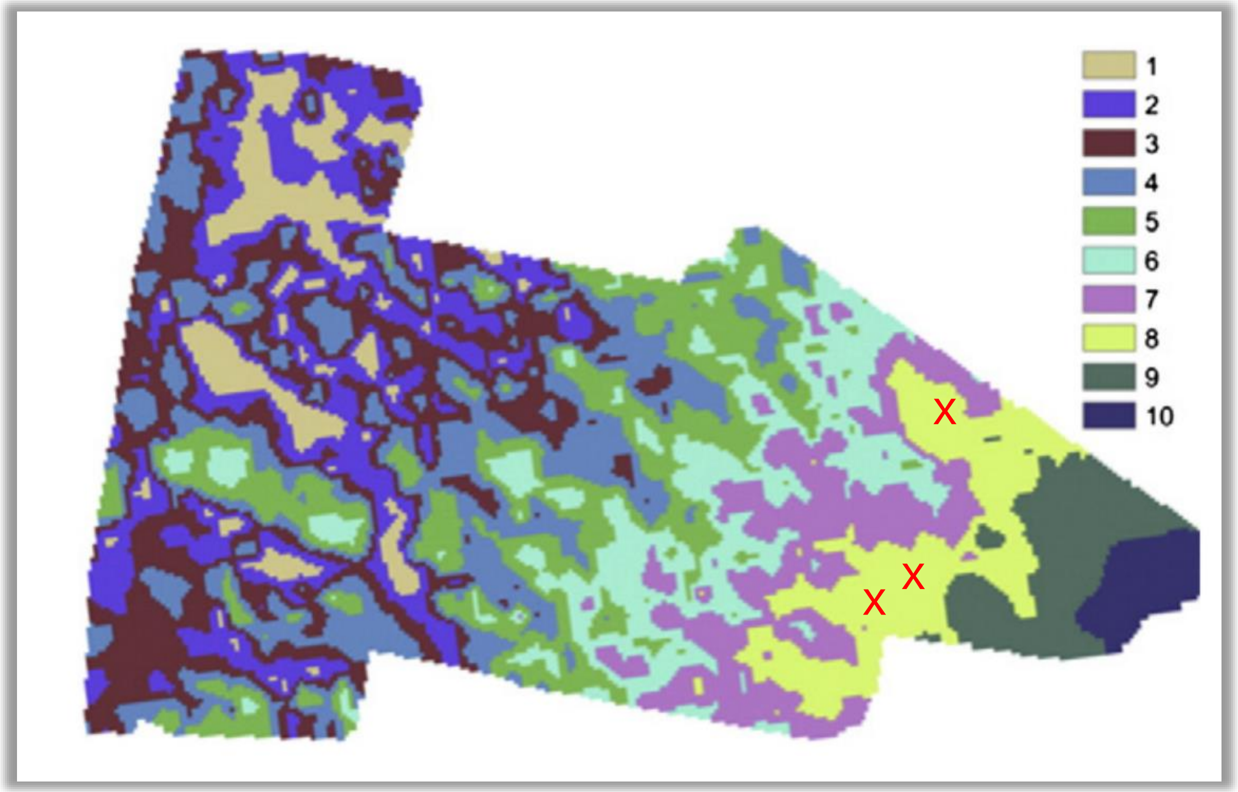
Project and leakage emissions from biomass

Version 05.0

Further changes resulting from the revision process (3)

- Section 8.2.1.2 Sampling Design: Stratified Random Sampling

- Predefined requirement of the sampling strategy to enable independent auditing



de Gruijter, J.J. et al. (2016). Farm-scale soil carbon auditing. Geoderma, 265 (2016), pp. 120-130, 10.1016/j.geoderma.2015.11.010

Uncertainty: Major changes

- Clarification of the 'true-up' process for QA1.
- Inclusion of Monte Carlo approach to uncertainty deduction for QA1.
- Updated uncertainty examples for QA1 to be based on default stratified random sampling.
- Added uncertainty examples for QA2, including examples in which proximal sensing is used.
- Final uncertainty deduction now based on Probability of Exceedance method in order to align with VCS Methodology Requirements, v.4.3 (17 Jan 2023).

Uncertainty: Quantification Approach 1

- QA 1 = Model and measure
  - SOC sampling > initialize process-based model for baseline and project scenarios > difference between scenarios = VCUs
- Key sources of uncertainty
  - Model prediction error – How accurately does your model simulate the effect of improved practices on SOC and/or GHG fluxes?
    - Initially determined through VMD0053.
    - Updated periodically based on re-measurement of SOC in the project.
  - Sampling error – How does sampling/modeling only a portion of the project contribute to uncertainty of VCU estimates?
    - Sampling design and density determine this number.
    - Scales with intensity of sampling/modeling effort.
- True-up
  - Carbon stocks for the project scenario are periodically re-measured.
  - These data are used to update the estimate of model prediction error and current VCUs the project should be issued.
  - Can also be used to recalibrate the model if the proponent so decides.
- Two uncertainty estimation pathways
  - Analytical approach – calculate model prediction error and sampling error separately then combine them to estimate total variance.
  - MC approach - generate posteriors for all modeled 'points' in the project that incorporate model prediction error. Iteratively sample from those posteriors to generate estimates of model prediction error and sampling error. Better at capturing errors from models with parameter uncertainty or when error is likely to vary based on specific conditions.

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Uncertainty: Quantification Approach 2

- QA 2 = Measure and re-measure
  - SOC sampling in the project area and at control sites that represent the baseline scenario > difference between scenarios = VCUs
- Sources of uncertainty
  - Sampling error – How does sampling only a portion of the project and control sites contribute to uncertainty of VCU estimates?
    - Sampling design and density determine this number.
    - Scales with intensity of sampling/modeling effort.
  - Measurement error – How accurate is the method you're using to determine SOC content of soil samples?
    - Error is assumed to be negligible when proponents use equivalent soil mass methods and dry combustion in labs with demonstrated quality control.
    - Error of alternative methods, such as soil spectroscopy, must be determined and propagated through to estimates of overall uncertainty.

- Two uncertainty estimation pathways
  - Analytical approach – Applicable when conventional dry combustion methods are used. Variance of the estimate of ERRs (project – baseline) is a function of the combined sampling error of project and baseline areas, minus their covariance.
  - MC approach – Applicable when using alternative methods such as soil spectroscopy. Generate posteriors for all sample points based on prediction error of spectroscopy model. Iteratively sample from those posteriors to generate estimates of model prediction error and sampling error.

VVB Accreditation Requirements

ISO/UNFCCC Accreditation Requirements to conduct validation/verifications using VM0042

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Verra Scope vs. Accreditation Scope

UNFCCC/ISO Accreditation Scopes	VERRA Sectoral Scopes
1. Energy (renewable/non-renewable)	1. Energy (renewable/non-renewable)
2. Energy distribution	2. Energy distribution
3. Energy demand	3. Energy demand
4. Manufacturing industries	4. Manufacturing industries
10. Fugitive emissions from fuels	10. Fugitive emissions from fuels
11. Fugitive emissions from Industrial gases	11. Fugitive emissions from Industrial gases
12. Solvent use	12. Solvent use
13. Waste handling and disposal	13. Waste handling and disposal
14. Afforestation and reforestation	14. Agriculture, Forestry, Land Use
15. Agriculture	15. Livestock and manure management
16. Carbon capture and storage of CO2 in geological format	16. Carbon capture and storage

- VVBs approved for AFOLU, must ensure they have the underlying ISO and/or UNFCCC accreditation scope for conducting Agriculture audits under Scope 15

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Thank You!

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